Radiography Curriculum

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Radiography Curriculum *was produced by the ASRT Radiography Curriculum Revision Project Group.*

Introduction

Advances in diagnostic imaging have brought forth necessary changes in the education of radiologic technologists. A national committee representing a variety of program types from across the country developed the curriculum based on research conducted by the Educational Testing Service (ETS) in 1999 (*The Practice of Radiography*). This document is the product of more than two years of revisions based on contributions from a variety of communities of interest through meetings, open forums and electronic communications. Comments from The American Registry of Radiologic Technologists (ARRT) and the Joint Review Committee on Education in Radiologic Technology (JRCERT) were also included in this revision to maintain continuity among the professional curriculum, accreditation *Standards* and the certification examination.

This curriculum is divided into specific content areas that represent the essential components of an entry-level radiography program. The content and objectives should be organized to meet the mission, goals and needs of each radiography 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.

Advances in diagnostic imaging and employer expectations demand more independent judgment by radiographers. Consequently, critical thinking skills must be fostered, developed and assessed in the educational process. Critical thinking has been incorporated in multiple content areas. These areas include, but are not limited to, clinical practice and the recommended post-secondary general education. It is expected that the faculty will continue to develop and implement critical thinking throughout the curriculum.

New content and objectives have been added to the radiography curriculum. New areas include human diversity, clinical competency, ethical considerations of genetics and a recommended general education component. Clinical and didactic competencies have been correlated. Content related to advanced modalities (e.g., quality management, computed tomography, magnetic resonance imaging, mammography) have been modified. Some content areas have been retitled or reorganized and outdated content eliminated.

In summary, the new radiography curriculum is based on the latest data relevant to the profession and reflects the changing health care environment. The curriculum offers a foundation for individual lifelong learning and transition to baccalaureate level studies. It allows for faculty flexibility in the development of a curriculum designed to meet the needs of the local community yet meet the requirements for the JRCERT standards and the ARRT examination.

Recommended General Education

General education is an integral part of the development of the professional radiographer. 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 an entry-level radiographer. Knowledge gained from general education serves to enhance the content and application of the radiography 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 Post-Secondary 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

Radiography Curriculum

Table of Contents

Fundamentals of Radiologic Science and Health Care

Description
Content is designed to provide an overview of the foundations in radiography and the practitioner's role in the health care delivery system. Principles, practices and policies of the health care organization(s) will be examined and discussed in addition to the professional responsibilities of the radiographer.

Objectives
1. Identify other health science professions that participate in the patient's total health care.
2. Describe the relationship of these health care workers 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. Discuss the relationship between institutional administrative personnel and radiology services.
7. Describe relationships and interdependencies of departments within a health care institution.
8. Identify and discuss the responsibilities and relationships of all personnel in the radiology department.
9. Explain patient services available in the radiology department.
10. Differentiate between programmatic and institutional accreditation.
11. Define accreditation, credentialing, certification, licensure and regulations.
12. Explain the purposes of accreditation and certification and identify the agencies involved.
13. Discuss the general employment outlook for the graduate radiographer.
14. Discuss career advancement and opportunities for the radiographer.
15. Identify the benefits of continuing education as related to improved patient care and professional enhancement.

Content

I. The Health Science Professions

A. Radiologic technology
   1. Radiography
      a. Magnetic resonance imaging
      b. Computed tomography
      c. Mammography
      d. Cardiovascular-interventional technology
      e. Bone densitometry
      f. 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. Hospital Organization

A. Philosophy

B. Mission
    1. Role within the community
    2. Commitment to education within the profession and community health

C. Administrative services
    1. Governing board
    2. Hospital administration
    3. Admissions
    4. Information systems
    5. Procurement
    6. Accounting
    7. Support services
        a. Facilities management
        b. Environmental services (housekeeping)
        c. Security
    8. Personnel

D. Medical services
    1. Personnel
        a. Medical director
        b. Medical staff
        c. House staff
            1) Medical residents
            2) Interns
            3) Medical students
    2. Nursing services
    3. Clinical services
        a. Internal medicine
        b. Surgery
        c. Mental health
        d. Geriatrics
        e. Pediatrics
    4. Clinical support services
        a. Dietary
        b. Medical laboratories

c. Oncology
d. Pastoral care
e. Rehabilitation
f. Social services

IV. Radiology Organization

A. Professional personnel
1. Radiology director/chairman
2. Radiologists
a. Attending
b. Fellow
c. Resident
d. Intern
3. Radiation physicists
4. Radiographer
a. Administrative director
b. Chief/senior technologist
c. Staff technologist
d. Quality control/assurance officer/technologist
5. Radiology nurses

B. Support personnel
1. Clerical staff
a. Administrative assistant
b. Receptionist
c. Medical secretary
2. Financing/accounting
3. Patient transportation services
4. File room/image management
5. Information systems manager
a. Radiology information systems
b. Picture archiving and communication systems

C. Patient services

D. Educational programs
1. Educational/program director
2. Clinical coordinator
3. Didactic instructor
4. Clinical instructor
5. Students

V. Accreditation

A. Definition

B. Programmatic accreditation
   1. Joint Review Committee on Education in Radiologic Technology (JRCERT)

C. 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 (formerly Health Care Financing Administration, HCFA)
      c. State agencies

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
      d. Other
   2. State
      a. Certification and licensure

VII. Professional Organizations

A. Purpose, function, activities

B. Local Organizations

C. State organizations

D. National
   1. American Healthcare Radiology Administrators (AHRA)
   2. American Society of Radiologic Technologists (ASRT)
   3. Association of Collegiate Educators in Radiologic Technology (ACERT)
   4. Association of Educators in Radiologic Sciences (AERS)

E. International
   International Society of Radiographers and Radiological Technologists (ISSRT)

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. Post-primary certification
    3. Collegiate/educational programs

B. Employment considerations
    1. Geographic mobility
    2. Economic factors
    3. Manpower issues

C. Additional employment opportunities
    1. Administration
    2. Physics
    3. Research
    4. Industrial
    5. Education
        a. Administration
        b. Faculty
            1) Didactic
            2) Clinical

D. Continuing education and competency requirements
    1. Definition
    2. Rationale
    3. Requirements
        a. ARRT
        b. State
        c. Institution
    4. Opportunities

Ethics and Law in the Radiologic Sciences

Description
Content is designed to provide a fundamental background in ethics. The historical and philosophical basis of ethics, as well as the elements of ethical behavior, will be discussed. The student will examine a variety of ethical issues and dilemmas found in clinical practice.

An introduction to legal terminology, concepts and principles will also be presented. Topics include misconduct, malpractice, legal and professional standards and the ASRT scope of practice. The importance of proper documentation and informed consent is emphasized.

Objectives
1. Describe specialized standards of behavior for the healing arts as a continuum, with historical and philosophical roots in the earliest periods of human history.
2. List the major milestones in the development of codes of behavior and ethical standards in the healing arts.
3. Explain ethics as a branch of philosophy and the moral, social and cultural basis of the development of an ethic.
4. Describe the moral, social and cultural basis of ethics.
5. Apply medical/professional ethics in the context of a broader societal ethic.
6. Explain the role of ethical behavior in health care delivery.
7. Differentiate between empathetic rapport and sympathetic involvement in relationships with patients and relate these to ethical conduct.
8. Explain concepts of personal honesty, integrity, accountability, competence and compassion as ethical imperatives in health care.
9. List legal/professional standards and their relationship to practice in health professions.
10. Identify specific situations and conditions that give rise to ethical dilemmas in health care.
11. Discuss the *US Genome Project* relative to the cause of genetically induced disease.
12. Explore the ethical issues of genetic screening.
13. Explain the genetic counseling responsibility of health care providers.
14. Employ a basic system of examination, clarification, determination of alternatives and decision-making in addressing ethical questions.
15. Explain select concepts embodied in principles of patients' rights, the doctrine of informed (patient) consent and other issues related to patients' rights.
16. Explain the legal implications of professional liability, malpractice, professional negligence/carelessness and other legal doctrines applicable to professional practice.
17. Describe the importance of accurate, complete, correct methods of documentation as a legal/ethical imperative.
18. Explore theoretical situations and questions relating to the ethics of care and health care delivery.

19. Explain specific legal terms, principles and laws.
20. Outline the elements necessary for a valid malpractice claim.
21. Define specific legal doctrines to include vicarious liability, respondeat superior, and res ipsa loquitur.
22. Describe the scope of practice for radiography, the elements that comprise it and responsibilities of the radiographer.
23. Differentiate between professional and legal standards and describe how each relates to the radiography profession.
24. Describe institutional and professional liability protection typically available to the radiographer.
25. Describe the elements and implications of informed consent.
26. Identify standards for disclosure relative to informed consent.
27. Describe how consent forms are utilized relative to specific radiographic procedures.

Content

I. Historical and Philosophical Context

A. Origins of the healing arts
   1. Healing, healers, magic, religion
   2. Principles, duties and virtues of a health professional
   3. Milestones in the history of medical ethics
   4. Holistic considerations

II. Ethics and Ethical Behavior

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. 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
   1. Education
   2. Accreditation
   3. Credentialing
   4. Clinical practice

I. Code of professional ethics

J. Ethical principles
   1. Beneficence
   2. Non-malfeasance
   3. Respect for autonomy

K. Organizational ethics
   1. Mission statement
   2. JCAHO

L. Analyzing ethical problems
   1. Goal theories
   2. Rights theories
   3. Duty theories

III. Ethical Issues in Health Care

A. Individual and societal rights

B. Autonomy vs. behavior control
   1. Access and distribution of health care
   2. Justice
   3. Fairness
   4. Economics

C. Financing health care: Who pays?

D. Technology and scarce resources

E. Access to quality health care

F. Human experimentation and research

G. Medical/health care research

H. End of life decisions
   1. Living wills
   2. Advanced directives
   3. Nonintervention

I. Ethical decision making
   1. Weighing data
   2. Alternatives
   3. Risks vs. benefits

J. Genetics

IV. 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 doctrines
    a. Vicarious liability
    b. Respondeat superior
    c. Res ipsa loquitur
5. Legal and professional standards
    a. Standard of care
    b. Scope of practice
6. Protection
    a. Individual
    b. Institutional

B. Scope of practice and responsibilities of the radiographer (ASRT practice standards for medical imaging and radiation therapy)
    1. Correct patient identification
    2. Correct identification/marking of radiograph
    3. Accurate assessment of patient condition prior to and during radiographic examination
    4. Composition of radiographic image quality
    5. Accurate documentation as required

C. Practice standards

V. Patient Consent

A. Definition

B. Types
    1. Implied
    2. Written
    3. Oral

C. Condition for 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 JCAHO Standards for Disclosure

D. Documentation of consent
    1. Form and contents
    2. Use in legal actions

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.

