

Limited X-Ray Machine Operator Curriculum

*Sponsored by the American Society of Radiologic Technologists, 15000 Central Ave. SE,
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Introduction

The ASRT defines a limited x-ray machine operator (LXMO) as an individual other than a radiologic technologist who performs diagnostic x-ray procedures on selected anatomical sites. LXMO is the term that replaces other terms including, but not limited to, radiologic technician, x-ray technician and limited permittee.

Although LXMOs perform imaging tasks within a limited scope, the ASRT believes that, within the specific area of radiography, the knowledge and cognitive skills underlying the intelligent performance of the LXMO must be equivalent to that of the general radiographer.

The ASRT does not endorse the adoption of provisions relating to limited x-ray machine operators unless these persons are currently licensed by the state to perform limited medical imaging services. This curriculum document is intended to establish national, standardized educational guidelines for LXMOs, including clinical and didactic components. The document contains education appropriate to body areas as defined through the limited scope examinations offered by ARRT or other nationally recognized certifying agencies. The content is designed to assure quality patient care, radiation protection and production of quality images.

This curriculum is divided into specific content areas that represent the essential components of a LXMO program. The content and objectives should be organized to meet the mission, goals and needs of each LXMO program. Proposed minimum hours of didactic instruction and clinical experience have been included to assist in program planning. 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.

Advances in diagnostic imaging and employer expectations demand independent judgment by LXMOs. Consequently, critical thinking skills must be fostered, developed and assessed in the educational process. Critical thinking has been incorporated in multiple content areas. It is expected that the faculty will develop and implement critical thinking throughout the curriculum.

In summary, the LXMO core curriculum is based upon data relevant to today's health care environment. The curriculum offers a foundation for lifelong learning and transition to general radiography studies. It allows for faculty flexibility in the development of curriculum designed to meet the needs of individuals performing diagnostic x-ray procedures within a limited scope of practice.

LXMO Operator Curriculum

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Core Content

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Fundamentals, Ethics and Law of Health Care

Description

Content is designed to provide an overview of the foundations in radiologic science and the LXMO'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 LXMO. The elements of ethical behavior will be discussed, as well as a variety of ethical issues and dilemmas found in clinical practice. An introduction to legal terminology, concepts and principles also will be presented. Topics include misconduct, malpractice, legal and professional standards. The importance of proper documentation and informed consent is emphasized.

Proposed minimum hours of instruction: 10

Objectives

1. Identify other health science professions that 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. Discuss the role and value of a mission statement to the operation of an institution.
6. Describe relationships and interdependencies within health care.
7. List patient services that may be available in a radiology department.
8. Define accreditation, credentialing, certification, licensure and regulations.
9. Discuss the general employment outlook for the graduate LXMO.
10. Discuss career advancement and opportunities for the LXMO.
11. Identify the benefits of continuing education as related to improved patient care and professional enhancement.
12. Describe the moral, social and cultural basis of ethics.
13. Explain the role of ethical behavior in health care delivery.
14. Differentiate between empathetic rapport and sympathetic involvement in relationships with patients and relate these to ethical conduct.
15. Explain concepts of personal honesty, integrity, accountability, competence and compassion as ethical imperatives in health care.
16. List legal/professional standards and their relationship to practice in health professions.
17. Identify specific situations and conditions that give rise to ethical dilemmas in health care.
18. Employ a basic system of examination, clarification, determination of alternatives and decision-making in addressing ethical questions.
19. Explain select concepts embodied in Health Insurance Portability and Accountability Act (HIPAA), principles of patients' rights, the doctrine of informed (patient) consent and other issues related to patients' rights.
20. Explain the legal implications of LXMO liability, malpractice, negligence/carelessness and other legal doctrines applicable to limited scope practice.
21. Describe the importance of accurate, complete, correct methods of documentation as a legal/ethical imperative.

22. Describe the scope of practice for the LXMO, the elements that comprise it and responsibilities of the LXMO.
23. Describe institutional and professional liability protection typically available to the LXMO.

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Content

I. The Health Science Professions

- A. Radiologic technology
 - 1. Radiography
 - a. General diagnostic imaging
 - b. Magnetic resonance imaging
 - c. Computed tomography
 - d. Mammography
 - e. Cardiovascular-interventional technology
 - f. Bone densitometry
 - g. Quality management
 - 2. Radiation therapy
 - 3. Nuclear medicine technology
 - 4. Diagnostic medical sonography
- B. Health care professions
 - 1. Health information technology
 - 2. Medical laboratory sciences
 - 3. Occupational therapy
 - 4. Pharmacy
 - 5. Physical therapy
 - 6. Respiratory therapy
 - 7. Social services
 - 8. Nursing
 - 9. Other

II. The Health Care Environment

- A. Health care systems
 - 1. Hospitals
 - a. Veterans Administration
 - b. Not-for-profit
 - c. For-profit
 - d. System/network
 - 2. Clinics
 - 3. Independent facilities
 - 4. Mental health facilities
 - 5. Long-term/residential facilities
 - 6. Hospice
- B. Health care delivery settings
 - 1. Outpatient/ambulatory care
 - 2. Inpatient
 - 3. Long-term care
 - 4. Preventive care
 - 5. Home health care
 - 6. Telehealth/telemedicine

- C. Payment/reimbursement systems
 - 1. Self pay
 - 2. Indemnity insurance
 - 3. Entitlement/governmental programs
 - a. Medicare
 - b. Medicaid
 - 4. Managed care

III. Facility Organization

- A. Philosophy and mission
 - 1. Role within the community
 - 2. Commitment to education within the profession and community health
- B. Administrative services
 - 1. Management
 - 2. Personnel
 - 3. Procurement
 - 4. Accounting and billing
 - 5. Patient registration
 - 6. Information systems
- C. Medical services
 - 1. Physician
 - 2. Clinical
 - 3. Nursing
 - 4. Support

IV. Radiology Organization

- A. Professional personnel
 - 1. Radiographer
 - a. Administrative director
 - b. Radiologist assistant
 - c. Chief/senior technologist
 - d. Quality control/assurance officer/technologist
 - e. Staff technologist
 - 2. LXMO
 - 3. R.T. Aide
 - 4. Radiologist
 - 5. Radiation physicist
 - 6. Radiology nurse
- B. Support personnel
 - 1. Clerical staff
 - 2. File room/image management

3. Information systems manager
 - a. Radiology information systems (RIS)
 - b. Picture archiving and communication systems (PACS)

C. Patient services

V. Accreditation

A. Definition

B. Institution accreditation

1. Educational institution (college)
2. Health care organization(s)
 - a. National
 - 1) Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
 - 2) American College of Radiology (ACR)
 - b. Federal
Centers for Medicare and Medicaid Services (CMS, formerly Health Care Financing Administration, HCFA)
 - c. State agencies

C. Programmatic accreditation

1. Joint Review Committee on Education in Radiologic Technology (JRCERT)
2. Educational programs
 - a. Educational/program director
 - b. Clinical coordinator
 - c. Didactic instructor
 - d. Clinical instructor
 - e. Students

VI. Professional Credentialing

A. Definition

B. Agencies

1. National
 - a. American Registry of Radiologic Technologists (ARRT)
 - b. Nuclear Medicine Technology Certification Board (NMTCB)
 - c. American Registry of Diagnostic Medical Sonographers (ARDMS)
 - d. Other
2. State
 - a. Certification and licensure
 - b. LXMO

VII. Professional Organizations

A. Purpose, function, activities

- B. Local Organizations
- C. State organizations
- D. National
 - 1. American Society of Radiologic Technologists (ASRT)
 - 2. Association of Collegiate Educators in Radiologic Technology (ACERT)
 - 3. Association of Educators in Radiologic Sciences (AERS)
 - 4. American Healthcare Radiology Administrators (AHRA)
- E. International
 - International Society of Radiographers and Radiological Technologists (ISRRT)
- F. Related associations organizations
 - 1. American Board of Radiology (ABR)
 - 2. American College of Radiology (ACR)
 - 3. Radiological Society of North America (RSNA)

VIII. Professional Development

- A. Methods of advancement
 - 1. Continuing education programs
 - 2. General radiography programs
 - 3. Postprimary certification
 - 4. Collegiate/educational programs
- B. Employment considerations
 - 1. Geographic mobility
 - 2. Economic factors
 - 3. Manpower issues
- C. Additional career ladders
 - 1. Radiographer
 - 2. Education
 - a. Administration
 - b. Faculty
 - 1) Didactic
 - 2) Clinical
 - 3. Postprimary modalities
 - 4. Radiologist assistant
 - 5. Administration
 - 6. Physics
 - 7. Research
- D. Continuing education and competency requirements
 - 1. Definition
 - 2. Rationale

3. Requirements
 - a. State
 - b. Institution
4. Opportunities

IX. Ethics in Health Care

- A. Moral reasoning
- B. Personal behavior standards
- C. Competence
- D. Professional attributes
 1. Compassion
 2. Empathy
 3. Sympathy
 4. Honesty
 5. Integrity
 6. Accountability
- E. Limited scope of practice defined
 1. Lines of authority
 2. Areas of responsibility
 3. Limitations
- F. Self-assessment and self-governance
- G. Continuing professional education
- H. Professional standards of clinical practice
- I. Code of professional ethics
- J. Ethical principles
 1. Beneficence
 2. Nonmaleficence
 3. Respect for autonomy
- K. Organizational ethics
 1. Mission statement
 2. JCAHO
- L. Individual and societal rights
- M. Autonomy vs. behavior control
 1. Access and distribution of health care

2. Justice
3. Fairness
4. Economics

N. Access to quality health care

O. Medical/health care research

P. End-of-life decisions

1. Living wills
2. Advanced directives
3. Nonintervention

Q. Ethical decision making

1. Weighing data
2. Alternatives
3. Risks vs. benefits

X. Legal Responsibilities

A. Parameters of legal responsibility

1. Professional liability
 - a. Direct
 - b. Indirect
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
 - 2) Contributory
 - b. Elements of malpractice
 - 1) Duty
 - 2) Dereliction (breach)
 - 3) Causation
 - 4) Damage
4. Legal and professional standards
 - a. Standard of care
 - b. Patient's Bill of Rights
 - c. HIPAA
 - 1) Individual
 - 2) Institutional

- B. Scope of practice and responsibilities of the LXMO
 - 1. Definition
 - 2. Supervision
 - 3. State statute
 - 4. Limitations
 - a. Anatomic areas
 - b. Radiographic procedures

XI. Patient Consent

- A. Rationale
- B. Definition
 - 1. Implied
 - 2. Written
 - 3. Oral
- C. Condition for legal 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 JCAHO Standards for Disclosure

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 radiographic orders and interpretation of diagnostic reports. Related terminology is addressed.

