Radiography Professional Curriculum

Sponsored by the American Society of Radiologic Technologists, 15000 Central Ave. SE, Albuquerque, NM 87123-3917.

Contents

Introduction

This revision of the Radiography Professional Curriculum represents the cognitive base of entry-level education the practice of radiography. The professional curriculum is presented in defined course content units. The course content shall be delivered in its entirety. Additional information may be incorporated in each content area as deemed appropriate.

Instructional methods to deliver the professional curriculum are typically lecture, laboratory and clinical practicum. The educational community is encouraged to also include seminars, discussion groups, case studies and clinical conferences as elements of the professional curriculum for radiography.

Curriculum sequence in each program, while an instructional or programmatic prerogative, should reflect modern educational philosophy and practice. As the cognitive base of the professional educational process of radiographers, curriculum sequence is the blueprint by which basic knowledge is translated into effective, competent clinical practice.

The bibliography is not intended to be inclusive or exclusive of all available instructional resources nor is it intended to serve as an endorsement of the publications. The educational community is encouraged to supplement the bibliography with topical information from new publications, journals, periodicals and other media.

The ASRT is grateful to the Committee members for their invaluable contribution and expertise in development of the professional curriculum. The efforts of these professionals have resulted in this professional curriculum for the preparation of radiographers.

General Education

The following high school courses* are recommended prior to admission by all radiography programs:

SCIENCE

Biology

Biology offers pupils exploratory experiences and activities in the fundamental concept of life. Biology expands and refines the biological concepts introduced in the elementary and middle school or junior high grades. Laboratory and field experiences are an integral component of Biology.

Chemistry

Chemistry offers pupils general laboratory experiences and activities in the concepts of chemistry through the study of the position of substances and of their effects upon one another.

Physics

Physics offers pupils general laboratory experiences and activities in the concepts of the physical interactions of matter and energy.

MATH

Algebra I

Provides an understanding of basic algebra, the concepts, skills structure and applications are emphasized.

Algebra II

Provides detailed knowledge of algebra with the emphasis on in-depth development of algebraic functions.

Geometry

An understanding of an appreciation for geometric concepts, emphasis placed on discovery, proof, and application of geometric relationships and principles.

PRIMARY ADVANTAGES

General education provides:

Greater accessibility for career mobility and advanced education.
Increased parity with other health care disciplines.

Rationale for general education in college programs:

The requirement of general education for college radiograph programs is chided by some as an embellishment of inflation of education for radiographers. On the contrary, given the more rent high technology of medicine, radiographers have proven need for enhancement of interpersonal

* Note: Non-traditional students who did not complete high school but later earned a GED may be evaluated based on GED math and science scores.

skills for interacting with patients, staff and the public. The course listed on the following pages for high school graduates are intended to serve as background education for all radiography programs. General education at the college level is intended to further develop high school educational skills and place graduates in the job market with a more competitive, increased level of education, thus increasing the potential of career success.

The following general education courses are recommended for, but not limited to, college-based radiography programs to reinforce high school requirements;

English Composition I
This course introduces students to the writing of brief informal essays, with primary attention given to academic writing. Several short essays and a final examination are required of each student. English also provides a basic introduction to research methods and the library.

English Composition II
Writing of extended compositions, including research papers requiring knowledge of library resources and conventions of formal documentation; extension of critical reading skills developed in English I. More advanced treatment of critical reading skills is also provided. Each student will write at least one longer research paper and several critical papers.

Intermediate Algebra
Prerequisite: Elementary algebra or its equivalent. Algebraic and rational expressions, exponents and radicals, theory of quadratic equations, introduction of polynormial, rational exponential and logarithmic functions.

Fundamental Physics with Lab
An introduction to the physics of mechanics (levers, pulleys and wedges); electricity (magnetism, electrical conduction, and magnets); and optics (colors, mirrors, and lenses).

Fundamental Psychology
Introduction to the methods and major content areas of psychology: sensation, perception, learning, cognition, human development, abnormal and social psychology.

Computer Literacy Basic Information Course
Introduction to the fundamental principles of computer technology. Computer concepts, terminology and applications are explored.

Note: To convert quarter hours to semester hours for classification purpose, total the number of credit hours earned and multiply by .67.

Department Organization

Course Description

This unit provides students with an overview of radiography and its role in health care delivery. Student responsibilities will be outlined. Students will be oriented to academic and administrative structure, key departments and personnel and to the profession as a whole. Basic principles of radiation protection will be introduced.