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.

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 and emergency patient care procedures will be described, as well as infection control procedures utilizing standard precautions. The role of the radiographer in patient education will be identified.

Objectives

1. Identify the responsibilities of the health care facility and members of the health care team.
2. List the general responsibilities of the radiographer.
3. Describe the scope of practice for the radiographer as defined by the ASRT and state licensure.
4. Explain select perceptions of death and dying from patient and technologist viewpoints.
5. Describe ethical, emotional, personal and physical aspects of death.
6. List the stages of dying and describe the characteristics of each stage.
7. Identify the support mechanisms available to the terminally ill.
8. Identify methods for determining the correct patient for a given procedure.
9. Explain the use of various communication devices and systems.
10. Explain specific aspects of a radiographic procedure to the patient.
11. Demonstrate correct principles of body mechanics applicable to patient care.
12. Demonstrate techniques for specific types of patient transfer.
13. Demonstrate select procedures for turning patients with various health conditions.
14. Describe select immobilization techniques for various types of procedures and patient conditions.
15. Describe specific patient safety measures and concerns.
16. Explain the purpose, legal considerations and procedures for reporting an accident or incident.
17. Describe methods for evaluation of patient status.
18. List the information to be collected prior to patient examination.
19. Describe vital signs used to assess patient condition.
20. Convert a Fahrenheit measurement to the Celsius equivalent.
21. State the normal temperature values for the oral and rectal routes of measurement.
22. Describe the method of monitoring respiration and state the normal values expected.
23. Identify the normal values for blood pressure for males and females.
24. Identify the seven major sites for monitoring the pulse and indicate the normal values.
25. Assess patient vital signs.
26. List the normal ranges for specific laboratory studies.
27. Define terms related to infection control.
28. Describe the importance of Standard Precautions and Isolation Procedures.

29. Explain sources and modes of transmission of infection and disease.
30. List institutional/departmental procedures for infection control.
31. Describe methods for the prevention of infection to the health worker and patient.
32. Identify symptoms related to specific emergency situations.
33. Describe the emergency medical code system for the institution and the role of the student during a medical emergency.
34. Explain the special considerations necessary when performing radiographic procedures on an infant or a child.
35. Explain the special considerations necessary when performing radiographic procedures on a geriatric patient.
36. Describe the symptoms and precautions taken for a patient with a head injury.
37. Describe the symptoms and precautions taken for a patient with a spinal injury.
38. Explain the types, immobilization devices and positioning for upper and lower extremity fractures.
39. Describe the symptoms and precautions taken for a patient with massive wounds.
40. Describe the classifications and medical interventions for burns.
41. Describe the symptoms and medical interventions for a patient having a contrast agent reaction.
42. Explain the role of the technologist in patient education.
43. Describe the patient preparation for various barium studies.
44. Describe the procedure to properly prepare a patient for a barium study.
45. Identify specific types of tubes, lines, catheters and collection devices.
46. Explain the purpose, precautions and care of tubes, lines, catheters and collection devices.
47. Outline the steps in the operation and maintenance of suction and oxygen equipment and demonstrate their use.
48. Demonstrate competency in cardiopulmonary resuscitation (CPR).
49. Demonstrate the use of specific medical emergency equipment and supplies.
50. Demonstrate select first aid techniques.
51. Describe the monitoring, pre- and post-procedure care, drug administration and special precautions for a patient undergoing myelography and urography.
52. Demonstrate the appropriate procedure for gathering information prior to performing a mobile radiographic examination.
53. Describe the initial steps in performing a mobile procedure.
54. Explain the procedure for placing an image receptor under a patient in an orthopedic bed frame.
55. Describe the special problems faced in performing procedures on a patient with tracheotomy and specific tubes, drains and catheters.
56. Describe the procedure for producing diagnostic images in the surgical suite.
57. Explain the appropriate radiation protection required when performing mobile/surgical radiography.

Content

I. Radiographer and Health Care Team

A. Responsibilities of the health care facility
   1. Caring for all patients regardless of condition
   2. Caring for the trauma patient
   3. Caring for the pediatric patient
   4. Caring for the geriatric patient
   5. Promoting health
   6. Preventing illness
   7. Education
   8. Research

B. Health care team
   1. Make-up of health care team
   2. Responsibilities

C. Responsibilities of the radiographer
   1. Performing radiographic examination
   2. Assisting the radiologist
   3. Providing patient care
   4. Scope of practice
      a. ASRT
      b. State licensure

II. Attitudes and Communication in Patient Care

A. Health-illness continuum

B. Developing professional attitudes
   1. Serving as health role models
   2. Sympathy
   3. Empathy
   4. Assertiveness

C. Communication across the age continuum
   1. Neonates
   2. Pediatric
   3. Adolescent
   4. Young adult
   5. Elderly

D. 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

E. Psychological considerations
1. Dying and death
    a. Understanding the process
    b. Aspects of death
        1) Emotional
        2) Personal
        3) Physical
            a) Pain
            b) Suffering

c) Disability
d) Deterioration

c. Stages of dying
1) Rejection
2) Denial
3) Anger
4) Bargaining
5) Acceptance

d. Patient support services
1) Family/friends
2) Pastoral care
3) Patient-to-patient support groups
4) Psychological support groups
5) Hospice
6) Home care

2. Patient's emotional responses
a. General behavior
b. Influencing factors
1) Age
2) Sex
3) Marital/family status
4) Socioeconomic factors
5) Cultural/religious variations
6) Physical condition
7) Self-image
8) Past life experiences
9) Beliefs
10) Attitudes
11) Prejudices
12) Self-awareness

III. Patient/Technologist 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

C. Interaction with patient family members and friends – simulations

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
   5. Practicum

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. Disabled patients
   6. Geriatric patients
   7. Pediatric patients
   8. Patients with intravenous infusions
   9. Patients with tubes or catheters
   10. Metastatic disease
   11. Practice

D. Positioning for safety and comfort
   1. Positions
      a. Supine
      b. Protective side-lying
      c. Protective prone position
      d. Fowler's
      e. Semi-Fowler's
      f. Sims'

g. Trendelenburg
h. Lithotomy
i. Knee-chest

2. Safety straps and rails

E. Immobilization techniques
1. Purpose
2. Adult
a. Types
b. Applications
c. Devices
3. 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
a. Fahrenheit
b. Celsius
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
1. Procedures
2. Demonstration

D. Review of laboratory data
Normal ranges for:
   a. BUN
   b. Creatinine
   c. Hemoglobin
   d. RBC
   e. Platelets

E. Patient chart
   1. Aspects of patient chart
   2. Confidentiality of patient information
   3. Retrieving specific information
   4. Proper documentation in the chart

VI. Infection Control

A. Terminology
   1. Nosocomial
   2. Communicable
   3. Infectious pathogens
   4. Human Immunodeficiency Virus (HIV)
   5. Hepatitis
      a. Hepatitis A Virus (HAV)
      b. Hepatitis B Virus (HBV)
      c. Hepatitis C Virus (HCV)
      d. Others

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
   1. Transmission-based precautions

E. Asepsis
   1. Medical
      a. Definition

b. Procedures
    1) Handwashing
    2) Chemical disinfectants
2. Surgical
    a. Definition
    b. Growth requirements for microorganisms
    c. Methods used to control microorganisms
        1) Moist heat
            a) Boiling
            b) Steam under pressure
        2) Dry heat
            a) Incineration
            b) Dry heat
        3) Gas
        4) Chemicals
    d. Procedures – Demonstration
        1) Opening packs
        2) Gowning/gloving
        3) Skin preparation
        4) Draping
        5) Dressing changes
    e. Packing
    f. Storage
    g. Rules for surgical asepsis

F. Environmental asepsis
1. Handling linens
2. Wound care
    a. Cleansing
    b. Dressing
3. Techniques
    a. Dress
    b. Hair
    c. Handwashing
    d. Gloves
    e. Eye protection
    f. Cleaning and proper disposal of contaminated waste
4. Practice

G. Isolation techniques and communicable diseases
1. Category-specific
2. Disease-specific
3. Standard precautions

4. Examples
    a. HIV virus (AIDS)
    b. Hepatitis
        1) Type A
        2) Type B
        3) Type C (non-A or -B)
    c. Tuberculosis (TB)
    d. Respiratory syncytial Virus (RSV)
    e. Other

H. Isolation patient in radiology department
1. Procedure
    a. Gowning
    b. Gloving
    c. Masking
2. Patient transfer
3. Cleaning and proper disposal of contaminated waste
4. Cleaning of cassettes and imaging equipment

I. Precautions for the compromised patient (reverse isolation)
1. Purpose
2. Procedure

J. Psychological considerations

VII. Medical Emergencies

A. Terminology

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. Unique Situations and Trauma

A. Head injuries
   1. Four levels of consciousness
   2. Symptoms
   3. Medical intervention
   4. Adult vs. pediatric

B. Spinal injuries
   1. Assessment
   2. Symptoms
   3. Medical intervention
   4. Transportation

C. Extremity fractures
   1. Types
   2. Symptoms
   3. Splints
   4. Casts
   5. Positioning
   6. Adult vs. pediatric

D. Wounds
   1. Symptoms
   2. Medical intervention

E. Burns
   1. Burn classifications
   2. Medical intervention

F. Reactions to contrast agents
   1. Signs and symptoms of mild, moderate and severe contrast reactions
   2. Medical interventions for each type of reaction
   3. Vasovagal reactions

IX. Barium Studies

A. Patient education
   1. Technologist's responsibility
   2. Standard procedure

B. Preparation for examination
   1. Diet
   2. Laxatives
   3. Enemas
      a. Saline
      b. Fleet
      c. Oil-retention
      d. Tap-water
      e. Soap suds
   4. Procedure
   5. Follow-up care

X. Tubes, Catheters, Lines and Collection Devices

A. Terminology

B. Nasogastric/nasointestinal

C. Suction
   1. Adult vs. pediatric
   2. Special precautions

D. Tracheostomy
   1. Suction techniques
   2. CPR with tracheostomy

E. Chest tube

F. Tissue drains

G. Oxygen administration
   1. Values
   2. Oxygen therapy

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

H. Urinary collection
1. Procedure
    a. Male
    b. Female
2. Alternative methods of urinary drainage
3. Documentation

I. Other ostomies
1. Ileostomy
2. Ureteroileostomy

XI. Care of Patients During Myelography and Urography

A. Monitoring and care during invasive procedures
1. Preparation for cardiac monitoring
2. ECG rhythms
    a. Normal
    b. Abnormal
3. Patient care considerations
    a. Adverse reactions
        1) Reactions to contrast media
        2) Other medical conditions

B. Myelography
1. Explanation of procedure
2. Pre- and post-procedure care
3. Intrathecal drug administration
4. Special precautions

C. Urography
1. Explanation of procedure
2. Pre- and post-procedure care
3. Special precautions

XII. Mobile and Surgical Radiography

A. Prior to bedside procedure:
1. Exam order
2. Chart
3. Right patient – right procedure

B. Steps followed during bedside procedure

C. Bedside procedure for neonate

D. Bedside procedure for the orthopedic patient

E. Special situations

F. Radiography in surgery
   1. Surgical clothing
   2. Equipment preparation
   3. Sterile fields
   4. Communication skills

G. Radiation protection

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.