Proposed minimum hours of instruction: 10

Objectives

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

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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

- C. Symbols
 - 1. Pharmaceutical symbols and terms
 - 2. Math and science symbols and constants
 - a. Examples
 - b. Interpretations

III. Radiologic Technology Procedures and Terminology

- A. Radiography
- B. Radiation oncology
- C. Nuclear medicine
- D. Sonography

IV. Understanding Orders, Requests and Diagnostic Reports

- A. Radiographic orders and requisitions – components
 - 1. Procedures ordered
 - 2. Patient history
 - 3. Clinical information

- B. Diagnostic reports
 - 1. Content
 - 2. Interpretation

Patient Care in Radiologic Sciences

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 LXMO in patient education will be identified. Content also will include the study of factors that influence relationships with patients and professional peers. Understanding human diversity assists the student in providing better patient care.

Proposed minimum hours of instruction: 30

Objectives

1. Identify the responsibilities of the health care facility and members of the health care team.
2. Describe the scope of practice for the LXMO as defined by state licensure.
3. Describe ethical, emotional, personal and physical aspects of death.
4. Identify methods for determining the correct patient for a given procedure.
5. Explain the use of various communication methods.
6. Explain specific aspects of a radiographic procedure to the patient.
7. Demonstrate correct principles of body mechanics applicable to patient care.
8. Demonstrate techniques for specific types of patient transfer.
9. Demonstrate select procedures for turning patients with various health conditions.
10. Describe select immobilization techniques for various types of procedures and patient conditions.
11. Explain the purpose, legal considerations and procedures for reporting an accident or incident.
12. Describe methods for evaluation of patient status.
13. List the information to be collected prior to patient examination.
14. Describe vital signs used to assess patient condition.
15. Assess patient vital signs.
16. Define terms related to infection control.
17. Describe the importance of standard precautions.
18. Explain sources and modes of transmission of infection and disease.
19. List institutional/departmental procedures for infection control.
20. Describe methods for the prevention of infection to the health worker and patient.
21. Identify symptoms related to specific emergency situations.
22. Describe the emergency medical code system for the institution and the role of the LXMO during a medical emergency.
23. Explain the special considerations necessary when performing radiographic procedures on an infant or a child.
24. Explain the special considerations necessary when performing radiographic procedures on a geriatric patient.
25. Explain the types, immobilization devices and positioning for upper and lower extremity fractures.
26. Identify specific types of tubes, lines, catheters and collection devices.

27. Demonstrate competency in cardiopulmonary resuscitation (CPR).
28. Demonstrate select first-aid techniques.
29. Explain the influence a person's value system has on his or her behavior.
30. Describe how professional values influence patient care.
31. Differentiate between culture and ethnicity.
32. Explain how a person's cultural beliefs towards illness affect his or her recovery.
33. Discuss the societal factors that influence the quality of health care.
34. Describe the culture of poverty and its effect on health care.
35. Discuss family dynamics in a cultural, social, ethnic and lifestyle context.

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Content

I. LXMO and 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 geriatric patient
 - 4. Promoting health
 - 5. Preventing illness
 - 6. Education
 - 7. Research

- B. Responsibilities of the LXMO
 - 1. Performing radiographic examination
 - 2. Assisting the licensed practitioner
 - 3. Providing patient care
 - 4. Scope of practice
 - a. State licensure

II. Attitudes and Communication in Patient Care

- A. Health-illness continuum

- B. Age specific communication
 - 1. Neonates
 - 2. Pediatric
 - 3. Adolescent
 - 4. Young adult
 - 5. Elderly

- C. Communication
 - 1. Verbal
 - a. Presentation of material
 - b. Attitudes
 - c. Voice tone and volume
 - d. Effective listening
 - 2. Nonverbal communication
 - a. Facial expression
 - b. Physical appearance
 - c. Touch
 - d. Meta communication
 - e. Eye contact
 - 3. Cultural variations
 - 4. Challenges of communication
 - a. Non-English-speaking patients
 - b. Hearing, vision and speech impairments
 - c. Impaired mental function
 - d. Altered states of consciousness

- e. Communicating with children and adolescents
- f. Communicating with geriatric patients
- g. Communicating under stress
- h. Human diversity
- i. Artificial speech
 - 1) Transesophageal puncture (TEP)
 - 2) Esophageal speech
 - 3) Electrolarynx devices
- 5. Other factors that impede communication
 - a. Colloquialism/slang
 - b. Medical jargon
- 6. Feedback
- 7. Patient interactions
 - a. Establishing communication guidelines
 - b. Reducing distance
 - c. Listening
 - d. Using therapeutic silence
 - e. Responding to the feeling and the meaning of the patient's statement
 - f. Restating the main idea
 - g. Reflecting the main idea
 - h. Making observations
- 8. Communicating with families
- 9. Communicating with other health care professionals

D. Psychological considerations

- 1. Dying and death
 - a. Aspects of death
 - 1) Emotional
 - 2) Personal
 - 3) Physical
 - b. Patient support services
- 2. Patient's emotional responses

III. Patient/LXMO Interactions

A. Patient identification methods

- 1. Interview/questioning
- 2. Chart/requisition
- 3. Wrist band

B. Procedure questions and explanations

- 1. Positioning
- 2. Length of procedure
- 3. Audio and visual intercommunication systems
- 4. Room noises
- 5. Immobilization devices
- 6. Machine type

7. Machine movement
8. Machine-patient contact
9. Application of auxiliary equipment

IV. Safety and Transfer Positioning

- A. Environmental safety
 1. Fire
 2. Electrical
 3. Hazardous materials
 4. Radioactive materials
 5. Personal belongings
 6. Occupational Safety and 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. Three-carrier lift
 - c. Log roll
 - d. Positioning for safety, comfort and/or exams
 5. Patients with disabilities
 6. Geriatric patients
 7. Pediatric patients
 8. Patients with intravenous infusions
 9. Patients with tubes or catheters
 10. Metastatic disease

- D. Patient positions
 1. Supine
 2. Protective side-lying
 3. Protective prone position
 4. Fowler's
 5. Semi-Fowler's
 6. Sims'
 7. Trendelenburg
 8. Lithotomy
 9. Knee-chest

E. Immobilization techniques

1. Purpose
2. Safety straps and rails
3. Adult
 - a. Types
 - b. Applications
 - c. Devices
4. Pediatric
 - a. Types
 - b. Applications
 - c. Devices

F. 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. Respiration
4. Blood pressure
5. Normal values
6. Interfering factors
7. Terminology
8. Adult vs. pediatric
9. Documentation
10. Pain assessment
11. Weight

C. Acquiring and recording vital signs

D. Patient records

1. Aspects of patient records
2. Confidentiality of patient information
3. Retrieving specific information
4. Proper documentation in patient record
5. HIPAA

VI. Infection Control

- A. Terminology
 - 1. Nosocomial
 - 2. Communicable
 - 3. Infectious pathogens

- B. Centers for Disease Control and Prevention (CDC)
 - 1. Purpose
 - 2. Publications and bulletins

- C. Cycle of infection
 - 1. Infectious pathogens – bloodborne and airborne
 - 2. Reservoir of infection
 - 3. Susceptible host
 - 4. Transmission of disease
 - a. Direct
 - b. Indirect

- D. Preventing disease transmission

- E. Medical asepsis
 - 1. Definition
 - 2. Procedures
 - a. Handwashing
 - b. Chemical disinfectants

- F. Environmental asepsis
 - 1. Handling linens
 - 2. Techniques
 - a. Dress
 - b. Hair
 - c. Handwashing
 - d. Gloves
 - e. Eye protection
 - f. Cleaning and proper disposal of contaminated waste

- 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 -B)
 - 3. Tuberculosis (TB)
 - 4. Respiratory Syncytial Virus (RSV)
 - 5. Other

VII. Medical Emergencies and First Aid

- A. Basic first-aid technique
- B. Emergency equipment
- C. Latex reactions
- D. Shock
 - 1. Signs and symptoms
 - 2. Types
 - a. Hypovolemic
 - b. Septic
 - c. Cardiogenic
 - d. Neurogenic
 - e. Anaphylactic/allergic
 - 3. Medical intervention
- E. Diabetic emergencies – signs, symptoms and interventions
 - 1. Hypoglycemia
 - 2. Ketoacidosis
 - 3. Hyperosmolar coma
- F. Respiratory and cardiac failure – signs, symptoms and interventions
 - 1. Adult vs. pediatric
 - 2. Equipment
- G. Airway obstruction – signs, symptoms and interventions
- H. Cerebral vascular accident (stroke) – signs, symptoms and interventions
- I. Fainting and convulsive seizures, signs, symptoms and interventions
 - 1. Types
 - a. Nonconvulsive (Petit mal)
 - b. Convulsive (Grand mal)
 - 2. Reasons for fainting
- J. Other medical conditions
 - 1. Epistaxis
 - 2. Nausea
 - 3. Postural hypotension
 - 4. Vertigo
 - 5. Asthma