Objectives

The student will:

1. State the rules and regulations of the educational program regarding class attendance, grading, vacation/sick leave and the appeals procedure.
2. Define the *Essentials and Guidelines of an Accredited Educational Program for the Radiographer* and state its purpose.
3. Discuss the departmental and hospital rules and regulations which directly or indirectly affect students.
4. List the major duties and responsibilities of a radiography student.
5. Identify basic radiation safety procedures for staff and patients.
6. State the procedure for monitoring of occupational exposed individuals.
7. State the policies concerning communicable disease and pregnancy for students enrolled in the program.

Content

I. Rules and Regulations of the Educational Program

A. Welcome and Introduction
   1. Program officials
      a. Director
      b. Clinical supervisors
      c. Chief of service
      d. Others

B. General Information
   1. Curriculum for the program
   2. Course registration
   3. Tuition and fee policies
   4. Student insurance
   5. Textbooks
   6. Graduation requirements
   7. Student agreement and affirmation
   8. Miscellaneous

C. Program Rules and Regulations
   1. Educational schedule
      a. Didactic
      b. Clinical

2. Policies
    a. Attendance
    b. Disciplinary
    c. Educational rights
    d. Dress code
    e. Grading policy
    f. Health
    g. Pregnancy
    h. Vacation and sick leave policy
    i. Appeals procedure
3. Program governance
    a. Master plan
    b. *Essentials and Guidelines of an Accredited Program for the Radiographer*
    c. School and university guidelines.

D. Clinical Department(s) Rules and Regulations
1. Competency-based education
    a. Objectives
    b. Required competencies
    c. Evaluation
        1) Formulative
        2) Summative
2. Operation schedule
3. Conference schedule
4. Didactic and clinical hours
5. Equipment
6. Record keeping
7. Dress code
8. Security measures
9. Parking regulations
10. Emergencies/incident reporting
11. Supervision
12. Clinical education centers
13. JCAHO and OSHA regulations
14. Universal precautions
15. Right-to-know
16. Testing and evaluation

E. Duties and Responsibilities of Students
1. Didactic
    a. Attendance
    b. Class participation
    c. Assignments
    d. Examinations
2. Laboratory

a. Attendance
b. Assignments
c. Evaluation

3. Clinical
   a. General patient care
   b. Radiation treatment delivery
   c. Simulation procedures
   d. Dosimetry
4. Radiation safety (basic)
   a. Purpose
      1) Patient
      2) Personnel
   b. Principles
      1) ALARA
      2) Monitoring
         a) Devices
         b) Reports
      3) Personal safety
      4) Patient safety

II. The Health Science Professions

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Identify other health science professions which impact on the total health care provided to patients seen in radiology.
   2. Describe the relationship of these health care workers to the integrated care of patients.

B. Content
   1. Radiologic technology
      a. Radiography
      b. Radiation therapy
      c. Nuclear medicine
      d. Diagnostic medical sonography
      e. Magnetic resonance imaging
      f. Computerized tomography imaging
      g. Mammography
      h. Cardiovasular-interventional technology
   2. Other health care professions
      a. Medical records
      b. Medical laboratory sciences
      c. Occupational therapy
      d. Pharmacy
      e. Physical therapy
      f. Respiratory therapy
      g. Social services

h. Nursing
i. Other

III. Hospital Organization

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Discuss the philosophy and mission of the hospital.
2. Identify key administrative personnel and discuss their relationship with the radiology department.
3. Describe relationships and interdependencies of departments within the hospitals.

B. Content
1. Philosophy
2. Mission
3. Administrative services
   a. Governing board
   b. Hospital administration
   c. Admissions
   d. Information systems
   e. Procurement
   f. Accounting
   g. Housekeeping
   h. Laundry
   i. Security
   j. Personnel
4. Medical services
   a. Medical director
   b. Medical staff
   c. Resident staff
   d. Intern staff
   e. Medical students
   f. Nursing service
   g. Clinical services
5. Ancillary services
   a. Dietary
   b. Medical laboratories
   c. Oncology
   d. Otolaryngology
   e. Pastoral care
   f. Pharmacy
   g. Radiology
   h. Rehabilitation
   i. Social services

IV. Radiology Organization

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Identify key personnel and discuss their function in the radiology department.
2. Explain patient services available in the radiology department.
3. Discuss the educational programs in the radiology department.