Objectives
1. Identify the location of 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. Explain the terms atom, ion, atomic number and atomic weight.
5. Describe the nature of chemical bonds and compare the different types of chemical bonds.
6. Apply the pH scale to differentiate between acid and base substances.
7. Differentiate between polar and nonpolar compounds, and relate these to water solubility.
8. List different types of carbohydrates and give examples of each type.
9. Differentiate between the different types of lipids and determine common characteristics.
10. Describe the structure and functions of proteins.
11. Describe the structure of deoxyribonucleic acid (DNA) and the law of complementary base pairing.
12. Describe the structure of ribonucleic acid (RNA) and name the different types of RNA.
13. Characterize the structure of the cell membrane and the cytoskeleton.
14. Compare endocytosis and exocytosis.
15. Identify the structure and function of cilia and flagella.
16. Diagram the replication of DNA.
17. Diagram the phases of the cell cycle.
18. Describe genetic transcription and the post-transcriptional modifications that change pre-mRNA into mRNA.
19. List the functions of mRNA, tRNA and rRNA.
20. List the functions of the rough endoplasmic reticulum and Golgi apparatus in post-transitional modifications of secretory proteins.
21. Outline the sequence of events that occur in the synthesis packaging and exocytosis of secretory proteins.
22. Differentiate between the stages of meiosis and mitosis and identify the stages of each reproductive process.
23. Define the following: anabolism, catabolism and metabolism.
24. Characterize the role of enzymes in metabolism.
25. Describe carbohydrate metabolism.
26. Describe lipid metabolism.
27. Describe the Krebs cycle in general terms and its functional significance.
28. Express the significance of ketone.
29. List the factors that affect the basal metabolic rate.

30. Diagram the germinal layers of the embryo.
31. Classify tissue types, describe the functional characteristics of each and give examples of their location within the human body.
32. Identify and locate the bones of the human skeleton.
33. Identify bony processes and depressions found on the human skeleton.
34. Describe articulations of the axial and appendicular skeleton.
35. Differentiate the primary and secondary curves of the spine.
36. Describe sesamoid bones and locate examples on radiographs.
37. Summarize the functions of the skeletal system.
38. Label different types of articulations.
39. Compare the types, locations and movements permitted by the different types of articulations.
40. Examine the organization of muscle at the gross and microscopic levels.
41. Differentiate between the structures of each type of muscle tissue.
42. State the function of each type of muscle tissue.
43. Name and locate the major muscles of the skeleton.
44. Differentiate between the structure and function of different types of nerve cells.
45. State the structure of the brain and the relationship of its component parts.
46. Describe the brain functions.
47. List the meninges and describe the function of each.
48. Outline the formation, circulation and function of cerebrospinal fluid.
49. Describe the structure and function of the spinal cord.
50. Determine the distribution and function of cranial and spinal nerves.
51. Summarize the structure and function of components making up the autonomic nervous system.
52. Describe the structures and functions of the components making up the human eye and ear.
53. List the component body parts involved in the senses of smell and taste.
54. List the somatic senses.
55. Define endocrine.
56. Describe the characteristics and functions of the components making up the endocrine system.
57. Identify the location and describe the structure of each component of the endocrine system.
58. Identify the major hormone(s) secreted by each component of the endocrine system.
59. Describe the hard and soft palates.
60. Differentiate between deciduous and permanent teeth in terms of age for eruption and number.
61. Differentiate between the types of teeth in terms of number, location within the jaws and their function.
62. Label the component parts of a tooth.
63. Describe the structure and function of the tongue.
64. Identify the structure, function and locations of the salivary glands.
65. Recite and label the primary organs of the digestive system.
66. Describe the function(s) of each primary organ of the digestive system.

67. Differentiate between the layers of tissue that comprise the esophagus, stomach, small intestine, large intestine and rectum.
68. Differentiate between peritoneum, omentum and mesentery.
69. List and label the accessory organs of the digestive system, and describe their function.
70. Identify the secretions of accessory organs of the digestive system and the function of each.
71. Explain the purpose of digestion.
72. List the digestive processes that occur in the body.
73. Describe the composition and characteristics of blood.
74. List the types of blood cells and state their functions.
75. Differentiate between blood plasma and serum.
76. Outline the clotting mechanism.
77. List the blood types.
78. Explain the term Rh factor.
79. Explain the antigen/antibody relationship and its use in blood typing.
80. Label the parts of the human heart.
81. Describe the flow of blood through the body and identify the main vessels.
82. Describe the structure and function of arteries, veins and capillaries.
83. Differentiate between arterial blood in systemic circulation and arterial blood in pulmonary circulation.
84. Differentiate between normal and common abnormal electrocardiogram (ECG) tracings.
85. Summarize the structure, distribution and function of lymphatic vessels.
86. Outline the major pathways of lymphatic circulation.
87. Identify the location of major lymph node clusters.
88. Differentiate between nonspecific defenses and specific immunity.
89. Explain antibody production and function.
90. List the different types and functions of T- and B-cells and explain their functions.
91. Label the components of the respiratory system.
92. Describe the physiology and regulation of respiration.
93. Label the parts of the kidneys, ureters, bladder and urethra.
94. Describe the function of each organ of the urinary system.
95. Describe the composition and formation of urine.
96. Explain micturition.
97. Label the anatomy of the male and female reproductive organs.
98. Analyze the function of each of the male and female reproductive organs.
99. Demonstrate the use of topographical landmarks to locate internal structures.
100. Identify major anatomical structures found within sectional images.

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. Chemical Composition

A. Atoms

B. Chemical bonds

C. Inorganic compounds
   1. Acids
   2. Bases
   3. Salts
   4. Acid-base balance
   5. Maintaining pH

D. Organic compounds
   1. Carbohydrates
   2. Lipids
   3. Proteins
   4. Nucleic acids
   5. DNA
   6. RNA
   7. Adenosine triphosphate (ATP)
   8. Cyclic AMP (adensoine-3', 5' monophosphate)

III. Cell Structure and Genetic Control

A. Cell membrane
   1. Chemistry
   2. Structure
   3. Physiology
   4. Types of transport processes
      a. Diffusion
      b. Osmosis
      c. Filtration
      d. Active transport/physiological pumps
      e. Phagocytosis and pinocytosis

B. Cytoplasm

C. Organelles
   1. Nucleus
   2. Ribosomes
   3. Endoplasmic reticulum
   4. Golgi complex
   5. Mitochondria
   6. Lysosomes
   7. Peroxisomes
   8. Cytoskeleton
   9. Centrosome and centrioles
   10. Flagella and cilia

D. Gene action
   1. Protein synthesis
   2. Nucleic acid (RNA/DNA) synthesis
   3. Transcription
   4. Translation

E. Reproduction of cells
   1. Mitosis
   2. Meiosis

F. Aberration/abnormal cell division

IV. Metabolism

A. Anabolism

B. Catabolism

C. Enzymes and metabolism

D. Carbohydrate metabolism

E. Lipid metabolism

F. Protein metabolism

G. Regulation and homeostasis

V. Tissues

A. Embryonic layers
   1. Ectoderm
   2. Endoderm
   3. Mesoderm

B. Types of tissue
   1. Epithelial
   2. Connective
   3. Muscle
   4. Nerve

C. Tissue repair and homeostasis

VI. 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

VII. Muscular System

A. Types, characteristics and functions
1. Smooth
2. Cardiac
3. 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

IX. Sensory System

A. General senses
1. Nociperception
2. Chemoreception
3. Thermoreception
4. Mechanoreception

B. Special senses – structure, function
   1. Vision
   2. Hearing and equilibrium
   3. Olfaction
   4. Gustation
   5. Tactile

X. Endocrine System

A. Hormone structure, function and location

B. Homeostatic control

C. Endocrine Tissue
   1. Pituitary (hypophysis) gland
   2. Pineal gland
   3. Thyroid gland
   4. Parathyroid gland
   5. Adrenal (suprarenal) glands
   6. Heart and kidneys
   7. Digestive system
   8. Pancreas
   9. Testes
   10. Ovaries
   11. Thymus
   12. Placenta

XI. Digestive System

A. Primary organs – structure, function and location
   1. Oral cavity
   2. Esophagus
   3. Stomach
   4. Small intestine
   5. Large intestine
   6. Rectum

B. Accessory organs – structure, function and location
   1. Salivary glands
   2. Pancreas
   3. Liver
   4. Gallbladder

C. Digestive processes
    1. Ingestion
    2. Peristalsis
    3. Digestion
    4. Absorption
    5. Defecation

XII. Cardiovascular system

A. Blood
   1. Composition
   2. Clotting system
   3. Hemopoiesis
   4. Function

B. Heart and vessels
   1. Anatomy
   2. Function

C. ECG tracings
   1. Normal
   2. Abnormal

XIII. Lymphatic System and Immunity

A. Lymphatic system
   1. Lymph vessels
   2. Lymphatic organs
      a. Thymus
      b. Lymph nodes
      c. Spleen
   3. Lymphatic tissue
      a. Tonsils
      b. Peyer's patches

B. Immune system
   1. Nonspecific defenses
      a. Physical barriers
      b. Phagocytic cells
      c. Immunological surveillance
      d. Complement
      e. Inflammation
   2. Humoral immunity
      a. Production
      b. Structure
      c. Function
   3. Types of immunoglobulins
      a. Regulation of immune response
         1) Monokines
         2) Lymphokines
      b. Immunological competence

XIV. Respiratory System

A. Components, structure and function
   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

XV. Urinary System

A. Components, structure and function
   1. Kidneys
   2. Ureters
   3. Bladder
   4. Urethra

B. Urine
   1. Physical characteristics
   2. Chemical composition

C. Micturition

XVI. Reproductive System

A. Male – structure, function and location
   1. External organs
   2. Internal organs

B. Female – structure, function and location
   1. External organs
   2. Internal organs
   3. Mammary glands

C. Reproductive physiology
   1. Ovarian cycle
   2. Menstrual cycle
   3. Aging and menopause

XVII. Topography

A. Landmarks
   1. Cranium
   2. Neck
   3. Spine
   4. Thorax
   5. Abdomen
   6. Pelvis
   7. Extremities

B. Underlying anatomy
   1. Cranium
   2. Neck
   3. Spine
   4. Thorax
   5. Abdomen
   6. Pelvis
   7. Extremities

XVIII. Sectional Anatomy

A. Structures and locations
   1. Head and neck
   2. Thorax
   3. Abdomen/pelvis
   4. Vertebral column
   5. Extremities

Radiographic Procedures

Description
Content is designed to provide a knowledge base necessary to perform standard radiographic procedures along with the application to special studies. Consideration will be given to the production of images of optimal diagnostic quality. Laboratory experience should be used to complement the didactic portion.