VIII. Tubes, Catheters, Lines and Collection Devices

- A. Terminology

- B. Nasogastric/nasointestinal
- C. Tracheostomy
- D. Chest tube
- E. Tissue drains
- F. Oxygen administration
 - 1. Values
 - 2. Oxygen therapy
 - 3. Oxygen delivery systems
 - a. Low-flow systems
 - b. High-flow systems
 - 4. Documentation
 - 5. Special precautions
- G. Urinary collection
 - 1. Procedure
 - a. Male
 - b. Female
 - 2. Alternative methods of urinary drainage
 - 3. Documentation
- H. Other ostomies
 - 1. Ileostomy
 - 2. Ureteroileostomy

IX. Values

- A. Personal
 - 1. Values development
 - 2. Effect on medical care
 - 3. Impact on patient care
 - 4. Values clarification
- B. Professional
 - 1. Values development
 - 2. Values conflict
 - 3. Impact on patient care

X. Culture, Ethnicity and Diversity

- A. Societal and individual factors
 - 1. Socioeconomic
 - a. Effects on health care
 - b. Culture of poverty

- c. Relationship to disease occurrence
- 2. Gender
 - a. Social bias
 - b. Medical treatment bias
 - c. Cultural differences
- 3. Family structure
 - a. Two parent
 - b. Single parent
 - c. Nontraditional
 - d. Extended
 - e. Cultural differences
- 4. Urban vs. rural living environment
 - a. Availability of health care services
 - b. Social acceptance of diverse cultural differences
- 5. Religion
- 6. Lifestyle choices and behaviors
- 7. Mentally and physically challenged

ASRT

Human Structure and Function

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.

Proposed minimum hours of instruction: 10

Objectives

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

Content

I. Anatomical Nomenclature

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

- B. Body planes
 - 1. Median/mid-sagittal
 - 2. Sagittal
 - 3. Coronal
 - 4. Transverse
 - 5. Longitudinal

- C. Body cavities – structural limits, function, contents
 - 1. Cranial
 - 2. Thoracic
 - 3. Abdominal/pelvic

II. Landmarks and Underlying Anatomy

- A. Cranium
- B. Neck
- C. Spine
- D. Thorax
- E. Abdomen
- F. Pelvis
- G. Extremities

III. 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

IV. Cardiovascular System

A. Blood

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

B. Heart and vessels

- 1. Anatomy
- 2. Function

V. 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

VI. 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

VII. Muscular System – Types, Characteristics and Functions

- A. Smooth
- B. Cardiac
- C. Skeletal

VIII. Nervous System

A. Introduction

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

- B. Neural tissue
 - 1. Types, location, physiology
 - a. Neurons
 - b. Neuroglia
- C. Anatomy, functions
 - 1. Central nervous system
 - 2. Peripheral nervous

ASRT

Procedures of the LXMO

Description

Content is designed to provide a knowledge base necessary to perform standard radiographic procedures within a limited scope of practice. Consideration will be given to the production of images of optimal diagnostic quality. The LXMO also will be introduced to clinical manifestations of pathologic processes, their radiographic appearance and relevance to radiographic procedures. Laboratory experience should be used to complement the didactic portion.

Note: It is recognized that the scope of practice for LXMOs will vary based on state statutes and licensing/permit restriction. The procedures taught and emphasis given to the scope of practice of the LXMO must not exceed the area of diagnostic study allowed by state license or permit.

Proposed minimum hours of instruction:

- **Chest and thorax – 15**
- **Extremities:**
 - **Upper extremity and Pectoral girdle – 20**
 - **Lower extremity – 20**
- **Podiatric – 10**
- **Vertebral column – 15**
- **Cranium – 20**

Objectives

1. Describe standard positioning terms.
2. Demonstrate proper use of positioning aids.
3. Discuss general procedural considerations for radiographic examinations.
4. Adapt general procedural considerations to specific clinical settings.
5. Identify the structures demonstrated on routine radiographic images.
6. Adapt radiographic procedures based on special considerations.
7. Simulate radiographic procedures on a person* or phantom in a laboratory setting.
8. Evaluate images for positioning, centering, appropriate anatomy and overall image quality.
9. Discuss equipment and supplies necessary to complete radiographic procedures.
10. List and explain the routine and special views for assigned radiographic procedures performed within limited scope(s) of practice.
11. Explain radiographic procedures to patients/family members.
12. Modify directions to patients with various communication problems.
13. Apply general radiation safety and protection practices associated with radiologic examinations.
14. Define basic terms related to pathology.
15. Describe the basic manifestations of pathological conditions.
16. Describe the radiographic appearance of selected diseases.
17. Describe adaptive techniques relevant to radiographic examination of selected diseases.

**Radiographs on people must be exposed for diagnostic purposes and not solely to demonstrate techniques or obtain experience and must be prescribed by a licensed practitioner.*

Content

I. Standard Terminology for Positioning and Projection

- A. Standard terms
 - 1. Radiographic position
 - 2. Radiographic projection
 - 3. Radiographic view

- B. Positioning terminology
 - 1. Recumbent
 - 2. Supine
 - 3. Prone
 - 4. Trendelenburg
 - 5. Decubitus
 - 6. Erect and upright
 - 7. Anterior position
 - 8. Posterior position
 - 9. Oblique position

- C. General planes
 - 1. Sagittal or mid-sagittal
 - 2. Coronal or mid-coronal
 - 3. Transverse
 - 4. Longitudinal

- D. Terminology of movement and direction
 - 1. Cephalad/caudad
 - 2. Inferior/superior
 - 3. Proximal/distal
 - 4. Plantar/palmar
 - 5. Pronate/supinate
 - 6. Flexion/extension
 - 7. Abduction/adduction
 - 8. Inversion/eversion
 - 9. Medial/lateral

- E. Positioning aids
 - 1. Sponges
 - 2. Sandbags
 - 3. Compression bands
 - 4. Immobilization devices

- F. Accessory equipment
 - 1. Calipers
 - 2. Lead strips
 - 3. Lead shields or shadow shields

4. Lead markers
5. Image receptor holders

II. Evaluation of Radiographic Orders

- A. Patient identification
- B. Verification of procedure(s) ordered
- C. Review of clinical history
- D. Taking clinical history and patient assessment
 1. Questioning/interviewing skills
 2. Establish pregnancy status
 3. Determining the chief complaint
 - a. Localization
 - b. Chronology
 - c. Quality
 - d. Severity
 - e. Onset
 - f. Aggravating or alleviating factors
 - g. Associated manifestations
 4. Special considerations for age, disability and cultural background
- E. Patient preparation
 1. Procedure explanation
 2. Appropriate disrobing and gowning
 3. Removal of items that may cause artifacts
- F. Room preparation
 1. Cleanliness, organization and appearance
 2. Necessary supplies and accessory equipment available
- G. Patient assistance
- H. Patient monitoring
- I. Patient dismissal

III. Positioning Considerations for Routine Radiographic Procedures

- A. Patient instructions
- B. Patient positioning
- C. Part placement
 1. Lines
 2. Landmarks

- D. Image receptor selection and placement
- E. Appropriate grid use
- F. Beam alignment and angulation
- G. Beam limitation and shielding
- H. Special considerations
 - 1. Atypical conditions
 - 2. Age specific
 - 3. Special needs patients
- I. Anatomy and positioning for the following studies:
 - 1. Chest and thorax
 - a. Lungs
 - 1) AP/PA
 - 2) Lateral
 - 3) Apical lordotic
 - b. Ribs
 - 2. Extremities
 - a. Upper extremity
 - 1) Fingers
 - 2) Hand
 - 3) Wrist
 - 4) Radius/ulna
 - 5) Elbow
 - 6) Humerus
 - b. Pectoral girdle
 - 1) Shoulder joint
 - 2) Clavicle
 - c. Lower extremity
 - 1) Toes
 - 2) Foot
 - 3) Ankle
 - 4) Calcaneus
 - 5) Tibia/fibula
 - 6) Knee/patella
 - 7) Distal femur
 - 3. Podiatric
 - a. Foot
 - b. Ankle
 - 4. Vertebral column
 - a. Cervical
 - b. Thoracic

- c. Lumbar
- d. Scoliosis survey
- 5. Cranium
 - a. Skull
 - b. Facial bones
 - c. Nasal bones
 - d. Orbits
 - e. Pantomography mandible
 - f. Paranasal sinuses
- J. Image evaluation

IV. Patient Communication

- A. Barriers to communication
 - 1. Types
 - 2. Strategies
- B. Clinical situations
- C. Common radiation safety issues and concerns

V. Definitions/Terminology

- A. Pathology
- B. Disease
 - 1. Acute
 - 2. Chronic
- C. Etiology
- D. Diagnosis
 - 1. Signs (objective)
 - 2. Symptoms (subjective)
- E. Prognosis

VI. Relevance to Radiographic Procedures

- A. Purpose of the procedure
- B. Manifestations of pathology
- C. Technical considerations
- D. Patient considerations

- E. Radiographic appearance
 - 1. Chest and thorax
 - 2. Extremities
 - 3. Podiatric
 - 4. Vertebral column
 - 5. Cranium

ASRT

Imaging Production and Evaluation

Description

Content is designed to establish a knowledge base in factors that govern and influence the production and recording of radiologic images. Film and electronic imaging with related accessories will be emphasized. Radiographic image analysis methods will be introduced using actual images. Included are the importance of minimum imaging standards, discussion of a problem-solving technique for image evaluation and the factors that can affect image quality. Class demonstrations/labs are recommended to demonstrate application of theory.