B. Content
   1. Professional personnel
      a. Director/chairman
      b. Radiologists
         1) Attending
         2) Resident
         3) Intern
      c. Radiation physicists
         1) Staff physicist
      d. Radiographer
         1) Administrative director
         2) Chief/senior technologist
         3) Staff technologist
         4) Educational director
            a) Didactic instructor
            b) Clinical instructor
            c) Student
      e. Nurses
         1) Head nurse
         2) Staff nurse
      f. Social worker
   2. Support personnel
      a. Clerical staff
         1) Administrative assistant
         2) Receptionist
         3) Medical secretary
      b. Accounting
         1) Billing
         2) Purchasing
      c. Transportation services
   3. Patient services
   4. Educational programs

V. Accreditation and Credentialing

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define accreditation, credentialing, certification, licensure and regulations.
   2. Describe how the JRCERT *Essentials and Guidelines of an Accredited Educational Program for the Radiographer* relate to the educational program.
   3. Explain the difference between the accreditation and credentialing processes, and identify agencies involved in each process.

B. Content:
   1. Definition
      a. Accreditation
         1) Certification
         2) Licensure
         3) Registration
      b. Credentialing
   2. Organizations
      a. Agencies
         1) National
         2) Regional
         3) State
         4) Other
      b. Structure and functions
         1) *Essentials and Guidelines of an Accredited Educational Program for the Radiographer*.
         2) Program accreditation
         3) Individual credentialing

VI. Professional Organizations

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Describe purposes, functions and activities of professional organizations.
   2. Identify international, national, state and local organizations for the radiographer.

B. Content
   1. Purpose, function, activities
   2. National and international
      a. International Society of Radiographers and Radiologic Technologists (ARRT)
      b. International Society of Radiographers and Radiologic Technologists (ISSRT)
      c. American Healthcare Radiology Administrators (AHRA)
      d. Association of Educators in Radiologic Sciences (AERS)
      e. American consortium on Education in Radiologic Technology (ACERT)
      f. American Board of Radiology (ABR)
      g. American College of Radiology (ACR)
      h. Radiological Society of North America (RSNA)
   3. State organizations
   4. Local organizations

VII. Professional Development

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Discuss the general employment outlook and economic return for the graduate radiographer.
   2. Discuss career advancement and opportunities for the radiographer.
   3. Identify the benefits of continuing education as related to improved patient care and professional enhancement.

B. Content
    1. Methods of advancement
        a. Continuing education programs
        b. Collegiate programs
        c. Geographic mobility
        d. Economic considerations
        e. Manpower issues
    2. Clinical
        a. Administration
        b. Physics
        c. Research
    3. Industrial
        a. Commercial
        b. Governmental
    4. Education
        a. Administration
        b. Clinical
        c. Higher education
    5. Continuing education and competency requirements
        a. Definition
        b. Rationale
        c. Requirements
            1) ARRT
            2) State
            3) Institution
        d. Opportunities

Ethics in the Radiologic Sciences

Course Description

This unit is designed to provide the student with an understanding of the parameters of professional practice. It will include a discussion of the radiographer's major areas of responsibility in the delivery of health care.

Objectives

The student will:

1. Identify historical and philosophical context.
2. Understand ethical philosophy

Content

I. Historical and Philosophical Context

A. Objectives: following the completion of this unit, the student radiographer will:

1. Identify and appreciate specialized standards of behavior for the healing arts as a continuum, with historical and philosophical roots in the earliest periods of human history.
2. Define and describe the major milestones in the development of codes of behavior and ethical standards in the healing arts.

B. Content

1. Origins of the healing arts
2. Healing, healers, magic, religion
3. Principles, duties and virtues of a healer
4. Milestones in the history of medical ethics
5. Holistic consideration

II. Ethics, A Branch of Philosophy

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Identify and appreciate significance of the health professions.
2. Recognize identifying features of various health disciplines.
3. Reflect upon and reinforce the personal choice of a health profession's career by contact with peers and mentors during this course.
4. Recognize "ethics" as a branch of philosophy, and the moral, social and cultural basis of the development of an ethic.
5. Appreciate medical and professional ethics in the context of a broader societal ethic.
6. Explore, reflect upon and appreciate ethics as a "search for ideal behavior" a dynamic process; an ongoing perfection of behavior; not a fixed set of rules.