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. Cite the structures demonstrated on routine radiographic/fluoroscopic procedures.
6. Adapt radiographic/fluoroscopic procedures based on special considerations.
7. Simulate radiographic/fluoroscopic 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/fluoroscopic procedures.
10. Recite the patient preparation necessary for various contrast and special studies.
11. List and explain the routine and special views for all radiographic/fluoroscopic procedures.
12. Explain the purpose for using contrast media.
13. Differentiate between positive and negative contrast agents.
14. Name the type, dosage and route of administration of contrast media commonly used to perform radiographic contrast and special studies.
15. Describe the general purpose, and unique features resulting from special radiographic/fluoroscopic studies.
16. Distinguish between the types and purpose for various upper and lower gastrointestinal studies.
17. Identify methods and barriers of communication and describe how each may be utilized or overcome effectively during patient education.
18. Explain radiographic procedures to patients/family members.
19. Modify directions to patients with various communication problems.
20. Apply general radiation safety and protection practices associated with radiologic examinations.

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. Skull lines
   1. Glabellomeatal line
   2. Interpupillary line
   3. Orbitomeatal line
   4. Infraorbitomeatal line
   5. Acanthiomeatal line
   6. Mentomeatal line

E. Skull landmarks
   1. Auricular point
   2. Gonion (angle)
   3. Mental point
   4. Acanthion
   5. Nasion
   6. Glabella
   7. Inner canthus
   8. Outer canthus
   9. Infraorbital margin
   10. Occlusal plane
   11. External auditory meatus
   12. Mastoid tip

F. 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

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

H. Accessory equipment
   1. Calipers
   2. Lead strips
   3. Lead shields or shadow shields
   4. Lead markers
   5. Image receptor holders

II. General Considerations

A. Evaluation of radiographic orders
   1. Patient identification
   2. Verification of procedure(s) ordered
   3. Review of clinical history
   4. Taking clinical history and patient assessment
      a. Role of the radiographer
      b. Questioning skills
      c. Determining the chief complaint
      d. Localization
      e. Chronology
      f. Quality
      g. Severity
      h. Onset
      i. Aggravating or alleviating factors
      j. Associated manifestations
      k. Special considerations for age, disability and cultural background
      l. Determining previous allergic reactions
   5. Establishment of patient rapport
      a. Procedure explanation
      b. Determination of pregnancy

6. Patient preparation
    a. Verification of appropriate dietary preparation
    b. Verification of appropriate medication preparation
    c. Appropriate disrobing and gowning
    d. Removal of items that may cause artifacts
7. Room preparation
    a. Cleanliness, organization and appearance
    b. Necessary supplies and accessory equipment available
8. Patient assistance
9. Patient monitoring
10. Image evaluation
11. Patient dismissal

III. Positioning Considerations for Routine Radiographic Procedures

A. Patient instructions

B. Patient positioning

C. Part placement

D. Image receptor selection and placement

E. Beam alignment and angulation

F. Beam limitation and shielding

G. Special considerations
1. Atypical conditions
2. Mobile procedures
3. Surgical unit procedures
4. Age specific
5. Special needs patients
6. Trauma

H. Positioning for the following studies:
1. Skeletal system
    a. Upper extremity
        1) Fingers
        2) Hand
        3) Wrist
        4) Radius/ulna
        5) Elbow
        6) Humerus
    b. Shoulder girdle
        1) Shoulder joint
        2) Scapula

3) Clavicle
4) Acromioclavicular articulations

c. Lower extremity
1) Toes
2) Foot
3) Ankle
4) Calcaneus
5) Tibia/fibula
6) Knee/patella
7) Femur

d. Pelvic girdle
1) Pelvis
2) Hip

e. Vertebral column
1) Cervical
2) Thoracic
3) Lumbar
4) Sacrum and coccyx
5) Sacroiliac articulations
6) Scoliosis survey

f. Bony thorax
1) Ribs
2) Sternum
3) Sternoclavicular articulations

g. Skull

h. Facial and paranasal sinuses
1) Facial bones
2) Nasal bones
3) Orbits/optic foramina
4) Zygomatic arches
5) Mandible
6) Temporomandibular articulations
7) Paranasal sinuses

i. Respiratory system
1) Upper airway
2) Lungs

j. Abdomen
1) Viscera
2) Female reproductive organs

IV. Procedural Considerations for Contrast Studies

A. Equipment and materials needed

B. Contrast media
1. Purpose

2. Types
    a. Negative agents
        1) Carbon dioxide
        2) Air
        3) Nitrous oxide
    b. Positive agents
        1) Barium sulfate
        2) Iodinated

C. Single and double contrast examinations
    1. Upper gastrointestinal system
    2. Lower gastrointestinal system
    3. Follow-up care

D. General procedure

E. Patient and body part positioning

F. Structures and functions demonstrated

G. Positioning for the following body systems:
    1. Digestive system
        a. Esophagus
        b. Stomach
        c. Small bowel
        d. Colon/rectum
    2. Biliary system
        a. Gallbladder
        b. Biliary ducts
        c. Endoscopic retrograde cholangiographic pancreatography (ERCP)
        d. Operative cholangiography
    3. Urinary system
        a. Intravenous urography
        b. Retrograde urography
        c. Cystography and cystourethrography

H. Procedural considerations for the following special studies:
    1. Arthrography
    2. Myelography
    3. Venography
    4. Other

V. Patient Education

A. Communication
   1. Types
   2. Barriers
      Methods for overcoming barriers

B. Clinical situations

C. Common radiation safety issues and concerns

Imaging and Processing

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. Class demonstrations/labs are used to demonstrate application of theory.

Objectives
1. Discuss practical considerations in setting standards for acceptable image quality.
2. Assess radiographic density on radiographic images.
3. Distinguish between acceptable and unacceptable image densities.
4. Analyze the relationships of factors that control and affect image density.
5. Critique the radiographic contrast within various radiographic images.
6. Differentiate between subject contrast and image receptor contrast.
7. Distinguish between acceptable and unacceptable contrast scales.
8. Compare long-scale and short-scale contrast images.
9. Analyze the relationships of factors that control and affect radiographic contrast.
10. Critique recorded detail on various radiographic images.
11. Differentiate between umbra and focal spot blur.
12. Analyze the relationships of factors affecting recorded detail.
13. Define distortion.
14. Differentiate between shape and size distortion.
15. Perform calculations to determine image magnification and percent magnification.
16. Differentiate between magnification as distortion and macro-radiography.
17. Summarize the relationships of factors affecting distortion.
18. Formulate a plan of action to decrease image distortion.
19. Summarize the relationships of factors affecting exposure latitude.
20. Describe the operation and applications for different types of beam-limiting devices.
21. Evaluate beam-limiting devices.
22. Select the most appropriate beam-limiting device to be used for a given clinical situation.
23. Explain beam filtration.
24. Describe the change in the half value layer (HVL) when additional filtration is added to the beam.
25. Summarize the relationships of factors affecting scattered and secondary radiation.
26. Evaluate the effects of scattered radiation on the image.
27. Compare types of grid.
28. Articulate the advantages and disadvantages of grid use.
29. Describe grid maintenance.
30. Select the most appropriate grid for a given clinical situation.
31. Interpret grid efficiency in terms of grid ratio and frequency.
32. Define grid cut-off.
33. Summarize the factors influencing grid cut-off.

34. Evaluate grid artifacts.
35. Formulate a set of rules for grid use to prevent grid cut-off and artifacts.
36. Explain the use of standardized radiographic technique charts.
37. Explain exposure factor considerations involved in technique selection.
38. Compare fixed kilovolt peak (kVp) and variable kVp systems.
39. Formulate a technique chart using either a fixed kVp or variable kVp system.
40. Calculate the photographic effect when exposure factors are given.
41. Apply mAs reciprocity to clinical simulations.
42. Describe the function of each component of radiographic film.
43. Explain latent image formation.
44. Discuss photostimulable phosphor plates as image receptors.
45. Discuss how an image is retrieved from a photostimulable phosphor.
46. Describe the features of the characteristic curve and explain its purpose.
47. Compare the characteristic curve for differing types of image receptors, both film and photostimulable phosphor plates.
48. Select the most appropriate image receptor to be used for given clinical situations.
49. Describe various type of image receptor holder.
50. Describe the function of each component of an intensifying screen.
51. Select the most appropriate intensifying screen for given clinical situations.
52. Explain the classifications of intensifying screens and the applications of each.
53. Identify procedures that ensure a long screen life devoid of artifacts and distortion.
54. Employ a quality control program for intensifying screens.
55. Differentiate between traditional intensifying screens and photostimulable phosphors.
56. Discuss darkroom-related OSHA standards for health and safety.
57. Discuss safelight illumination appropriate for specific image receptor systems.
58. Discuss the possible causes and health implications of “darkroom chemical sensitivity.”
59. Describe the effects of storage on image quality.
60. List image archiving options.
61. Describe the operation and utilization of wet and dry processing.
62. Analyze the effects of processing on image quality.
63. Identify key components of an automatic film processor.
64. Demonstrate how various film sizes are fed into the film processor.
65. Analyze the steps of the processing cycle providing the specific action and duration of time for each step.
66. Identify the purpose of a daily quality control program for processors.
67. Discuss digital image processing and postprocessing.
68. Identify types of image artifacts and analyze the artifacts to determine the cause.
69. Compare methods of silver recovery.
70. Evaluate silver recovery security in terms of control, theft and misappropriation.