Proposed minimum hours of instruction: 60

Objectives

1. Discuss standards for acceptable image quality.
2. Analyze the relationships of factors that control and affect image density.
3. Assess radiographic density on radiographic images.
4. Critique the radiographic contrast within various radiographic images.
5. Differentiate between subject contrast and image receptor contrast.
6. Compare long-scale and short-scale contrast images.
7. Analyze the relationships of factors that control and affect radiographic contrast.
8. Critique recorded detail on various radiographic images.
9. Differentiate between umbra and focal spot blur.
10. Analyze the relationships of factors affecting recorded detail.
11. Differentiate between shape and size distortion.
12. Summarize the relationships of factors affecting distortion.
13. Formulate a plan of action to decrease image distortion.
14. Summarize the relationships of factors affecting exposure latitude.
15. Describe the operation and applications for different types of beam-limiting devices.
16. Select the most appropriate beam-limiting device to be used for a given clinical situation.
17. Explain beam filtration.
18. Summarize the relationships of factors affecting scattered and secondary radiation.
19. Evaluate the effects of scattered radiation on the image.
20. Compare types of grid.
21. Articulate the advantages and disadvantages of grid use.
22. Describe grid maintenance.
23. Select the most appropriate grid for a given clinical situation.
24. Evaluate grid artifacts.
25. Formulate a set of rules for grid use to prevent grid cut-off and artifacts.
26. Explain the use of standardized radiographic technique charts.
27. Explain exposure factor considerations involved in technique selection.
28. Compare fixed kilovolt peak (kVp) and variable kVp systems.
29. Formulate a technique chart using either a fixed kVp or variable kVp system.
30. Calculate the photographic effect when exposure factors are given.
31. Apply mAs reciprocity to clinical simulations.
32. Describe the function of each component of radiographic film.

33. Explain latent image formation.
34. Discuss photostimulable phosphor plates as image receptors.
35. Discuss how an image is retrieved from a photostimulable phosphor.
36. Describe the features of the characteristic curve and explain its purpose.
37. Select the most appropriate image receptor to be used for given clinical situations.
38. Describe various types of image receptor holder.
39. Describe the function of each component of an intensifying screen.
40. Explain the classifications of intensifying screens and the applications of each.
41. Identify procedures that ensure a long screen life devoid of artifacts and distortion.
42. Discuss darkroom-related OSHA standards for health and safety.
43. Discuss safelight illumination appropriate for specific image receptor systems.
44. Discuss the possible causes and health implications of “darkroom chemical sensitivity.”
45. Describe the effects of storage on image quality.
46. Describe the operation and use of wet and dry processing.
47. Analyze the effects of processing on image quality.
48. Demonstrate how various film sizes are fed into the film processor.
49. Analyze the steps of the processing cycle providing the specific action and duration of time for each step.
50. Identify the purpose of a daily quality control program for processors.
51. Discuss digital image processing and postprocessing.
52. Identify types of image artifacts and analyze the artifacts to determine the cause.
53. Describe an effective image analysis method.
54. Summarize the importance of proper positioning and centering.
55. Apply the process for evaluating radiographs for adequate density, contrast, recorded detail and acceptable limits of distortion.
56. Discuss the impact of patient preparation on the resulting radiographic image.
57. Analyze images to determine the appropriate use of beam restriction.
58. Identify common equipment malfunctions that affect image quality.
59. Differentiate between technical factor problems, procedural factor problems and equipment malfunctions.

Content

I. Imaging Quality Standards

- A. Licensed practitioner involvement in setting image standards
- B. Patient care and safety concerns
- C. Procedures for maintaining image standards

II. Radiographic Density

- A. Definition
- B. Acceptable range
- C. Factors
 - 1. mAs
 - 2. kVp
 - 3. Distance
 - 4. Image receptors
 - 5. Grids
 - 6. Beam limitation
 - 7. Patient considerations
 - a. Anatomic part
 - b. Pathology
 - 8. Processing
 - a. Automatic
 - b. Dry
 - 9. Filtration
 - 10. Heel effect

III. Radiographic Contrast

- A. Definition
- B. Types
 - 1. Long scale
 - 2. Short scale
- C. Components
 - 1. Subject
 - 2. Image receptor system
- D. Factors
 - 1. kVp
 - 2. Scattered radiation
 - 3. Fog
 - 4. mAs
 - 5. Grids

6. Beam limitation
7. Filtration
8. Image receptor system
9. Patient considerations
 - a. Anatomic part
 - b. Pathology
10. Distance
11. Processing
 - a. Wet
 - b. Dry

IV. Recorded Detail

- A. Definition
- B. Components
 1. Umbra
 2. Focal spot blur
- C. Factors
 1. Geometric unsharpness
 - a. Source-to-image distance (SID)
 - b. Object-to-image distance (OID)
 - c. Focal spot
 - d. Structural shape
 2. Materials unsharpness
 - a. Image receptor system
 - b. Screen/film contact
 3. Motion blur
 - a. Voluntary
 - b. Involuntary
 4. Image noise
 - a. Quantum mottle
 - b. Signal-to-noise ratio

V. Distortion

- A. Definition
- B. Types
 1. Shape
 - a. Foreshortening
 - b. Elongation
 2. Size (magnification)
- C. Factors
 1. Distance
 2. Tube/part/image receptor relationships

VI. Exposure Latitude

- A. Definition
- B. Factors
 - 1. kVp
 - 2. Image receptor system

VII. Beam-limiting Devices

- A. Definition
- B. Purposes
 - 1. Patient dose
 - 2. Scatter production
 - 3. Image density
 - 4. Image contrast
- C. Types, function and application of each
 - 1. Apertures/diaphragms
 - 2. Cones
 - 3. Collimator
 - a. Manual
 - b. Problem-based learning (PBL)
 - 4. Lead masks
 - 5. Alignment
 - a. Light field
 - b. Computed radiography (CR)

VIII. Beam Filtration

- A. Definition
- B. Rationale
- C. Composition
- D. Types
 - 1. Inherent
 - 2. Added
 - 3. Total
 - 4. Compensatory
 - a. Construction
 - b. Applications
- E. Image quality
 - 1. Density
 - 2. Contrast

F. Patient exposure

IX. Scattered and Secondary Radiation

A. Definitions

B. Factors

1. kVp
2. Patient considerations
3. Beam limitation
4. Grids
5. Distance

C. Effects

1. Patient dose
2. Image quality
3. Occupational exposure

X. Control of Exit/Remnant Radiation

A. kVp selection

B. Grids

1. Purpose
2. Components
3. Types/patterns
 - a. Focused
 - b. Parallel
 - c. Linear
 - d. Cross
4. Terms/definitions
 - a. Grid focusing distance
 - b. Focal range
 - c. Convergent line/point
5. Efficiency
 - a. Ratio
 - b. Frequency (lead content)
6. Selection
 - a. kVp
 - b. Patient considerations
 - c. Distance
 - d. Beam limitation
 - e. Latitude
7. Cut-off
 - a. Definition
 - b. Factors
8. Artifacts

XI. Technique Formulation

- A. Purpose
 - 1. Standardization of exposure
 - 2. Image consistency

- B. Considerations
 - 1. Choice of technique system
 - 2. Patient measurement
 - 3. Image processing

- C. Types
 - 1. Optimum kVp/variable mAs
 - 2. Variable kVp/fixed mAs
 - 3. Anatomic programmed radiography (APR)
 - 4. Automatic exposure control (AEC)
 - 5. Digital systems

XII. Exposure Calculations

- A. Factors
 - 1. Distance
 - 2. mAs
 - 3. kVp
 - 4. Grids
 - 5. Image receptor system

- B. Calculations
 - 1. Photographic effect
 - 2. mAs reciprocity

XIII. Image Receptor Handling and Storage

- A. Processing considerations
 - 1. Temperature
 - 2. Humidity
 - 3. Light
 - 4. Radiation
 - 5. Handling

- B. Storage considerations
 - 1. Temperature
 - 2. Humidity
 - 3. Light
 - 4. Radiation
 - 5. Gases/fumes
 - 6. Handling
 - 7. Pressure

8. Inventory control
 - a. Purchasing consumables
 - b. Expiration date
 - c. Maximum storage time

XIV. Characteristics of Image Receptors

- A. Types
 1. Film
 2. Photostimulable phosphors
- B. Composition
 1. Components
 2. Structure
 3. Function
- C. Definition, influence and application of image receptors properties
 1. Contrast
 2. Speed/sensitivity
 3. Latitude
 4. Recorded detail
- D. Latent image formation
- E. Digital systems
 1. Definition/purpose
 2. Image formation
 3. Exposure indicator
- F. Characteristic curves
 1. Speed
 2. Contrast
 3. Exposure latitude

XV. Image Receptor Holders and Intensifying Screens

- A. Image receptor holders
 1. Cassettes
 - a. Purpose
 - b. Construction
 - c. Application
 - d. Loading/unloading
 - e. Maintenance
- B. Intensifying screens
 1. Purpose
 2. Construction/composition
 3. Principles of function
 - a. Fluorescence

- b. Phosphorescence
- c. Quantum noise
- d. Film/screen contact
- e. Technical influences
- 4. Classification/applications
 - a. Phosphor
 - b. Speed/sensitivity
 - c. Patient dosage
- 5. Maintenance
 - a. Handling
 - b. Cleaning

XVI. Processing of the Images

- A. Darkroom lighting
 - 1. Safelights
 - a. Definition
 - b. Filters
 - c. Bulb size/color
 - 2. Warning/indicator lights
 - 3. Dry processing
- B. Processor systems/functions
 - 1. Dry
 - 2. Wet
 - a. Chemical
 - b. Transport
 - c. Replenishment
 - d. Recirculation
 - e. Temperature control
 - f. Wash
 - g. Dryer
- C. Processing cycle
 - 1. Image receptor feed
 - 2. Development
 - a. Action
 - b. Time/temperature
 - 3. Fixing
 - a. Action
 - b. Time/temperature
 - 4. Wash
 - a. Action
 - b. Time/temperature
 - 5. Dry
 - a. Action
 - b. Time/temperature

- D. Maintenance/cleaning
 - 1. Shut-down procedure
 - 2. Start-up procedure
- E. Processor quality control
- F. Darkroom chemical sensitivity
- G. Material safety data sheets (MSDS)