B. Content

1. The "Examined" life, reflection, motivation
2. Search for ideal behavior

3. Professional ethics
4. Classical philosophy
5. Medieval philosophy
6. Contemporary philosophy
7. Relationship of personal, cultural, societal and professional ethical system.
8. Ethical behavior in health care
9. Components of Hippocratic oath
    a. Scope of practice
    b. Confidentiality
    c. Respect for profession
    d. Personal behavior imperatives

III. Elements of Ethical Behavior

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Be sensitized to the central role of ethical behavior in health care delivery.
2. Be sensitized to the development of moral reasoning, current theories of same in a psychological or educational context and explore their personal stage of development in this regard.
3. Differentiate between empathetic rapport and sympathetic involvement in relationships with patients and relate these to ethical conduct.
4. Identify legal and professional standards and their relationship to practice in health professions.
5. Identify and describe accepted "codes" or guidelines" for professional ethics in their chosen health profession, and those elements therein that are similar to other health professions, and those unique to their respective discipline(s).

B. Content:
1. Moral reasoning
2. Personal behavior standards
3. Competence
4. Compassion, empathy, sympathy
5. Honesty, integrity, accountability
6. Scope of practice defined
    a. Lines of authority
    b. Areas of responsibility
    c. Limitations
    d. Orders, prescriptions
7. Self-assessment and self-governance
8. Continuing professional education
9. Professional standards
    a. Education
    b. Accreditation
    c. Credentialing
    d. Clinical practice
10. Code of professional ethics

IV. Ethical Issues and Dilemmas in Health Care

A. Objectives: Following the completion of this unit, the student radiographe will:

1. Recognize and identify those situations and conditions which give rise to ethical dilemmas in health care.
2. Identify and employ a basic system of examination, clarification, determination of alternatives and decision making in ethical questions.
3. Identify, discuss and define the concepts embodied in principles of patient's rights; the doctrine of informed (patient) consent; and other issues related to patients' rights.
4. Identify, discuss and define the legal implications of professional liability, malpractice, professional negligence or carelessness and other legal doctrines applicable to professional practice.
5. Identify, discuss and appreciate the significance of accurate, complete, correct methods of medical record keeping as a legal and ethical imperative.
6. In groups, and individually, explore, discuss and articulate responses to theoretical situations and questions relating to the ethics of care and health care delivery.

B. Content

1. Individual and societal rights
2. Autonomy versus behavior control
   a. Access and distribution of health care
   b. Justice
   c. Fairness
   d. Economics
3. Financing health care – who pays?
4. Access to good health, health care and technology
5. Human experimentation: Risks, rights and volunteers, implications for students and practitioners.
6. Medical and health care research
7. Decisions of the terminally ill: living wills, advanced directives, non-intervention
8. Analyzing ethical problems, goal theories, rights theories, duty theories
9. Ethical decision making: weighting data, alternatives, risks versus benefits

Introductory Law in the Radiologic Sciences

Course Description

This unit is designed to provide the student with an understanding of introductory law in the radiologic sciences. The elements of malpractice and causes of actions will be discussed. We will look at employment issues, contracts and the litigation process. It will include a discussion of the radiographer's major areas of responsibility in the delivery of health care.

Objectives

The student will:

1. Be aware of legal responsibilities
2. Understand patient consent.

Content

I. Legal Responsibilities

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Define the following terms:
   a. Direct professional liability
   b. Indirect professional liability
   c. Gross negligence
   d. Contributory negligence
   e. Standard of care
   f. Negligence
2. Define the following terms:
   a. Libel/slander
   b. Assault/battery
   c. False imprisonment
   d. Invasion of privacy
   e. Breach of confidentiality
3. Discuss the elements necessary for valid malpractice claim.
4. Define and discuss the doctrines of:
   a. Vicarious liability
   b. Borrowed servant
   c. Respondent superior
   d. Res ipsa loquitur
5. Discuss the ASRT Scope of Practice for the radiographer and describe the elements that comprise it.
6. Discuss the limits of responsibility for the radiographer as defined by the Scope of Practice.
7. Differentiate between professional and legal standards and describe how each relates to radiography practice.
8. Discuss institutional and professional liability protection typically available to the radiographer.