Content

I. Imaging Quality Standards

A. Practical approach for setting image standards

B. Radiologist involvement in setting image standards

C. Patient care and safety concerns

D. Procedures for maintaining image standards

II. Radiographic Density

A. Definition

B. Acceptable range

C. Factors
1. mAs
2. kVp
3. Distance
4. Film-screen combinations
5. Grids
6. Beam limitation
7. Patient considerations
   a. Anatomic part
   b. Pathology
8. Processing
   a. Automatic
   b. Dry
9. Contrast media
10. Filtration
11. Heel effect
12. Digital systems (Window: level)

III. Radiographic Contrast

A. Definition

B. Types
1. Long scale
2. Short scale

C. Components
1. Subject
2. Image receptor

D. Factors
   1. kVp
   2. Scattered radiation
   3. Fog
   4. mAs
   5. Grids
   6. Beam limitation
   7. Filtration
   8. Intensifying screens
   9. Photostimulable phosphors
   10. Signal to noise ratio
   11. Patient considerations
      a. Anatomic part
      b. Pathology
   12. Distance
   13. Processing
      a. Wet
      b. Dry
   14. Contrast media
   15. Digital systems (Window: width)

IV. Recorded Detail

A. Definition

B. Components
   1. Umbra
   2. Focal spot blur

C. Factors
   1. Geometric unsharpness
      a. SID
      b. OID
      c. Focal spot
      d. Structural shape
   2. Materials unsharpness
      a. Intensifying screens
      b. Image receptor system
      c. Photostimulable phosphors
      d. 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. Intensifying screens
   3. Film
   4. Photostimulable phosphors
   5. Digital systems
   6. Image receptor

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. PBL
   4. Lead masks
   5. Alignment
      a. Light field
      b. 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. HVL
   1. Definition
   2. Applications

F. Image quality
   1. Density
   2. Contrast

G. Patient exposure

IX. Scattered and Secondary Radiation

A. Definitions

B. Factors
   1. kVp
   2. Patient considerations
   3. Beam limitation
   4. Grids
   5. Distance
   6. Contrast media

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

X. Control of Exit Radiation

A. kVp selection

B. Grids
   1. Purpose
   2. Components

3. Construction
    a. Canting
    b. Interspace material
4. Types/patterns
    a. Focused
    b. Parallel
    c. Linear
    d. Cross
5. Terms/definitions
    a. Grid focusing distance
    b. Focal range
    c. Convergent line/point
6. Efficiency
    a. Ratio
    b. Frequency (lead content)
7. Selection
    a. kVp
    b. Patient considerations
    c. Distance
    d. Beam limitation
    e. Latitude
8. Cut-off
    a. Definition
    b. Factors
9. 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. Automated exposure
    4. Digital

D. Applications

XII. Exposure Calculations

A. Factors
   1. Distance
   2. mAs
   3. kVp
   4. Grids
   5. Intensifying screens
   6. Image receptors
   7. Focal spot
   8. Digital exposure indicator

B. Calculations
   1. Density/contrast
      a. Photographic effect
      b. Visual effect
   2. Focal spot blur
      a. Edge gradient
      b. Definition
   3. Distortion
      a. Magnification factor
      b. Percent magnification
   4. 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. Composition
   1. Components
   2. Structure
   3. Function

B. Types
   1. Film
   2. Photostimulable phosphors
      a. Construction
      b. Applications

C. Definition, influence and application of image receptors properties
   1. Contrast
   2. Speed/sensitivity
   3. Latitude
   4. Recorded detail

D. Latent image formation
   1. Sensitivity specks
      a. Definition
      b. Location

E. Digital systems
   1. Definition/purpose
   2. Sensitometric equipment
   3. Graphing
   4. Interpretation
   5. Curve construction and graphing
   6. Evaluation
   7. Histograms

F. Characteristic curves
   Comparisons
      a. Speed
      b. Control
      c. 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
        a. Intensifying screens
    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
        c. Testing
        d. Evaluating

XVI. Processing Area Considerations

A. Location/construction/function
    1. Centralized/decentralized
    2. Access
    3. Ease of operation

B. Lighting
    1. Safelights
        a. Definition
        b. Filters
        c. Bulb size/color
        d. Testing
    2. Warning lights
    3. Dry processing
        a. Location
        b. Purpose
        c. Function/operation

C. Communication

D. Safety

XVII. Processing of the Images

A. Units
    1. Purpose

2. Structure
    a. Components
    b. Function
3. Systems/functions
    a. Dry
    b. Wet
        1) Chemical
        2) Transport
        3) Replenishment
        4) Recirculation
        5) Temperature control
        6) Wash
        7) Dryer

B. Processing cycle
1. Image receptor feed
2. Development
    a. Chemicals
    b. Time/temperature
3. Fixing
    a. Chemicals
    b. Time/temperature
4. Wash
    a. Action
    b. Time/temperature
5. Dry
    a. Action
    b. Time/temperature

C. Maintenance/cleaning
1. Shut-down procedure
2. Start-up procedure

D. Digital image processors
1. Equipment
2. Latent image conversion

E. Quality control

F. Documentation

G. Darkroom chemical sensitivity

H. Material Safety Data Sheets (MSDS)

XVIII. Digital Processing

A. Algorithms

B. Histograms

C. Resolution

D. Postprocessing
   1. Edge enhancement
   2. Smoothing
   3. Magnification
   4. Subtraction

E. Exposure indicator (patient dose)

XIX. Artifacts

A. Definition

B. Types

C. Causes

D. Effects

E. Preventive/corrective maintenance

XX. Silver Recovery

A. Definition

B. Rationale
   1. OSHA guidelines

C. Methods
   1. Electrolytic
      a. Process
      b. Advantages
      c. Disadvantages
   2. Metallic replacement/ion exchange
      a. Process
      b. Advantages
      c. Disadvantages
   3. Discarded film
      a. Unexposed
      b. Exposed

D. Security
    1. Control
    2. Theft
    3. Misappropriation

Imaging Equipment

Description
Content is designed to establish a knowledge base in radiographic, fluoroscopic, mobile and tomographic equipment requirements and design. The content will also provide a basic knowledge of quality control.

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 general components and function of the primary, secondary and filament circuits.
5. Identify the function of solid-state rectification.
6. Compare single phase, three phase, high frequency and falling load generators in terms of radiation production and efficiency.
7. Discuss permanent installation of radiographic equipment in terms of purpose, components, types and applications.
8. Demonstrate operation of various types of permanently installed radiographic equipment.
9. Discuss mobile units in terms of purpose, components, types and applications.
10. Demonstrate operation of various types of mobile unit radiographic equipment.
11. Discuss the application of automatic exposure control (AEC) devices.
12. Explain image-intensified fluoroscopy.
13. Discuss gain and conversion factors as related to image intensification.
14. Discuss fluoroscopic image formation in terms of image size and brightness.
15. Indicate the purpose, construction and application of video camera tubes, TV monitors and video recorders.
16. Identify fluoroscopic recording equipment.
17. Explain the purpose, principles and application of conventional tomography.
18. Discuss the purpose and procedure of radiographic magnification.
19. Discuss electronic imaging equipment used in radiography and fluoroscopy.
20. Discuss flat panel detectors used in digital electronic x-ray equipment.
21. Differentiate between quality improvement/management, quality assurance and quality control.
22. List the benefits of a quality management program to the patient and to the department.
23. List elements of a quality management program and discuss how each is related to the quality management program.
24. Discuss the proper test equipment/procedures for evaluating the operation of the x-ray generator.
25. Evaluate the performance of the x-ray generator.

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. Components and functions
   1. Primary circuit
   2. Secondary circuit
   3. Filament circuit

E. Rectification
   1. Purpose
   2. Solid state
   3. Types
      a. Single phase
      b. Three phase
      c. Falling load
      d. High frequency

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. Mobile units
   1. Types
   2. Components
   3. Purpose
   4. Applications

C. Automatic exposure control (AEC) devices
    1. Ionization chambers
    2. Maximum 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

III. Diagnostic X-Ray Tubes

A. Rotating anode, cathode, tube housing construction
    1. Design
    2. Function

B. Extending tube life
    1. Warm-up procedures
    2. Rotor considerations
    3. Filament considerations
    4. Tube loading
    5. Tube movement
    6. Heat units

IV. Image Intensified Fluoroscopy

A. Image intensifier tube components
    1. Glass envelope
    2. Input phosphor
    3. Photocathode
    4. Electrostatic lenses
    5. Anode
    6. Output phosphor
    7. Function

B. Intensification principles
    1. Brightness gain
    2. Flux gain
    3. Minification gain
    4. Conversion factor
    5. Automatic brightness control
    6. Resolution
    7. Distortion
    8. Quantum mottle
    9. Noise
    10. Multifield intensification
    11. Magnification
    12. Dose

C. Viewing and recording systems
    1. Video camera tube
    2. Charged coupled device (CCD)
    3. Television monitor
    4. Cassette spot film
    5. Film cameras
    6. Video recorders
    7. Cine radiography
    8. Archival disks

D. Digital fluoroscopy
    1. Analog to digital
    2. Digital to analog

E. Operations and technique

V. Conventional Tomography

A. Purpose

B. Principles

C. Equipment

D. Applications

VI. Magnification Radiography

A. Purpose

B. Procedure

VII. Electronic Imaging

A. Purpose

B. Principles

C. Equipment
    1. Flat panel detectors
        a. Description
        b. Function
        c. Types
            1) Amorphous silicon
            2) Amorphous selenium
            3) CCD
            4) Other detectors
    2. Thin film transistor (TFT)

VIII. Quality Control

A. Definitions
   1. Quality improvement/management
   2. Quality assurance
   3. Quality control

B. Benefits
   1. Patient
   2. Reduction in radiation exposure
   3. Efficacy of patient care
   4. Departmental
   5. Consistency in production of quality diagnostic images
   6. Cost-effectiveness

C. Elements
   1. Standards for quality
   2. Communications
   3. Quality management manual
   4. Responsibility and administration
   5. Test equipment, procedures and training
   6. Record-keeping
   7. Test review
   8. Evaluation
   9. Continuing education

D. Generator calibration
   1. kVp
   2. Milliamperage
   3. Timer accuracy

E. Miscellaneous
   1. Illuminator calibration
   2. Video monitor calibration

Image Analysis

Description
Content is designed to provide a basis for analyzing radiographic 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. Actual images will be included for analysis.