XVII. Digital Processing

- A. Algorithms
- B. Histograms
- C. Resolution
- D. Postprocessing
 - 1. Edge enhancement
 - 2. Smoothing
 - 3. Magnification
 - 4. Window level
 - 5. Window width
- E. Exposure indicator (patient dose)

XVIII. Artifacts

- A. Definition
- B. Types
- C. Causes
- D. Effects
- E. Preventive/corrective maintenance

XIX. Imaging Standards

- A. Purpose
- B. Problem-solving process
 - 1. Determining cause of problems
 - 2. Recommending corrective action
- C. Establishing acceptable limits

XX. Image Quality Factors

- A. Density
- B. Contrast
- C. Recorded detail
- D. Distortion
- E. AEC
- F. Processing
- G. CR
- H. Digital radiography (DR)

XXI. Procedural Factors

- A. Image identification
 - 1. Patient information
 - 2. Date of examination
 - 3. Procedure(s) performed
 - 4. Proper use of identification makers
 - 5. Institutional data
- B. Positioning
 - 1. Anatomical considerations
 - a. Anatomy of interest
 - b. Plane/baseline reference
 - c. Central ray angulation
 - d. Anatomical variations
 - e. Body habitus
 - f. Pathology
 - 2. Positioning aids
- C. Centering
 - 1. Central ray location
 - 2. Area of interest
 - 3. Beam alignment and angulation
- D. Radiation protection
 - 1. Collimation/beam limitation
 - 2. Shielding
 - 3. Repeats

- 4. Image receptor
 - a. Size
 - b. Speed

E. Patient preparation

F. Artifacts

XXII. Corrective Action

- A. Equipment
 - 1. Radiographic unit
 - 2. Image processing
- B. Technical factors
- C. Procedural factors
- D. Artifacts

ASRT

Imaging Equipment and Radiation Production

Description

Content is designed to establish a knowledge base in radiographic equipment and x-ray production. Topics include atomic structure, the nature and characteristics of radiation and the fundamentals of photon interactions with matter.

Proposed minimum hours of instruction: 50

Objectives

1. Define potential difference, current and resistance.
2. Describe the characteristics of direct and alternating currents.
3. Describe electrical protective devices.
4. Identify the function of solid-state rectification.
5. Compare single phase, three phase, high frequency and falling load generators in terms of radiation production and efficiency.
6. Demonstrate operation of radiographic equipment.
7. Discuss the application of AEC devices.
8. Discuss electronic imaging equipment used in radiography.
9. Discuss the benefits of a quality management program to the patient and to the department.
10. Describe the structure of the atom.
11. Discuss the characteristics and function of a proton, neutron and electron.
12. Discuss the energy levels of the atom.
13. Explain the processes of ionization and excitation.
14. Describe the electromagnetic spectrum.
15. Define and describe wavelength and frequency and how they are related to velocity.
16. Explain the relationship of energy and frequency.
17. Identify the properties of x-rays.
18. State the principles of x-ray production.
19. Compare the production of bremsstrahlung and characteristic radiations.
20. Describe the conditions necessary to produce x-radiation.
21. Describe the x-ray emission spectra.
22. Identify the factors affecting the x-ray emission spectra.
23. Discuss various photon interactions with matter.
24. Discuss relationships of wavelength and frequency to beam characteristics.
25. Discuss the clinical significance of the photoelectric and modified scattering interactions in diagnostic imaging.

Content

I. X-Ray Circuit

- A. Electricity
 - 1. Potential difference
 - 2. Current
 - a. Direct
 - b. Alternating
 - 3. Resistance
- B. Protective devices
 - 1. Ground
 - 2. Circuit breaker
- C. Transformers
 - 1. Step-up
 - 2. Step-down
- D. Rectification

II. Radiographic Equipment

- A. Permanent installation
 - 1. Tubes
 - 2. Collimators
 - 3. Tables
 - 4. Control panels
 - 5. Tube stands
 - 6. Wall units
 - 7. Manipulation of equipment
- B. AEC devices
 - 1. Ionization chambers
 - 2. Minimum reaction time
 - 3. Back-up time
 - 4. Positioning considerations
 - a. Cell locations
 - b. Cell size
 - c. Cell sensitivity
 - 5. Compensating for variations of patient size and pathology variations

III. Diagnostic X-Ray Tubes

- A. Design and function
 - 1. Rotating anode
 - 2. Cathode
 - 3. Tube housing construction

- B. Extending tube life
 - 1. Warm-up procedures
 - 2. Rotor considerations
 - 3. Filament considerations

IV. Electronic Imaging

- A. Purpose

- B. Principles

- C. Flat panel detectors
 - 1. Description
 - 2. Function

V. Quality Control

- A. Definitions

- B. Benefits
 - 1. Patient
 - 2. Department

VI. Structure of the Atom

- A. Nucleus
 - 1. Components
 - a. Proton
 - b. Neutron

- B. Structure
 - 1. Size
 - 2. Proton and electron balance
 - 3. Binding energy

- C. Electron shells
 - 1. Components
 - 2. Arrangements
 - a. Binding energy
 - b. Valence shell
 - c. Ionization
 - d. Excitation

VII. Nature of Radiation

- A. Radiation
 - 1. Electromagnetic
 - a. Spectrum
 - b. Properties
 - c. Ionization and excitation

2. Nonionizing vs. ionizing

VIII. X-Ray Production

- A. Historical introduction
- B. Principles
- C. Types
 1. Bremsstrahlung
 2. Characteristic
 3. Percentage relationship with energy
- D. Common terms related to the x-ray beam
 1. Primary beam
 2. Exit/remnant beam
 3. Leakage radiation
- E. Conditions necessary for production
 1. Source
 2. Acceleration
 3. Concentration
 4. Deceleration
- F. X-ray emission spectra
 1. Continuous spectrum
 2. Discrete spectrum
 3. Minimum wavelength
- G. Factors affecting emission spectra
 1. kVp
 2. mA
 3. Time
 4. Atomic number of target
 5. Distance
 6. Filtration
 7. Voltage waveform
- H. Efficiency in production
 1. Description
 2. Frequency and wavelength

IX. Interaction of Photons With Matter

- A. Transmission of photons
 1. Attenuated radiation
 2. Exit/remnant radiation

- B. Unmodified scattering (coherent)
 - 1. Description of interaction
 - 2. Relation to atomic number
 - 3. Energy of incident photon and resulting product
 - 4. Probability of occurrence
 - 5. Application

- C. Photoelectric effect
 - 1. Description of interaction
 - 2. Relation to atomic number
 - 3. Energy of incident photon and resulting product
 - 4. Probability of occurrence

- D. Modified scattering (Compton)
 - 1. Description of interaction
 - 2. Relation to atomic number
 - 3. Energy
 - 4. Probability of occurrence

ASRT

Radiation Protection and Radiobiology

Description

Content is designed to present an overview of the responsibilities for protecting patients, personnel and the public from excessive radiation exposure. Radiation health and safety requirements of federal and state regulatory agencies, accreditation agencies and health care organizations are incorporated. Topics will include an overview of the principles of the interaction of radiation with living systems.

Proposed minimum hours of instruction: 40

Objectives

1. Identify and justify the need to minimize unproductive radiation exposure of humans.
2. Explain the objectives of a radiation protection program.
3. Define radiation units of measurement.
4. Identify dose equivalent limits (DEL) for occupational and nonoccupational radiation exposure with reference to the latest National Council on Radiation Protection and Measurements (NCRP) reports.
5. Describe the as low as reasonably achievable (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 risk level (NIRL).
9. Identify ionizing radiation sources from natural and man-made sources.
10. Comply with legal and ethical radiation protection responsibilities of radiation workers.
11. Describe the operation of various interlocking systems for equipment and indicate potential consequences of interlock system failure.
12. Distinguish between controlled and noncontrolled areas and list acceptable exposure levels.
13. Describe "Radiation Area" signs and identify appropriate placement sites.
14. Describe the function of federal, state and local regulations governing radiation protection practices.
15. Express the need and importance of personnel monitoring for radiation workers.
16. Describe personnel monitoring devices, including applications, advantages and limitations for each device.
17. Interpret personnel monitoring reports.
18. Compare values for dose equivalent limits for occupational radiation exposures (annual and lifetime).
19. Identify anatomical structures that are considered critical for potential late effects of whole body irradiation exposure.
20. Identify dose equivalent limits for the embryo and fetus in occupationally exposed women.
21. Distinguish between primary and secondary radiation barriers.
22. Demonstrate how the operation of various x-ray and ancillary equipment influence radiation safety and describe the potential consequences of equipment failure.
23. Perform calculations of exposure with varying time, distance and shielding.
24. Identify emergency procedures to be followed during failures of x-ray equipment.

25. Demonstrate how time, distance and shielding can be manipulated to keep radiation exposures to a minimum.
26. Discuss added and inherent filtration in terms of the effect on patient dosage.
27. Explain the purpose and importance of patient shielding.
28. Use the appropriate method of shielding for a given radiographic procedure.
29. Explain the relationship of exposure factors to patient dosage.
30. Identify the appropriate image receptor that will result in an optimum diagnostic image with the minimum radiation exposure to the patient.
31. Select the immobilization techniques used to eliminate voluntary motion.
32. Describe the characteristics of a molecule.
33. Describe principles of cellular biology.
34. Discuss directly and indirectly ionizing radiations.
35. Describe radiation-induced chemical reactions and potential biologic damage.
36. Evaluate factors influencing radiobiologic/biophysical events at the cellular and subcellular level.
37. Identify methods to measure radiation response.
38. Describe physical, chemical and biologic factors influencing radiation response of cells and tissues.
39. Explain factors influencing radiosensitivity.
40. Recognize the clinical significance of LD50/30 and LD30.
41. Examine effects of limited vs. total body exposure.
42. Relate short-term and long-term effects as a consequence of high and low radiation doses.
43. Differentiate between somatic and genetic radiation effects as well as discuss specific diseases or syndromes associated with them.
44. Discuss stochastic and nonstochastic (deterministic) effects.
45. Discuss risk estimates for radiation-induced malignancies.