B. Content
    1. Parameters of legal responsibility
        a. Professional liability
            1) Direct
            2) Indirect
        b. Intentional misconduct
            1) Libel and slander
            2) Assault and battery
            3) False imprisonment
            4) Invasion of privacy
            5) Breach of confidentiality
        c. Negligence and malpractice
            1) Definitions
                a) Gross
                b) Contributory
            2) Elements of malpractice
                a) Duty
                b) Dereliction (breach)
                c) Causation
                d) Damage
        d. Doctrines
            1) Vicarious liability
            2) Borrowed servant/captain of the ship
            3) Respondent superior
            4) Res ipsa loquitur
        e. Legal and professional standards
            1) Standard of care
            2) Scope of practice
        f. Protection
            1) Individual
            2) Institutional
    2. Selected responsibilities of the radiographer
        a. Correct patient identification
        b. Correct identification and marking of radiograph
        c. Accurate assessment of patient condition prior to and during radiographic examination.
        d. Composition of radiographic image quality
        e. Accurate documentation as required.

II. Patient Consent

A. Objectives: Following the completion of this unit, the student radiographer will:
    1. Define the term Informed consent.
    2. Describe the elements necessary for informed consent.
    3. Discuss standards for disclosure relative to informed consent.

4. Describe how consent forms are utilized relative to specific radiographic procedures.
5. Discuss how consent forms are used in legal action.

B. Content
   1. Definition
   2. Types
      a. Implied
      b. Written
      c. Oral
   3. Condition for valid consent
      a. Legal age
      b. Mental competence
      c. Voluntary action
      d. Provision of adequate information regarding case, procedure, alternatives, and risk
      e. American Hospital Association (AHA) and Joint Commission on Accreditation for Healthcare Organizations (JCAHO) Standards for Disclosure.
   4. Documentation of consent
      a. Form and contents
      b. Use in legal actions

Medical Terminology

Course Description

This unit will provide the student with an introduction to the origins of medical terminology. A word building system will be introduced, and abbreviations and symbols will be discussed. Also introduced in this course will be an orientation to the understanding of radiographic orders and interpretation of diagnostic reports. Related terminology is addressed.

Objectives

The student will:

1. Identify origins of medical terminology
2. Understand the word building process.
3. Review medical abbreviations and symbols.
4. Understand orders, requests and diagnostic reports
5. Be familiar with radiation science terms
6. Recognize operational and management terms

Content

I. Introduction to the Origin of Medical Terminology

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. List the primary and secondary language sources from which medical terms are derived.
   2. Give examples of medical terms from both the primary and secondary sources.

B. Content
   1. Primary language sources
      a. Greek
      b. Latin
   2. Secondary language sources
      a. English
      b. French
      c. German

II. The Word Building Process

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Given medical terms, operate and define each according to its basic elements.
   2. Given medical terms in noun and verb forms, change each to adjective or adverb forms
   3. Analyze medical terms that combine prefixes and suffixes with other word elements.
   4. From a list, select medical terms used in radiology.
   5. Translate medical terms into common language a patient could understand.
   6. Correctly pronounce medical terms.

B. Content
   1. Basic elements
      a. Root words
      b. Prefixes
      c. Suffixes
   2. Combining forms
   3. Parts of speech
      a. Nouns
      b. Verbs
      c. Adjectives
      d. Adverbs
   4. Translation of terms into common language
   5. Correct pronunciation of medical terms

III. Medical Abbreviations and Symbols

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Given abbreviations, provide definition for each.
   2. Given symbols, provide definition for each.
   3. Give medical orders which include abbreviations and symbols, translate into non-medical language.

B. Content
   1. Role in communications
   2. Abbreviations
      a. Examples
      b. Interpretations
   3. Symbols
      a. Greek alphabet – upper and lower case
      b. Pharmaceutical symbols and terms
      c. Math and science symbols and constants
      d. Examples
      e. Interpretations

IV. Understanding Orders, Requests and Diagnostic Reports

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Given radiologic orders, describe the procedures to be performed.
   2. Given diagnostic reports, translate into a language the patient can understand.
   3. Given a request for diagnostic imaging consultation services, describe procedures and procedures necessary to respond to requested service(s).

B. Content
   1. Radiographic orders and requisitions – components
      a. Procedures ordered
      b. Patient history
      c. Clinical information

2. Diagnostic reports
    a. Content
    b. Interpretation

V. Radiation Science Terms

A. Objectives: Following the completion of this unit, the student radiographer will:
    1. Given specific diagnostic imaging terms and procedures, define the terms and procedures.
    2. Given specific diagnostic imaging terms, identify and locate the places where procedures are performed.