Objectives
1. Discuss the elements of a diagnostic image.
2. Identify the steps in the decision-making process used in image analysis.
3. Describe an effective image analysis method.
4. Describe the role of the radiographer in image analysis.
5. Apply the process for evaluating radiographs for adequate density, contrast, recorded detail and acceptable limits of distortion.
6. Explain how the radiographer determines that the adequate level of penetration has been applied to produce the desired level of contrast.
7. List the parameters for evaluating visibility of detail on the image.
8. Discuss the method for evaluating image distortion.
9. Summarize the importance of proper positioning.
10. Discuss the impact of patient preparation on the resulting radiographic image.
11. Analyze images to determine the appropriate use of beam restriction.
12. Identify common equipment malfunctions that affect image quality.
13. Determine the corrective actions necessary to correct for common equipment malfunctions.
14. Differentiate between technical factor problems, procedural factor problems and equipment malfunctions.
15. Critique images for appropriate technical and procedural factors, and recommend corrective actions if necessary.

Content

I. Imaging Standards

A. Purpose

B. Problem-solving process

C. Role of the radiographer
   1. Determining cause of problems
   2. Recommending corrective action

D. Establishing acceptable limits

II. Image Quality Factors

A. Density

B. Contrast

C. Recorded detail

D. Distortion

E. Automatic exposure control (AEC)

F. Processing

G. Computed radiography

H. Digital radiography

III. 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
3. Special concerns for mobile radiography

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
1. Contrast agent
2. Pre-examination preparation

F. Artifacts

IV. Corrective Action

A. Equipment
1. Radiographic and fluoroscopic unit
2. Image processing

B. Technical factors

C. Procedural factors

D. Artifacts

Radiation Production and Characteristics

Description
Content is designed to establish a basic knowledge of atomic structure and terminology. Also presented are the nature and characteristics of radiation, x-ray production and the fundamentals of photon interactions with matter.

Objectives
1. Describe Bohr's theory of atomic structure.
2. Discuss the characteristics and function of a proton, neutron and electron.
3. Discuss the energy levels of the atom.
4. Explain the processes of ionization and excitation.
5. Define the terms relating to atomic nomenclature.
6. Describe the electromagnetic spectrum.
7. Define and describe wavelength and frequency and how they are related to velocity.
8. Explain the relationship of energy and frequency.
9. Explain the Wave-particle duality phenomena.
10. Identify the properties of x-rays.
11. Describe charged and uncharged forms of particulate radiation.
12. Describe radioactivity and radioactive decay in terms of alpha, beta and gamma emission.
13. State the principles of x-ray production.
14. Compare the production of bremsstrahlung and characteristic radiations.
15. Describe the conditions necessary to produce x-radiation.
16. Describe the x-ray emission spectra.
17. Identify the factors affecting the x-ray emission spectra.
18. Discuss various photon interactions with matter in terms of description of the interaction, relation to atomic number, photon energy and part density, and their applications in diagnostic radiology.
19. Discuss relationships of wavelength and frequency to beam characteristics.
20. Discuss the clinical significance of the photoelectric and modified scattering interactions in diagnostic imaging.

Content

I. Structure of the Atom

A. Bohr's theory
   1. Nucleus
      a. Components
         1) Proton
         2) Neutron
   2. Structure
      a. Size
      b. Proton and electron balance
      c. Binding energy
   3. Electron shells
      a. Components
      b. Arrangements
         1) Binding energy
         2) Valence shell
         3) Ionization
         4) Excitation

B. Nomenclature
   1. Atomic number
   2. Mass number

II. Nature of Radiation

A. Radiation
   1. Electromagnetic
      a. Spectrum
      b. Wave-particle duality
         1) Wave theory
         2) Particle theory
      c. Properties
      d. Ionization and excitation
   2. Particulate
      a. Types
      b. Characteristics
   3. Non-ionizing vs. ionizing
      a. Atomic number
      b. Energy
      c. Probability

B. Radioactivity
   1. Radioactive decay
      a. Alpha emission
      b. Beta emission
      c. Gamma emission
   2. Half-life ($T_{½}$)

III. 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. Remnant beam
   3. Leakage radiation
   4. Stray 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

IV. 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
        a. Atomic number
        b. Photon energy
        c. Part density
    5. Application

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

E. Pair production

F. Photodisintegration

Radiation Protection

Description
Content is designed to present an overview of the principles of radiation protection including the responsibilities of the radiographer for patients, personnel and the public. Radiation health and safety requirements of federal and state regulatory agencies, accreditation agencies and health care organizations are incorporated.

Objectives
1. Identify and justify the need to minimize unproductive radiation exposure of humans.
2. Distinguish between somatic and genetic radiation effects.
3. Differentiate between the stochastic and non-stochastic (deterministic) effects of radiation exposure.
4. Explain the objectives of a radiation protection program.
5. Define radiation and radioactivity units of measurement.
6. Identify dose equivalent limits (DEL) for occupational and non-occupational radiation exposure.
7. Describe the as low as reasonably achievable (ALARA) concept.
8. Identify the basis for occupational exposure limits.
9. Distinguish between perceived risk and comparable risk.
10. Describe the concept of negligible individual risk level (NIRL).
11. Identify ionizing radiation sources from natural and man-made sources.
12. Comply with legal and ethical radiation protection responsibilities of radiation workers.
13. Calculate dose equivalent limits (DEL) with reference to the latest National Council on Radiation Protection and Measurements (NCRP) reports.
14. Describe the theory and operation of radiation detection devices.
15. Identify appropriate applications and limitations for each radiation detection device.
16. Describe how isoexposure curves are used for radiation protection.
17. Identify performance standards for beam-directing, -defining and -limiting devices.
18. Describe procedures used to verify performance standards for equipment and indicate potential consequences of performance standards failure.
19. Describe the operation of various interlocking systems for equipment and indicate potential consequences of interlock system failure.
20. Identify conditions and locations evaluated in an area survey for radiation protection.
21. Distinguish between controlled and non-controlled areas and list acceptable exposure levels.
22. Describe “Radiation Area” signs and identify appropriate placement sites.
23. Describe the function of federal, state and local regulations governing radiation protection practices.
24. Describe the requirements for and responsibilities of a radiation safety officer.
25. Express the need and importance of personnel monitoring for radiation workers.

26. Describe personnel monitoring devices, including applications, advantages and limitations for each device.
27. Interpret personnel monitoring reports.
28. Compare values for dose equivalent limits for occupational radiation exposures (annual and lifetime).
29. Identify anatomical structures that are considered critical for potential late effects of whole body irradiation exposure.
30. Identify dose equivalent limits for the embryo and fetus in occupationally exposed women.
31. Distinguish between primary and secondary radiation barriers.
32. Demonstrate how the operation of various x-ray and ancillary equipment influences radiation safety and describe the potential consequences of equipment failure.
33. Perform calculations of exposure with varying time, distance and shielding.
34. Discuss the relationship between HVL and shielding design.
35. Identify emergency procedures to be followed during failures of x-ray equipment.
36. Demonstrate how time, distance and shielding can be manipulated to keep radiation exposures to a minimum.
37. Explain the relationship of beam-limiting devices to patient radiation protection.
38. Discuss added and inherent filtration in terms of the effect on patient dosage.
39. Explain the purpose and importance of patient shielding.
40. Use the appropriate method of shielding for a given radiographic procedure.
41. Explain the relationship of exposure factors to patient dosage.
42. Identify the appropriate image receptor that will result in an optimum diagnostic image with the minimum radiation exposure to the patient.
43. Select the immobilization techniques used to eliminate voluntary motion.
44. Describe the minimum source-to-tabletop distances for fixed and mobile fluoroscopic devices.
45. Apply safety factors for the patient (and others) in the room during mobile radiographic procedures.

Content

I. Introduction

A. Justification for radiation protection
   1. Somatic effects
   2. Genetic effects

B. Biologic damage potential of ionizing radiation
   1. Stochastic effects
   2. Non-stochastic effects

C. Objectives of a radiation protection program
   1. Documentation
   2. Occupational and non-occupational dose limits
   3. ALARA concept (optimization)
   4. Comparable risk
   5. NIRL

D. Sources of radiation
   1. Natural
   2. Man-made (artificial)

E. Legal and ethical responsibilities

II. Units, Detection and Measurement

A. Radiation units
   1. Exposure
      a. Coulomb/kilogram (C/kg)
      b. Roentgen (R)
   2. Absorbed dose
      a. Gray (Gy)
      b. Rad
   3. Dose equivalent
      a. Sievert (Sv)
      b. Rem
   4. Radioactivity
      a. Becquerel (Bq)
      b. Curie (Ci)

B. Dose reporting according to current NCRP reports

C. Measurement devices: (principle, application and types)
   1. Ion chambers
   2. Proportional counters
   3. Thermionic luminescent dosimeter (TLD)
   4. Optically stimulated luminescent dosimeter (OSLD)

III. 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/uncontrolled areas
   2. Conditions
   3. Recommendations
   4. "Radiation Area" sign posting

D. Regulatory/Advisory agencies
   1. International Council on Radiation Protection and Measurements (ICRP)
   2. 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

E. Radiation safety officer
   1. Requirement
   2. Responsibilities

IV. Personnel Monitoring

A. Historical perspective
   1. Evolution of standards
   2. Public Law 97-35 (The Patient Consumer Radiation Health and Safety Act of 1981)
   3. Public awareness
   4. NCRP recommendations
   5. ICRP recommendations

B. Requirements for personnel monitoring
   1. Deep dose equivalent (DDE)
   2. Shallow dose equivalent (SDE)
   3. Eye dose equivalent (EDE)
   4. Committed dose equivalent (CDE)
   5. Committed effective dose equivalent (CEDE)
   6. Total effective dose equivalent (TEDE)

C. Methods and types of personnel monitors
   1. Film badge

2. TLD
    a. Body badge
    b. Ring badge
3. OSLD

D. Records of accumulated dose
1. Purpose
2. Content
3. Length of record-keeping
4. Retrieval from previous employers

E. Dose recommendations
1. Occupational
2. Non-occupational limits
3. Critical organ sites
4. Embryo-fetus
5. Cumulative dose formula

F. Responsibilities for radiation protection
1. Radiographer
2. Radiation safety officer
3. Facility

V. Application

A. Design
1. Materials
2. Primary barrier
3. Secondary (scatter and leakage) barrier
4. HVL
5. Factors
    a. Use (U) controlled and uncontrolled
    b. Workload (W)
    c. Occupancy (T)
    d. Distance (D)
6. X-ray and ancillary equipment
    a. Beam-defining devices
    b. Exposure control devices
    c. On and off switches
    d. Interlocks
    e. Visual/audio monitors
    f. Emergency controls
    g. Quality control
        1) Calibration
        2) Standards

B. Regulations and recommendations
   1. Current NRC recommendations and/or regulations
   2. Current NCRP recommendations and/or regulations
   3. Applicable state regulations

C. Cardinal principles in protection
   1. Time
   2. Distance
   3. Shielding

D. Emergency procedures

VI. Patient Protection

A. Beam-limiting devices

B. Filtration

C. Shielding

D. Exposure factors

E. Image receptor system

F. Immobilization

G. Fluoroscopic procedures

H. Mobile radiography

I. Special considerations
   1. Pediatric patients
   2. Pregnant patients

Radiation Biology

Description
Content is designed to provide an overview of the principles of the interaction of radiation with living systems. Radiation effects on molecules, cells, tissues and the body as a whole are presented. Factors affecting biological response are presented, including acute and chronic effects of radiation.