Content

I. Introduction

- 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 risk level (NIRL)
- C. Sources of radiation
 - 1. Natural
 - 2. Man-made (artificial)
- D. Legal and ethical responsibilities

II. Radiation Units

- A. Exposure
 - 1. Coulomb/kilogram (C/kg)
 - 2. Roentgen (R)
- B. Absorbed dose
 - 1. Gray (Gy)
 - 2. Rad
- C. Dose equivalent
 - 1. Sievert (Sv)
 - 2. Rem

III. Regulations and Regulatory/Advisory Agencies

- A. Regulated areas
 - 1. Controlled/uncontrolled areas
 - 2. Conditions
 - 3. Recommendations
 - 4. "Radiation Area" sign posting
- B. Regulatory/Advisory agencies
 - 1. International Council on Radiation Protection and Measurements (ICRP)
 - 2. National Commission on Radiation Protection and Measurements (NCRP)
 - 3. Nuclear Regulatory Commission (NRC)
 - 4. The Consumer-Patient Radiation Health and Safety Act of 1981
 - 5. CARE Bill (Consumer Assurance of Radiologic Excellence)
 - 6. State agencies

IV. Personnel Monitoring

- A. Requirements for personnel monitoring
 - 1. Deep dose equivalent (DDE)

2. Shallow dose equivalent (SDE)
 3. Eye dose equivalent (EDE)
- B. Methods and types of personnel monitors
1. Film badge
 2. Thermo luminescent dosimeter (TLD)
 3. Optically stimulable luminescent dosimeter (OSLD)
- C. Records of accumulated dose
1. Purpose
 2. Content
 3. Length of record-keeping
 4. Retrieval from previous employers
- D. Dose recommendations
1. Occupational
 2. Nonoccupational limits
 3. Critical organ sites
 4. Embryo-fetus
 5. Cumulative dose formula
- E. Responsibilities for radiation protection
1. Facility
 2. LXMO
 3. Pregnant LXMO
- V. Application**
- A. Materials
- B. Primary barrier
- C. Secondary (scatter and leakage) barrier
- D. X-ray and ancillary equipment
1. Beam-defining devices
 2. Exposure control devices
 3. On and off switches
 4. Interlocks
 5. Visual/audio monitors
 6. Emergency controls
- E. Regulations and recommendations
1. Current NRC recommendations and/or regulations
 2. Current NCRP recommendations and/or regulations
 3. Applicable state regulations

- F. Cardinal principles in protection
 - 1. Time
 - 2. Distance
 - 3. Shielding

VI. Patient Protection

- A. Beam-limiting devices
- B. Filtration
- C. Shielding
- D. Exposure factors
- E. Image receptor system
- F. Immobilization
- G. Special considerations
 - 1. Pediatric patients
 - 2. 25-60 year old patients
 - 3. Geriatric patients
 - 4. Pregnant patients

VII. Elements of Radiation Biology

- A. Molecule
 - 1. Ionic bond
 - 2. Covalent bond
- B. Review of cell biology
 - 1. Basic unit of life
 - 2. Cell constituents
 - a. Protoplasm and metabolism
 - b. Organic and inorganic compounds
 - c. Basic cell chemistry
 - 3. Cell structure
 - a. Cell membrane
 - b. Cytoplasm
 - c. Organelles
 - d. Nucleus
 - 4. Cell growth
 - a. Mitosis
 - b. Meiosis
 - c. Cell cycle
 - d. Differentiation

- C. Types of ionizing radiations
 - 1. Electromagnetic radiations
 - a. X-rays
 - b. Gamma rays
 - 2. Absorption and ionization
 - a. Directly ionizing radiations
 - b. Indirectly ionizing radiations
- D. Sources of medical radiation exposure
 - 1. Diagnostic radiology
 - 2. Dental radiology
 - 3. Therapeutic radiology
 - 4. Nuclear medicine

VIII. Biophysical Events

- A. Molecular effects of radiation
 - 1. Radiolysis of water
 - 2. Target theory
 - a. Target molecules
 - b. Cell death
- B. The deposition of radiant energy
 - 1. Linear energy transfer (LET)
 - 2. Relative biological effectiveness (RBE)
 - 3. Factors influencing RBE
 - a. Linear Energy Transfer (LET)
 - b. Oxygen

IX. Radiation Effects

- A. Subcellular radiation effects
 - 1. Radiation effects of 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 effects
 - 2. Genetic effects
 - a. Mutagenesis
- D. Factors influencing radiation response

X. Radiosensitivity and Response

- A. Law of Bergonié and Tribondeau
 - 1. Differentiation
 - 2. Mitotic rate
 - 3. Metabolic rate
- B. Factors influencing cell survival
 - 1. LET
 - 2. Oxygen
 - 3. Fractionation
- C. Systemic response to radiation
 - 1. Hemopoietic system
 - 2. Skin
 - 3. Digestive
 - 4. Urinary
 - 5. Respiratory
 - 6. Reproductive
 - 7. Nervous
 - 8. Other
- D. Radiation dose-response curves
 - 1. Linear, nonthreshold
 - 2. Nonlinear, nonthreshold
 - 3. Linear, threshold
 - 4. Nonlinear, threshold
- E. Total body irradiation
 - 1. Acute radiation syndrome
 - a. Hemopoietic
 - b. Gastrointestinal
 - c. Central nervous system
 - 2. Stages of response and dose levels
 - 3. Factors influencing response
 - 4. Medical interventions of response

- F. Late effects of radiation
 - 1. Somatic responses
 - a. Mutagenesis
 - b. Carcinogenesis
 - 2. Stochastic effects
 - 3. Nonstochastic (deterministic) effects
 - 4. Genetic effects
 - 5. Occupational risks for radiation workers
 - 6. Carcinogenesis
- G. Risk estimates

ASRT

Clinical Practice

Description

Content and clinical practice experiences shall be designed for sequential development, application, critical analysis, integration, synthesis and evaluation of concepts and theories in the performance of radiologic procedures. Through structured sequential, competency-based assignments in clinical setting, concepts of team practice, patient-centered clinical practice and professional development shall be discussed, examined and evaluated. Clinical practice experiences shall be designed to provide patient care and assessment and competent performance of radiologic imaging. Levels of clinical competency and outcomes measurement shall ensure the well-being of the patient preparatory to, during and following the radiologic procedure.

Proposed minimum hours of clinical experience with each anatomic area:

- **Chest and thorax – 160**
- **Extremities:**
 - **Upper extremity and Pectoral girdle – 240**
 - **Lower extremity – 240**
- **Podiatric – 160**
- **Vertebral column – 240**
- **Cranium – 240**

Objectives

1. Execute imaging procedures under the appropriate level of supervision.
2. Adhere to concepts of team practice that focus on organizational theories, roles of team members and conflict resolution.
3. Adapt to changes and varying clinical situations.
4. Support patient-centered clinically effective service for all patients regardless of age, gender, disability, special needs, ethnicity or culture.
5. Integrate the use of appropriate and effective written, oral and nonverbal communication with patients, the public and members of the health care team (peers, licensed practitioner, administration, etc.) in the clinical setting.
6. Manage interactions with the patient and family in a manner that provides the desired psychosocial support.
7. Demonstrate skills in assessment and evaluation of psychological and physical changes in the patient's condition and carry out appropriate actions.
8. Examine gender, cultural, age and socioeconomic factors that influence patient compliance with procedures.
9. Adapt procedures to meet age-specific, disease-specific and cultural needs of patients.
10. Assess the patient and record patient histories.
11. Assess patient using the ABCs of CPR and demonstrate basic life support procedures.
12. Respond appropriately to patient emergencies.
13. Document care in the patient's record.
14. Apply standard precautions.
15. Apply the appropriate medical asepsis.

16. Demonstrate competency in the principles of radiation protection standards to include time, distance, shielding and radiation monitoring.
17. Apply the principles of total quality management.
18. Report equipment malfunctions to assist with appropriate corrective actions.
19. Examine procedure orders for accuracy and follow-up to make corrective changes when applicable.
20. Support safe, ethical and legal practices.
21. Integrate the LXMO's scope of practice and practice standards into clinical practice setting.
22. Act consistently to maintain patient confidentiality standards (HIPAA).
23. Carry out principles of transferring, positioning, immobilizing and restraining of patient.
24. Comply with departmental and institution procedures for response to emergencies, disasters and accidents.
25. Differentiate between emergency and nonemergency procedures.
26. Adhere to national, institutional and/or department standards, policies and procedures regarding care of patients, provision of radiologic procedures and the reduction of medical errors.
27. Ensure that performance reflects professional competence in the selection of technical factors to produce quality diagnostic images with lowest radiation exposure possible.
28. Critique images for appropriate clinical information, image quality and patient documentation.
29. Ensure that performance reflects professional competence in determining corrective measures to improve inadequate images.