B. Content
    1. Radiographic imaging procedures and terms
    2. Radiation oncology and cancer procedures and terms
    3. Nuclear medicine procedures and terms
    4. Sonography procedures and terms
    5. MR procedures and terms
    6. CT procedures and terms

VI. Operational and Management Terms

A. Objectives: Following the completion of this unit, the student radiographer will:
    1. Given operational and management terms and abbreviations, define the term or abbreviation.
    2. Given example scenarios utilizing operational and management terms and abbreviations, describe the implications for effective provision of radiologic services.
    3. Relate operational and management terminology to customers, clients and patient satisfactions.

B. Content
    1. Total quality management terms
        a. Quality assurance and assessment
        b. Quality control
        c. Quality improvements
        d. Client and patient services
    2. Budgeting and fiscal responsibility
        a. Current procedural terminology (CPT) codes
        b. Medicare, Medicaid and third party payor reimbursement terms
            1) Diagnostic related groups (DRG's)
            2) Perspective payment (PPD)
            3) Relative value scale (RVS)
        c. Revenues and expenditures account codes
        d. Personnel management terms

Radiologic Sciences Patient Care

Course Description

This unit will provide the student with 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 universal precautions. The role of the radiographer in patient education will be identified.

Course Outline

1. Introduction
2. Attitudes and communication in patient care.
3. Patient and technologist interactions
4. Safety and transfer positioning.
5. Evaluating physical needs
6. Infection control
7. Medical emergencies
8. Dealing with acute situations
9. Patient care for barium studies
10. Care of patients with tubes.
11. Care of patients during special procedures
12. Patient care during bedside radiography
13. Patient education
14. Health promotion
15. Substance abuse

I. Introduction

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Discuss the responsibilities of the health care facility.
   2. Discuss the responsibilities of the radiographer.
   3. Discuss the scope of practice for the radiographer.

B. Content
   1. The health care facility
      a. Responsibilities
         1) Caring for the ill
         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
   2. The health care team
      a. Responsibilities
   3. The radiographer

a. Responsibilities
    1) Performing radiographic examination
    2) Assisting the radiologist
    3) Providing patient care
b. Scope of practice

II. Attitudes and Communication in Patient Care

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Discuss the perceptions of death and dying from patient and technologist viewpoints.
2. Discuss ethical, emotional, personal and physical aspects of death.
3. List the stages of dying and describe the characteristics of each stage.
4. Identify the support mechanisms available to the terminally ill.

B. Content
1. Health-illness continuum
2. Developing professional attitudes
    a. Serving as health role models
    b. Sympathy
    c. Empathy
    d. Assertiveness
3. Communication
    a. Verbal
    b. Nonverbal
    c. Challenges in communication
        1) Patients who do not speak English
        2) Hearing, vision and speech problems
        3) Impaired mental function
        4) Altered states of consciousness
        5) Communicating with children and adolescents
        6) Communicating with geriatric patients
        7) Communicating under stress
        8) Cultural diversity
        9) Artificial speech
            a) Transesophageal puncture (TEP)
            b) Esophageal speech
            c) Electrolarynx devices
    d. Other factors that impede communication
        1) Colloquialism and slang
        2) Medical jargon
    e. Feedback
    f. Patient interactions
        1) Establishing communication guidelines
        2) Reducing distance
        3) Listening

4) Using therapeutic silence
5) Responding to the feeling and the meaning of the patient's statement.
6) Restating the main idea
7) Reflecting the main idea
8) Making observations

g. Communication with families
h. Communication with other health care professionals

4. Psychological considerations
   a. Dying and death
      1) Understanding the process
      2) Aspects of death
         a) Emotional
         b) Personal
         c) Physical
            (1) Pain
            (2) Suffering
            (3) Disability
            (4) Deterioration
      3) Stages of dying
         a) Rejection
         b) Denial
         c) Anger
         d) Bargaining
         e) Acceptance
      4) Patient support services
         a) Family and friends
         b) Pastoral care
         c) Patient-to-patient support groups
         d) Psychological support groups
         e) Hospice
         f) Health professionals
   b. Patient's emotional responses
      1) General behavior
      2) Influencing factors
         a) Age
         b) Sex
         c) Marital and family status
         d) Socioeconomic factors
         e) Cultural and religious variations
         f) Physical condition
         g) Self-image
         h) Past life experiences
         i) Beliefs
         j) Attitudes
         k) Prejudices

l) Self-awareness

c. Stress related "burnout"
   1) Definition
   2) Factors that increase burnout risk
   3) Psychological and behavioral signs and symptoms

III. Patient and Technologist Interactions

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Describe methods of determining the proper patient identification.
   2. Explain the use of:
      a. Audio and visual communication systems
      b. Immobilization devices
      c. Machine type
      d. Axillary equipment
   3. Alleviate fears by explaining:
      a. Positioning for examination
      b. Length of procedure
      c. Room noises
      d. Machine movement
      e. Machine and patient contact
   4. Given case studies, interact with patient's family members and friends.