Objectives
1. Describe the characteristics of a molecule.
2. Describe principles of cellular biology.
3. Identify sources of electromagnetic and particulate ionizing radiations.
4. Discuss directly and indirectly ionizing radiations.
5. Identify sources of radiation exposure.
6. Describe radiation-induced chemical reactions and potential biologic damage.
7. Evaluate factors influencing radiobiologic/biophysical events at the cellular and subcellular level.
8. Identify methods to measure radiation response.
9. Describe physical, chemical and biologic factors influencing radiation response of cells and tissues.
10. Explain factors influencing radiosensitivity.
11. Recognize the clinical significance of $LD_{50/30}$ and LD_{30}.
12. Examine effects of limited vs. total body exposure.
13. Relate short-term and long-term effects as a consequence of high and low radiation doses.
14. Differentiate between somatic and genetic radiation effects as well as discuss specific diseases or syndromes associated with them.
15. Discuss stochastic and non-stochastic (deterministic) effects.
16. Discuss risk estimates for radiation-induced malignancies.

Content

I. Introduction

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. Particulate radiations
      a. Alpha
      b. Beta
         1) Negatron
         2) Positron
      c. Fast neutrons
      d. Protons
   3. 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

II. 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. LET
      b. Oxygen

III. 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

IV. Radiosensitivity and Response

A. Law of Bergonié and Tribondeau
   1. Differentiation

2. Mitotic rate
3. Metabolic rate

B. Cell survival
   1. Factors influencing survival
      a. LET
      b. Oxygen
      c. 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. Non-stochastic (deterministic) effects
   4. Genetic effects
   5. Occupational risks for radiation workers
   6. Carcinogenesis

G. Risk estimates

Radiographic Pathology

Description
Content is designed to introduce theories of disease causation and the pathophysiologic disorders that compromise healthy systems. Etiology, pathophysiologic responses, clinical manifestations, radiographic appearance and management of alterations in body systems will be presented.

Objectives
1. Define basic terms related to pathology.
2. Describe the basic manifestations of pathological conditions and their relevance to radiologic procedures.
3. Discuss the classifications of trauma.
4. Describe examples, sites, complications and prognosis for classifications of trauma.
5. Describe radiologic procedures used in the diagnosis of trauma.
6. List the causes of tissue disruption.
7. Describe the process of tissue disruption.
8. Describe the healing process.
9. Identify complications connected with the repair and replacement of tissue.
10. List and define the systemic classifications of disease.
11. Describe the various systemic classifications of disease in terms of etiology, types, common sites, complications and prognosis.
12. Describe the radiographic appearance of selected diseases.
13. Identify radiologic procedures and interventional techniques appropriate for diseases common to each body system.
14. Identify diseases caused by or contributed to by genetic factors.

Content

I. Definitions/Terminology

A. Pathology

B. Disease
   1. Acute
   2. Chronic

C. Pathogenesis

D. Etiology
   1. Trauma
   2. Syndrome

E. Diagnosis
   1. Signs (objective)
   2. Symptoms (subjective)

F. Prognosis

G. Purpose of study

H. Manifestations of pathology

I. Relevance to radiographic procedures
   1. Technical considerations
   2. Patient considerations

II. Classifications (Definition, Examples, Sites, Complications, Prognosis)

A. Mechanical

B. Chemical

C. Thermal

D. Radiation

III. Trauma Diagnosis

A. Radiologic procedures

IV. Causes of Disease (Process, Examples)

A. Pathological

B. Traumatic

C. Surgical

D. Healing process

E. Complications

F. Genetics (caused by or contributed to by genetic factors)
   1. Cystic fibrosis
   2. Huntington's disease
   3. Various cancers
   4. Muscular dystrophy
   5. Cardiac disease
   6. Phenylketonuria (PKU)
   7. Sickle-cell anemia
   8. Tay-Sachs disease

V. Radiologic Pathology (Definitions, Etiology, Examples, Sites, Complications, Prognosis, Radiographic Appearance, Procedural and Technique Considerations)

A. Skeletal and articular

B. Muscular

C. Digestive

D. Respiratory

E. Urinary

F. Reproductive

G. Circulatory

H. Lymphatic

I. Endocrine

J. Nervous

K. Sensory organs

Computers in Radiologic Sciences

Description
Content is designed to introduce knowledge in computing and information processing. Computer applications in the radiologic sciences related to image capture, display, storage and distribution are presented.

Objectives
1. Identify various types of computers.
2. Define analog to digital conversion and digital signal processor.
3. Identify various terms related to computer fundamentals and components.
4. Describe major functions of central processing unit (CPU).
5. Differentiate the various input and output devices.
6. Give examples of various types of memory.
7. Describe computer care and preventive maintenance.
8. Explain computer operation.
9. Distinguish between analog computers and digital computers.
10. Discuss application of various types of software.
11. Explain the following computing applications as they relate to radiology: radiologic information systems (RIS), hospital information systems (HIS), and picture archiving communication systems (PACS).
12. Define digital imaging and communications in medicine (DICOM).
13. Discuss the impact the Internet has on the distribution of health information.

Content

I. Fundamentals

A. Types of computers
   1. Supercomputer/mainframe
   2. Minicomputer
   3. Microcomputer

B. Digital fundamentals
   1. Binary coding
   2. Digital signal processor (DSP)
      a. A-D conversion
      b. D-A conversion

C. Terminology

II. Components

A. CPU
   1. Arithmetic logic unit (ALU)
   2. Control unit (CU)

B. Input and output (I/O) devices (peripherals)
   1. Input
      a. Keyboards
      b. Non-keyboard devices
   2. Output
      a. Printers
      b. Video monitors
      c. Graphic displays
      d. Voice output
   3. Storage/memory
      a. Primary memory
         1) Random access memory (RAM)
         2) Read only memory (ROM)
      b. Secondary storage
         1) Magnetic tape
         2) Magnetic disk

III. Operations

A. Terminology
   1. Analog
   2. Digital
   3. Binary

B. Programming
   1. Definition
   2. Purpose

3. Languages
4. Software
    a. Word processing
    b. Database
    c. Spreadsheet
    d. Desktop publishing
    e. Graphics
    f. Integrated application programs

C. Considerations
1. Environmental conditions
2. Computer catastrophes
3. Ethical/legal concerns
4. Preventive maintenance
5. Security
    a. Passwords
    b. Limited access
    c. Firewalls

IV. Radiology Applications

A. Digital radiology

B. Patient information and systems scheduling

C. Quality control and quality assurance

D. Picture archiving and communications systems (PACS)

E. Hospital information systems (HIS)

F. Radiology information systems (RIS)

G. Digital imaging and communications in medicine (DICOM)

V. The Internet

A. History

B. Internet vs. intranet

C. Access to information

D. Security of patient information

E. Enhancer to customer service
1. Referring physician
2. General public

Pharmacology and Drug Administration

Description
Content is designed to provide basic concepts of pharmacology. The theory and practice of basic techniques of venipuncture and the administration of diagnostic contrast agents and/or intravenous medications is included. The appropriate delivery of patient care during these procedures is emphasized.

Considerations
Prior to introduction of this educational content, patient care objectives (including CPR/BLS certification), as well as objectives related to anatomy and physiology of the circulatory and excretory systems, should be successfully completed.

Though regulations regarding the administration of contrast media and intravenous medications vary in different states and institutions, the official position of the American Society of Radiologic Technologists is that venipuncture falls within the profession's general scope of practice and practice standards and that it, therefore, shall be included in the didactic and clinical curriculum with demonstrated competencies of all appropriate disciplines regardless of the state or institution where such curriculum is taught.

In states or institutions where students are permitted to perform intravenous injections, the program has specific ethical and legal responsibilities to the patient and the student. The student shall be assured that:

- Legal statutes allow performance of this procedure by student radiographers.
- Professional liability coverage is adequate.
- Adequate supervision is provided.
- Appropriate, structured, laboratory objectives are identified.
- Evaluation and demonstration of competency occurs before this task is performed unsupervised.

Objectives
1. Distinguish between the chemical, generic and trade names for select drugs.
2. Describe pharmacokinetic and pharmacodynamic principles of drugs.
3. Classify drugs according to specific categories.
4. Explain the action, uses and side effects for select drugs.
5. Explain the effects of select drugs on imaging procedures.
6. Define the categories of contrast agents and give specific examples for each category.
7. Explain the pharmacology of barium and iodine compounds.
8. Describe methods and techniques for the administration of various types of contrast agents.
9. Identify and describe the routes of drug administration.
10. Discuss the purposes and advantages of intravenous drug administration over other routes.

11. Differentiate between the two major sites of intravenous drug administration.
12. Identify, describe and document complications associated with intravenous drug therapy and appropriate actions to resolve these complications.
13. Discuss the various elements of initiating and discontinuing intravenous drug therapy.
14. Differentiate and document dose calculations for adult and pediatric patients.
15. Prepare for injection of contrast agents/intravenous medications, using aseptic technique.
16. Explain the current legal and ethical status of the radiographer's role in drug administration.
17. Explain a radiographer's professional liability concerning drug administration.