Content

I. Clinical Practice

- A. Code of ethics/professional behavior
 - 1. Scope of practice
 - 2. Practice standards
 - 3. Incident reporting mechanisms
 - 4. Standards for LXMO supervision in training
 - a. Precompetency assessment
 - b. Postcompetency assessment
- B. Professional communication
 - 1. Patients
 - 2. Patient's family
 - 3. Health care team
- C. Role of health care team members
 - 1. Technical
 - 2. Professional
 - 3. Patient's Bill of Rights
- D. Scheduling and sequencing of exams

II. Procedural Performance

- A. Order/requisition evaluation
- B. Radiographic room set-up
- C. Patient assessment
 - 1. Patient monitoring
 - a. Vitals
 - b. Equipment
 - 1) Crash cart
 - 2) Oxygen
 - c. Patient emergencies
 - 1) Cardiac/respiratory arrest
 - 2) Physical injury
 - 3) Seizures
 - 4) Diabetic emergencies
 - d. Basic life support
 - 2. Interpretation of patient records
 - a. HIPAA
 - b. Confidentiality
 - 3. Documentation
 - 4. Special considerations
 - a. Patient focused care
 - b. Standard precautions

- c. Medical asepsis
- 5. Communication style
- 6. Age specific
- 7. Cultural and socioeconomic sensitivity

D. Imaging

- 1. Positioning
 - a. Body mechanics
 - b. Positioning accessories
- 2. Technical considerations
 - a. Manual
 - b. Automatic exposure control (AEC)
 - c. Digital/computed radiography
- 3. Image processing
- 4. Image analysis
 - a. Image quality
 - 1) Density
 - 2) Contrast
 - 3) Recorded detail
 - 4) Distortion
 - b. Image postprocessing
 - c. Legal requirements for image documentation

E. Patient/personnel protection

- 1. Radiation
 - a. Time
 - b. Distance
 - c. Shielding
 - d. Radiation monitoring
 - e. Exposure reduction techniques
- 2. Equipment/accessories
 - a. Beam restriction
 - b. Filtration
 - c. Positioning
 - d. Image receptor system
 - e. Scatter radiation control techniques
 - f. Technical factor selection
- 3. Medical error reduction

III. Competency (Mandatory, Elective)*

A. Chest and thorax

- 1. Lungs
- 2. Ribs

B. Extremities

- 1. Upper extremity

- a. Fingers
- b. Hand
- c. Wrist
- d. Radius/ulna
- e. Elbow
- f. Humerus
- 2. Pectoral girdle
 - a. Shoulder joint
 - b. Clavicle
- 3. Lower extremity
 - a. Toes
 - b. Foot
 - c. Ankle
 - d. Calcaneus
 - e. Tibia/fibula
 - f. Knee/patella
 - g. Distal femur
- C. Cranium
 - 1. Skull
 - 2. Facial bones
 - 3. Nasal bones
 - 4. Orbits
 - 5. Pantomography mandible
 - 6. Paranasal sinuses
- D. Vertebral column
 - 1. Cervical
 - 2. Thoracic
 - 3. Lumbar
 - 4. Scoliosis survey

*Refer to Appendix A Inventory of Clinical Competencies for mandatory and elective requirements.

Recommendations for General Education

General education is an integral part of the development of the provider of patient care services. The content is designed to assist in the development of communication, human diversity, scientific inquiry, critical thinking and judgment skills required to perform the responsibilities of a LXMO. Knowledge gained from general education serves to enhance the content and application of the LXMO curriculum.

An additional goal of general education is to provide students with opportunities to explore broad areas of commonly held knowledge and to prepare them to contribute to society through personal, social and professional interactions with others. General education provides intellectual flexibility and knowledge to support lifelong learning that will prepare students for success in a rapidly changing world.

Recommended Postsecondary General Education:

- Mathematical/Logical Reasoning.
 - Develop skills in analysis, quantification and synthesis.
 - Apply problem-solving or modeling strategies.
- Communication.
 - Write, read, speak and listen critically.
 - Develop the ability to perceive, gather, organize and present information.
 - Locate, evaluate and synthesize material from diverse sources and points of view.
- Arts and Humanities.
 - Develop knowledge and understanding of the human condition.
 - Demonstrate respect for diverse populations.
 - Develop an understanding of ethics and the role they play in personal and professional lives.
 - Recognize and critically examine attitudes and values.
- Information Systems.
 - Develop knowledge base for use of computerized systems.
 - Use technology to retrieve, evaluate and apply information.
- Social/Behavioral Sciences.
 - Assist in adapting interactions to meet cultural/psychological needs of people.
 - Develop an understanding of individual and collective behavior.
 - Promote the development of leadership skills.
 - Develop capacity to exercise responsible and productive citizenship.
 - Function as a public-minded individual.

- Natural Sciences.
 - Develop understanding of scientific method.
 - Make informed judgments about science-related topics.
 - Develop a vocabulary of science.

ASRT

Appendix A

ASRT

LXMO Clinical Competencies and Assessment of Competency

The following is intended as a tool for documenting the successful completion of recommended mandatory and elective clinical competencies. It is recognized that within a given state the scope of practice of a LXMO may be restricted to one or two categories on this form.

Mandatory competencies are those felt to be particularly important to the role of a LXMO. The mandatory list represents a baseline of studies that will allow the student to demonstrate proficiency in a given category of patient exams. Observations generally are based on one sample of the student's performance, because it is impossible for the clinical instructor to be present in all clinical situations. Since inference on the student's competence cannot be made from one situation, an adequate number of observations need to be recorded by a variety of assessors. Multiple sampling of student performance can potentially make the assessment more valid and reliable. Students typically migrate through a sequence where they observe examples of a given exam being performed by a radiographer or licensed practitioner, assist in the performance of a number of the same exam, then perform the exam several times under the supervision of a radiographer or licensed practitioner. Programs of course have the prerogative to set values for the number of exams of a given type that students would be expected to observe, provide assistance and perform under supervision before a competency assessment is conducted.

Note the column heading for indicating if the competency assessment was conducted during an actual patient exam or through simulation. It is recognized that in the clinical setting not all patient exams are requested with a frequency that would assure competency testing can be conducted on patients only. Performing all required procedures under simulated conditions would not provide appropriate learning.

Chest	Mandatory	Elective	Date & Time Completed	Patient or Simulated	Verified By
Chest Single View	★				
Chest Two View	★				
Chest, age 6 years or younger		★			
Chest, wheelchair		★			
Apical lordotic		★			
Ribs	★				
Upper Extremity					
Finger	★				

Hand	☆				
Wrist	☆				
Radius/ulna	☆				
Elbow	☆				
Humerus	☆				
Extremity, age 6 years or younger		☆			
Pectoral girdle					
Shoulder joint	☆				
Clavicle		☆			
Lower Extremity					
Toes	☆				
Foot	☆				
Ankle	☆				
Calcaneus	☆				
Tibia/fibula	☆				
Knee/patella	☆				
Distal femur	☆				
Extremity, age 6 years or younger		☆			
Podiatric					
Foot	☆				
Ankle	☆				
Vertebral column					
Cervical	☆				
Thoracic	☆				
Lumbar	☆				

Scoliosis series		☆			
Cranium					
Skull	☆				
Facial bones	☆				
Nasal bones		☆			
Orbits		☆			
Pantomography mandible		☆			
Paranasal sinuses	☆				

General Patient Care		
Students are to demonstrate competency in the following patient care simulations.	Date Completed	Verified By
CPR		
Vital signs (blood pressure, pulse, respiration, temperature)		

The evaluation of competence in the performance of clinical procedures is a key element in the development of the LXMO. Competency-based standards are basic statements of outcomes; they are attributes required to fulfill the LXMO role at the beginning level. They reflect the knowledge; attitudes, values and skills associated with each aspect of performance in the workplace and are expressed in terms of proficient practice.

Performing competently in the clinical setting is more than the demonstration of certain behaviors associated with the completion of a single task. Competence in clinical practice encompasses attributes of knowledge, problem solving, technical skills, comprehension, attitudes and ethics. It enables an individual or group to perform a role or set of tasks to an appropriate level, grade, quality or achievement, thus making the individual competent in that role.

Competency is a complex concept requiring multiple assessment strategies to evaluate the effectiveness of student learning. Assessment should not only be concerned with psychomotor skills, but also an understanding of the principles underlying professional practice.

Elements to consider in structuring the performance criteria for a clinical competency assessment are:

- Evaluation of requisition and patient assessment.

- Radiographic room readiness.
- Patient care and management.
- Equipment operation and technique selection.
- Positioning skills.
- Radiation protection for patient, self and others.
- Image processing and evaluate whether the resulting images demonstrate proper:
 - Anatomical part(s).
 - Alignment.
 - Radiographic techniques.
 - Image identification.
 - Radiation protection.

Each of these items should have a written definition and description of the criteria used to satisfy the expectations of student performance. Example: Images demonstrate effective use of beam collimation. Criteria: Evidence of effective beam collimation will be determined by the visible appearance of radiation field collimation to the part(s) of interest on finished radiographs and/or projections. Field borders shall not exceed 1.25” beyond the part of interest.

Note: Some consideration should be given to the progression of student performance as experience is gained in the clinical setting. Expectation of student performance should be reasonable and obtainable during the early, middle and terminal periods of clinical exposure while at the same time incorporating increasing levels of skill improvement. Example: It may be reasonable to expect that early in the clinical experience a student would be able to place a patient in an oblique position of the wrist but need slight adjustment in the amount of obliquity of the wrist by the clinical evaluator for it to be properly positioned. However, it would be expected that the same student would be consistent in positioning an oblique wrist properly without adjustment by the clinical evaluator in the final phases of clinical experience.

A student behavioral assessment can be a very valuable component of an overall clinical assessment plan. Different from the competency assessment, the behavioral assessment is an opportunity to give students feedback on their development in the affective domain and in development of traits/characteristics valued by employers.

Models of competency and behavioral assessment forms are provided as aids in the development of similar instruments in a given program. We wish to thank the following parties for permitting the use of their forms in this document:

Rolla Technical Center, Rolla, Mo.

St. Catharine College, Bardstown, Ky.

University of New Mexico Radiography Program, Albuquerque, N.M.

Rolla Technical Center Radiologic Technology Program Performance Evaluation

NAME: _____ DATE: _____

INSTRUCTOR: _____ SCORE: _____/125

RATING SCALE: 5 ALWAYS MEETS EXPECTATIONS 2 MET EXPECTATIONS A FEW TIMES
 4 USUALLY MEETS EXPECTATIONS 1 MET EXPECTATIONS ONCE
 3 SOMETIMES MEETS EXPECTATIONS 0 NEVER MEETS EXPECTATIONS

Criteria:

Environmental Assessment: Student collects pertinent information regarding equipment, procedures and work environment.