B. Content
   1. Patient identification
   2. Procedure questions and explanations
      a. Positioning
      b. Length of procedure
      c. Audio and visual intercommunication systems
      d. Room noises
      e. Immobilization devices
      f. Machine type
      g. Machine movement
      h. Machine and patient contact
      i. Application of axillary equipment
   3. Interaction with patient's family members and friends

IV. Safety and Transfer Positioning

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Describe and demonstrate good principles of body mechanics applicable to patient care.
   2. Demonstrate techniques for various type of patient transfer.
   3. Describe and demonstrate the procedures for turning patients with various conditions.
   4. Describe and demonstrate restraint techniques for various types of procedures and patient conditions.

5. Describe the aspects of patient comfort and discuss the importance of each to the care and safety of the patient.
6. Given specific patient considerations and conditions, discuss various aspects of general patient care.
7. Discuss procedures for assuring security of property of inpatients and outpatients.

B. Content
   1. Safety
      a. Fire
         1) RCAF (rescue, confine, alert and fight)
      b. Electrical
      c. Hazardous materials
      d. Radioactive materials
      e. Personal belongings
      f. Occupational Safety and Health Administration (OSHA)
      g. Environmental Protection Agency (EPA)
   2. Body mechanics
      a. Proper body alignment
      b. Proper movement
      c. Proper balance
      d. Center of balance in the body
      e. Practicum
   3. Patient transfer and movement
      a. Assessing the patient's mobility
      b. Rules for safe patient transfer
      c. Wheelchair transfers
      d. Stretcher transfers
         1) Sheet transfer
         2) Three-carrier lift
         3) Log roll
         4) Positioning for safety, comfort and exams
      e. Disabled patients
      f. Geriatric patients
      g. Pediatric patients
      h. Patients with intravenous infusions
      i. Patients with tubes or catheters
      j. Metastatic disease
      k. Practicum
   4. Positioning for safety and comfort
      a. Positions
         1) Supine
         2) Protective side-lying
         3) Protective prone position
         4) Fowler's
         5) Semi-Fowler's

6) Sims'
7) Trendelenburg
8) Lithotomy
9) Knee chest

b. Safety straps and rails

5. Restraints and immobilization methods
   a. Purpose
   b. Adult
      1) Types
      2) Applications
   c. Pediatric
      1) Types
      2) Applications
6. Accidents and incident reports
   a. Purpose
   b. Legal considerations
   c. Documentation

V. Evaluating Physical Needs

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Describe methods for evaluation of patient status.
   2. Identify the information to be collected prior to patient examination.
   3. Describe vital signs used to assess patient condition.
   4. Convert a Fahrenheit measurement to a Celsius.
   5. State the normal temperature values for the oral and rectal methods of measurement for temperature.
   6. Describe the method of monitoring respirations and state the normal values expected.
   7. List the equipment necessary for acquisition of the blood pressure on a patient.
   8. Identify the normal values for blood pressure for males and females.
   9. Identify the seven major sites for monitoring the pulse and indicate the normal values.
   10. Demonstrate the assessment of vital signs.

B. Content
   1. Physical needs of the patient
   2. Purpose for developing evaluation skills
   3. Assessing patient status
   4. Physical signs
   5. Vital signs
      a. Temperature
      b. Pulse
      c. Respiration
      d. Blood pressure
      e. Normal values

f. Interfering factors
g. Terminology
h. Adult vs pediatric
i. Documentation

6. Weight
7. Review of laboratory reports
8. Practicum

VI. Infection Control

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Define each of the following:
   a. Infectious pathogens
   b. Communicable diseases
   c. Nosocomial infections
   d. Centers for Disease Control and Prevention (CDC)
   e. Human Immunodeficiency Virus (HIV)
   f. Hepatitis B Virus (HBV)
2. Describe the utilization of Universal Precautions and isolation procedures.
3. Describe sources and modes of transmission of infections and diseases.
4. Describe institutional and departmental procedures for infections control through Universal Precautions.
5. Discuss psychological considerations for the management of patients utilizing Universal Precautions.