Content

I. Drug Nomenclature

A. Chemical name

B. Generic name

C. Trade name

II. Methods of Drug Classification

A. Chemical group

B. Mechanism/site of action

C. Primary effect

III. General Pharmacologic Principles

A. Pharmacokinetics

B. Pharmacodynamics

IV. Five Rights of Drug Safety

A. The right medication

B. The right dose

C. The right patient

D. The right time

E. The right location

V. Drug Categories of Relevance to Radiography (Side Effects, Uses and Impacts on Medical Imaging)

A. Analgesics

B. Antiemetic drugs

C. Antianxiety drugs

D. Antidepressants

E. Anti-inflammatory drugs

F. Antiarrhythmic drugs

G. Vasodilators and vasoconstrictors

H. Diuretics

I. Antihypertensive drugs

J. Anticoagulant and coagulant drugs

K. Antiallergic and antihistamine drugs

L. Bronchodilators

M. Antibacterial drugs

N. Antiseptic and disinfectant agents

O. Sedative and hypotonic drugs

P. Anesthetic agents

Q. Cathartic and antidiarrheal drugs

R. Diagnostic contrast agents

VI. Classification of Contrast Agents

A. Types of compound
   1. Metallic salts
   2. Organic iodides
      a. Ionic contrast agents
      b. Nonionic contrast agents
   3. Iodized oils
   4. Gaseous

B. Beam attenuation characteristics
   1. Radiolucent (negative)
   2. Radiopaque (positive)
   3. Impact of atomic number

C. Pharmacologic profile of contrast agents
   1. Chemical composition
   2. Absorption characteristics
   3. Distribution characteristics
   4. Metabolic characteristics
   5. Elimination characteristics
   6. Indications, actions and effects
   7. Interactions and contraindications
   8. Patient reactions

D. Dosage

E. Preparation

VII. Routes of Drug Administration

A. Systemic
   1. Oral
   2. Rectal
   3. Tube/catheter
   4. Inhalation

B. Parenteral
   1. Intravenous
   2. Intra-arterial
   3. Intrathecal

VIII. Intravenous Drug Therapy

A. Purpose

B. Advantages

C. Methods
   1. Continuous infusion
   2. Intermittent infusion
   3. Direct injection

D. Sites of administration
   1. Peripheral
   2. Central

E. Complications
   1. Infiltration
   2. Extravasation
   3. Phlebitis
   4. Air embolism
   5. Drug incompatibility
   6. Low fluid level in container

F. Initiation of intravenous therapy
   1. Intravenous infusion/venipuncture equipment
   2. Patient identification, assessment and instructions
   3. Dosage, dose calculations and dose-response
      a. Adults
      b. Pediatrics
   4. Patient preparation
   5. Application of standard precautions

6. Procedure for intravenous infusion/direct puncture
7. Site observation
8. Emergency medical treatment procedure
    a. Appropriate codes
    b. Emergency cart (crash cart)
    c. Emergency medications
    d. Accessory equipment
        1) Oxygen
        2) Suction
    e. Emergency medical treatment follow-up tasks
9. Discontinuation of intravenous therapy
    a. Equipment/supplies for withdrawal
    b. Patient preparation
    c. Application of standard precautions
    d. Procedure of withdrawal
    e. Site observation
    f. Patient observation
    g. Post-procedural tasks
10. Documentation of administration
11. Documentation of complication/reaction

IX. Current Practice Status

A. Professional standards
    1. Scope of Practice
    2. Practice Standards
    3. Professional liability and negligence

B. State statutes

C. Employer prerogative

X. Informed Consent

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, competent performance of radiologic imaging and total quality management. Levels of competency and outcomes measurement shall ensure the well-being of the patient preparatory to, during and following the radiologic procedure.

Objectives
1. Exercise the priorities required in daily clinical practice.
2. Execute imaging procedures under the appropriate level of supervision.
3. Adhere to concepts of team practice that focus on organizational theories, roles of team members and conflict resolution.
4. Adapt to changes and varying clinical situations.
5. Support patient-centered clinically effective service for all patients regardless of age, gender, disability, special needs, ethnicity or culture.
6. Integrate the use of appropriate and effective written, oral and nonverbal communication with patients, the public and members of the health care team (peers, physicians, nurses, administration, etc.) in the clinical setting.
7. Choose patient and family education strategies appropriate to the comprehension level of patient/family.
8. Manage interactions with the patient and family in a manner that provides the desired psychosocial support.
9. Evaluate the patient's status and condition before, during and following the radiologic procedure to demonstrate competence in assessment skills.
10. Demonstrate skills in assessment and evaluation of psychological and physical changes in the patient's condition and carry out appropriate actions.
11. Examine gender, cultural, age and socioeconomic factors that influence patient compliance with procedures, diagnosis, treatment and follow-up of patients.
12. Adapt procedures to meet age-specific, disease-specific and cultural needs of patients.
13. Assess the patient and record patient histories.
14. Assess patient using the ABCs of CPR and demonstrate basic life support procedures.
15. Respond appropriately to patient emergencies.
16. Interpret patient side effects and/or complications of radiologic procedures, contrast administration and take appropriate actions.
17. Document care in the patient's record.

18. Differentiate between normal ECG rhythms and abnormal ECG tracings.
19. Apply standard and transmission-based precautions.
20. Apply the appropriate medical asepsis and sterile technique.
21. Prepare the technologies and methodologies for the performance of radiologic procedures.
22. Demonstrate competency in the principles of radiation protection standards to include time, distance, shielding and radiation monitoring.
23. Apply the principles of total quality management.
24. Report equipment malfunctions to assist with appropriate corrective actions.
25. Examine procedure orders for accuracy and follow-up to make corrective changes when applicable.
26. Support safe, ethical and legal practices.
27. Integrate the radiographer's scope of practice and practice standards into clinical practice setting.
28. Act consistently to maintain patient confidentiality standards.
29. Carry out principles of transferring, positioning, immobilizing and restraining of patient.
30. Comply with departmental and institution procedures for response to emergencies, disasters and accidents.
31. Break down the chain of command in emergencies, disasters and accidents.
32. Differentiate between emergency and non-emergency procedures.
33. 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.
34. Ensure that performance reflects professional competence in the selection of technical factors to produce quality diagnostic images with lowest radiation exposure possible.
35. Critique images for appropriate clinical information, image quality and patient documentation.
36. 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. CARE bill
   4. Incident reporting mechanisms
   5. Standards for supervision
      a. Direct
      b. Indirect

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 and corrective measures

B. Facilities set-up

C. Patient assessment (history), education and care (pre-, post-procedural)
   1. Patient monitoring – emergency and non-emergency
      a. Vitals
      b. Equipment
         1) Crash cart
         2) Oxygen
         3) Suction
      c. Patient emergencies
         1) Allergic reactions
         2) Cardiac/respiratory arrest
         3) Physical injury
         4) Seizures
         5) Diabetic emergencies
      d. Basic life support
   2. Interpretation of patient records
      a. Confidentiality

3. Documentation
4. Special considerations
    a. Patient focused care
    b. Standard precautions and transmission-based precautions
    c. Medical asepsis
    d. Sterile technique
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
        1) Basic quality control
        2) Reporting equipment failure
3. Image processing (automatic/digital)
4. Image analysis
    a. Image quality
        1) Density
        2) Contrast
        3) Recorded detail
    b. Image manipulation
        1) Conventional
        2) Digital
    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
    f. Room design
2. Equipment/accessories
    a. Beam restriction
    b. Filtration
    c. Positioning
    d. Image receptor system
    e. Scatter control techniques
        1) Grids

2) Air gap techniques
3) Reverse cassette

f. Technical factor selection

3. Medical error reduction

III. Competency (Mandatory, Elective)*

A. Thorax
1. Chest
2. Bony

B. Extremities
1. Upper
2. Lower

C. Cranium

D. Spine
1. Cervical
2. Thoracic
3. Lumbar
4. Pelvis
5. Myelography

E. Gastrointestinal
1. Abdomen
a. Recumbent
b. Erect
c. Lateral decubitus
2. Contrast studies
a. Esophagus
b. Upper gastrointestinal (GI)
c. Small bowel
d. Lower GI

F. Urinary
1. Urography
a. Intravenous urography
b. Cystography
c. Cystourethrography
d. Retrograde urography

G. Mobile/surgical
    1. Chest
    2. Abdominal
    3. Orthopedic
    4. C-arm
    5. Operative cholangiography

*Refer to ARRT Competency Requirements for mandatory and elective requirements.

Human Diversity

Description
Content is designed to promote better understanding of patients, the patients' families and professional peers through comparison of diverse populations based on their value system, cultural and ethnic influences, communication styles, socioeconomic influences, health risks and life stages. Content 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.

Objectives
1. Explain the development of a personal value system.
2. Discuss the interrelationship between personal, community and societal values.
3. Explain the influence a person's value system has on his or her behavior.
4. Discuss the development of personal and professional values.
5. Describe how professional values influence patient care.
6. Examine Kohlberg's theory on how an individual's morality influences his or her behavior.
7. Differentiate between culture and ethnicity.
8. Explain how a person's cultural beliefs towards illness affect his or her recovery.
9. Explain the origins of medical ethnocentrism.
10. Discuss the societal factors that influence the quality of health care.
11. Compare alternative/complementary medicine to the traditional Western model.
12. Describe the culture of poverty and its effect on health care.
13. Discuss family dynamics in a cultural, social, ethnic and lifestyle context.

Content

I. Values

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

B. Societal
1. Rights and privileges
2. Community values
3. Impact on patient care

C. Professional
1. Values development
2. Values conflict
3. Impact on patient care

D. Moral development
1. Individual behavior
2. Kohlberg's theory
3. Impact on patient care

II. Culture, Ethnicity and Diversity

A. Medical ethnocentrism

B. 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. Age
   a. Infant
      1) Needs
      2) Psychosocial development
      3) Family interactions
   b. Child
      1) Respect and authority
      2) Family and peer interactions
   c. Adolescent
      1) Autonomy and authority
      2) Family and peer interactions

d. Adulthood
    1) Career
    2) Family
    3) Stress and responsibilities
e. Middle age
    1) Social acceptance
    2) Success and responsibilities
    3) Boredom
    4) Family peer and social interactions
f. Elderly
    1) Aging process
    2) Ageism
    3) Challenges of aging
    4) Sensory deprivation
    5) Mental impairment
    6) Economic discrimination
    7) Friendship and family ties
    8) Death and dying
    9) Cultural bias toward aging

4. Family structure
    a. Two parent
    b. Single parent
    c. Nontraditional
    d. Extended
    e. Cultural differences
5. Urban vs. rural living environment
    a. Availability of health care services
    b. Social acceptance of diverse cultural differences
6. Religion
    a. Impact on health care choices
        1) Western medicine
        2) Alternative/complementary medicine
7. Lifestyle choices and behaviors
8. Family dynamics
9. Sexual orientation
10. Mentally and physically challenged

2002 Radiography Curriculum Revision Project Group

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Radiologic Science Resources

This list of Radiologic Science Resources will assist educators in sampling the pool of references and study materials pertaining to medical radiography. The resources list should be viewed as a snapshot of available materials. Omission of any one title is not intentional. Because the creation of literature and media related to the field is dynamic, educators are encouraged to search additional sources for recent updates, revisions and additions to this collection of titles.

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