Provides a safe, comfortable environment	0	1	2	3	4	5
Alert to equipment maintenance needs	0	1	2	3	4	5
Monitors equipment performance	0	1	2	3	4	5
Follows procedure protocol	0	1	2	3	4	5

Education: Student communicates with patients, the public and other health care providers about procedures, equipment and facilities.

Communicates/educates patients	0	1	2	3	4	5
Communicates within department	0	1	2	3	4	5
Communicates outside department	0	1	2	3	4	5
Communicates to ensure radiation safety	0	1	2	3	4	5

Performance: Student performs quality assurance activities or acquires information on equipment and materials.

Follows quality protocols	0	1	2	3	4	5
Monitors images for quality	0	1	2	3	4	5

Quality: Student strives to provide optimal care to all patients.

Contributes to health-care team	0	1	2	3	4	5
Ensures Service Excellence	0	1	2	3	4	5
Uses professional judgment and discretion	0	1	2	3	4	5
Anticipates and responds to patient needs	0	1	2	3	4	5

Self-Assessment: Student evaluates personal performance, knowledge and skills.

Demonstrates good work ethic	0	1	2	3	4	5
Exhibits appropriate behavior	0	1	2	3	4	5
Displays a positive attitude	0	1	2	3	4	5
Utilizes personal strengths	0	1	2	3	4	5
Problem-solves	0	1	2	3	4	5

Ethics: Student adheres to the profession's accepted Code of Ethics.

Respects patient dignity	0	1	2	3	4	5
Respects age-specific needs	0	1	2	3	4	5
Acts as a patient advocate	0	1	2	3	4	5
Delivers unbiased patient care	0	1	2	3	4	5
Maintains patient confidentiality	0	1	2	3	4	5
Adheres to established practice standards	0	1	2	3	4	5

Comments on back

Student signature: _____

St. Catharine College Radiology Program Film Analysis

1. Each projection counts for a total of 12 pts.

2. Each category is worth 3 pts.

Exam: _____

Final Score: _____

1. Projection: _____

Score: _____

___ Pt., tube, film alignment

___ Markers

___ No rotation, proper angle

___ Technical factor

2. Projection: _____

Score: _____

___ Pt., tube, film alignment

___ Markers

___ No rotation, proper angle

___ Technical factor

3. Projection: _____

Score: _____

___ Pt., tube, film alignment

___ Markers

___ No rotation, Proper angle

___ Technical factor

4. Projection: _____

Score: _____

___ Pt., tube, film alignment

___ Markers

___ No rotation, proper angle

___ Technical factor

5. Projection: _____

Score: _____

___ Pt., tube, film alignment

___ Markers

___ No rotation, proper angle

___ Technical factor

6. Projection: _____

Score: _____

___ Pt., tube, film alignment

___ Markers

___ No rotation, Proper angle

___ Technical factor

7. Projection: _____

Score: _____

___ Pt., tube, film alignment

___ Markers

___ No rotation, proper angle

___ Technical factor

8. Projection: _____

Score: _____

___ Pt., tube, film alignment

___ Markers

___ No rotation, proper angle

___ Technical factor

9. Projection: _____

Score: _____

___ Pt., tube, film alignment

___ Markers

___ No rotation, Proper angle

___ Technical factor

Film Critique and explanation of procedure:

Additional Comments:

Student signature: _____

Evaluator: _____

revised July 2003

St. Catharine College Radiography Program

Student: _____ Evaluator's Signature: _____
 Exam: _____ XR#: _____ Date: _____
 Challenge Level: _____ Level A (pt. requires limited assistance) _____ Level B (pt. requires moderate assistance)
 _____ Level C (pt. requires extensive assistance, e.g. ICN, ICU, Trauma, Infant, etc.)

Rate the following criteria between 1-3 (1 being the lowest and 3 being the highest). *Students must pass with an 85%.*

The maximum grade for a repeated competency is 90%.

PATIENT COMMUNICATION AND PREP	SCORE	COMMENTS
1. Prepared room, supplies, and equipment.		
2. Accurately interprets requisition.		
3. Correctly identifies patient.		
4. Explains proper patient instructions.		
5. Assisted patient appropriately (safety and privacy)		
6. Questions Pregnancy when appropriate.		
7. Records accurate history and assessment.		
8. Efficient and Effective performance (timely and organized)		
9. Follow through of requisition and radiographs.		
IMAGE PRODUCTION		
1. Selected proper screen/film combination.		
2. Utilized grid, bucky or tabletop properly.		
3. Positioned cassette properly.		
4. Film marked with correct patient information and markers		
5. Proper part alignment.		
6. Proper Projections.		
7. Film/tube/bucky alignment.		
8. Correct angle/distance utilized.		
9. Appropriate technical factors utilized.		
10. Appropriate demonstration of anatomy		
RADIATION SAFETY		
1. Collimation (never larger than film size)		
2. Films were not repeated		
3. Proper shielding.		
4. Self protection (aprons, gloves, etc.)		

Revised July 2003

Final Score: _____

Student Clinical Evaluation University of New Mexico Radiography Program

NAME: _____ DATE: _____

USE AND CARE OF EQUIPMENT IS:	POOR <input type="checkbox"/>	FAIR <input type="checkbox"/>	GOOD <input type="checkbox"/>	EXCELLENT <input type="checkbox"/>
APPLICATION OF KNOWLEDGE:	POOR <input type="checkbox"/>	FAIR <input type="checkbox"/>	GOOD <input type="checkbox"/>	EXCELLENT <input type="checkbox"/>
PROGRESS AT THIS STAGE OF CLINICAL EDUCATION IS:	EXCELLENT <input type="checkbox"/>	GOOD <input type="checkbox"/>	SLOW <input type="checkbox"/>	FAIR <input type="checkbox"/>
RADIOGRAPHIC QUALITY:	of excellent quality and consistency, rarely a retake <input type="checkbox"/>	fair; need of improvement <input type="checkbox"/>	is good; only a few retakes <input type="checkbox"/>	needs a lot of improvement; numerous retakes <input type="checkbox"/>
WHEN GIVEN DIRECTIONS:	seems constantly to make errors and needs to be told again <input type="checkbox"/>	usually follows them. Some errors made. <input type="checkbox"/>	always follows them consistently and without error <input type="checkbox"/>	Follows through; only occasional errors. <input type="checkbox"/>
WHEN SETTING TECHNIQUE:	has difficulty and is inconsistent in setting and adjusting technical factors; numerous mistakes. <input type="checkbox"/>	is normally accurate and is able to adjust technical factors with only a few errors <input type="checkbox"/>	is normally accurate and is able to adjust technical factors but errors are noted and could use some improvement <input type="checkbox"/>	is consistently accurate and has no problem in adjusting technical factors <input type="checkbox"/>
POSITIONING SKILLS ARE:	excellent and consistently accurate <input type="checkbox"/>	poor and has difficulty correcting errors <input type="checkbox"/>	good and is able to correct mistakes. <input type="checkbox"/>	fair but is unable to correct all mistakes <input type="checkbox"/>
USE OF TIME:	is poor. Makes no apparent attempt to utilize time, space and equipment to enhance clinical skills. <input type="checkbox"/>	is usually effective. Normally uses time to enhance clinical skills. <input type="checkbox"/>	fair but has difficulty organizing time to enhance clinical skills <input type="checkbox"/>	is excellent. Always uses time to enhance clinical skills. <input type="checkbox"/>
PUNCTUALITY	occasionally late <input type="checkbox"/>	always punctual <input type="checkbox"/>	very seldom late <input type="checkbox"/>	often late or absent <input type="checkbox"/>

APPEARANCE	at times careless <input type="checkbox"/>	unclean and untidy <input type="checkbox"/>	neat, good appearance <input type="checkbox"/>	very professional <input type="checkbox"/>
ATTITUDE AND COOPERATION	Has good attitude and is cooperative while in clinical <input type="checkbox"/>	Demonstrates excellent attitude and disposition and is very helpful in the clinical site <input type="checkbox"/>	Demonstrates fair attitude and cooperation in the clinical site <input type="checkbox"/>	Uncooperative and demonstrates a negative outlook <input type="checkbox"/>
REACTION TO CRITICISM	Accepts criticism but does not attempt to utilize suggestions offered <input type="checkbox"/>	Does not accept criticism well <input type="checkbox"/>	Accepts criticism and consistently attempts to utilize suggestions offered <input type="checkbox"/>	Accepts criticism and sometimes attempts to utilize suggestions offered <input type="checkbox"/>
SELF-IMAGE	Has fair confidence but at times is hesitant in performing some exams <input type="checkbox"/>	Demonstrates a high confidence level and this is evidenced by communication with others <input type="checkbox"/>	Lacks confidence in self and is hesitant clinical situations <input type="checkbox"/>	Has confidence in self and projects it in communicating with others <input type="checkbox"/>
INTEREST IN CLINICAL EDUCATION	Student seems indifferent to clinical education <input type="checkbox"/>	Student is very enthusiastic concerning clinical education <input type="checkbox"/>	Student demonstrates interest in clinical education <input type="checkbox"/>	Student demonstrates interest in clinical education, but is not consistent in this attitude <input type="checkbox"/>
TACT AND COURTESY	Good discretion and courtesy to patients and staff <input type="checkbox"/>	Needs to be more discreet and polite with patients and staff at times inconsiderate <input type="checkbox"/>	Excellent discretion and courtesy to all persons in the clinical environment <input type="checkbox"/>	Tact and courtesy are fair; at times seems to be somewhat indifferent <input type="checkbox"/>
WHEN DEALING WITH PATIENTS:	Does not seem to communicate well with patients; demonstrates limited concern <input type="checkbox"/>	Demonstrates empathy and utilizes excellent communications skills effectively <input type="checkbox"/>	Communicates basic required information <input type="checkbox"/>	Communicates basic required information well and shows concern for <input type="checkbox"/>

Comments: _____

Clinical Site: _____

Technologist: _____ **Student:** _____