B. Content

1. Terminology
   a. Nosocomial
   b. Communicable
   c. Infectious pathogens
2. Centers for Disease Control and Prevention
   a. Purpose
3. Cycle of infection
   a. Infectious pathogens
   b. Reservoir of infection
   c. Susceptible host
   d. Transmission of disease
      1) Direct
      2) Indirect
         a) Vehicle
         b) Vector
         c) Airborne
4. Preventing disease transmission
   a. Body substance precautions
5. Asepsis
   a. Medical

1) Definition
2) Procedure
    a) Soap
    b) Water
    c) Friction
    d) Chemical disinfectants

b. Surgical
1) Definition
2) Growth requirements for microorganisms
3) Methods used to control microorganisms
    a) Moist heat
        (1) Boiling
        (2) Steam under pressure
    b) Dry heat
        (1) Incineration
        (2) Dry heat oven
    c) Gas
    d) Chemicals
4) Procedures
    a) Opening packs
    b) Gowning and gloving
    c) Skin preparations
    d) Draping
    e) Dressing changes
5) Packing
6) Storage
7) Rules for surgical asepsis

6. Practical Asepsis
a. Handling linens
b. Wound care
    1) Cleansing
    2) Dressing
c. Techniques
    1) Dress
    2) Hair
    3) Hand washing
    4) Gloves
    5) Eye protection
    6) Cleaning and proper disposal of contaminated waste
d. Practicum

7. Isolation techniques and communicable diseases
a. Category specific
b. Disease-specific
c. Universal Precautions
d. Examples

1) HIV virus (AIDS)
2) Hepatitis
    a) Type A
    b) Type B
    c) Type C (non A or B)
3) Tuberculosis (TB)
4) Other

8. Isolation patient in the department
    a. Procedure
        1) Gowning
        2) Gloving
        3) Masking
    b. Patient transfer
    c. Cleaning and proper disposal of contaminated waste
9. Precautions for the compromised patient (reverse isolation)
    a. Purpose
    b. Procedure
10. Psychological considerations

VII. Medical Emergencies

A. Objectives: Following the completion of this unit, the student radiographer will:
    1. Identify symptoms which manifest the following emergencies:
        a. Cardiac arrest
        b. Shock
        c. Convulsion and seizure
        d. Hemorrhage
        e. Apnea
        f. Vomiting
        g. Aspiration
        h. Suspected or confirmed fractures
        i. Diabetic coma or insulin shock
    2. Describe the emergency medical code system for the institution and discuss the role of the student in this procedure.
    3. Given a CPR mannequin, demonstrate CPR competency.
    4. Discuss acute care procedures for the above emergencies.
    5. Discuss the use of medical emergency equipment and supplies.
    6. Given simulations, demonstrate the use of oxygen and suction equipment.
    7. Given simulations, demonstrate basic first aid techniques.

B. Content
    1. Terminology
    2. Emergency equipment
    3. Latex reactions
    4. Shock
        a. Signs and symptoms

b. Types
    1) Hypovolemic
    2) Septic
    3) Cardiogenic
    4) Neurogenic
    5) Anaphylactic or allergic
c. Medical intervention

5. Diabetic emergencies
    a. Hypoglycemia
        1) Signs and symptoms
        2) Medical intervention
    b. Ketoacidosis
        1) Signs and symptoms
        2) Medical intervention
    c. Hyperosmolar coma
        1) Signs and symptoms
        2) Medical intervention
6. Respiratory and cardiac failure
    a. Signs and symptoms
    b. Medical intervention
    c. Adult versus pediatric
    d. Equipment
7. Airway obstruction
    a. Signs and symptoms
    b. Medical intervention
    c. Adult vs pediatric
8. Cerebral vascular accident (stroke)
    a. Signs and symptoms
    b. Medical intervention
9. Convulsive seizures
    a. Signs and symptoms
    b. Medical intervention
10. Fainting
    a. Types
        1) Petit mal
        2) Grand Mal
    b. Symptoms
    c. Medical intervention
11. Other medical conditions
    a. Epistaxis
    b. Nausea
    c. Postural hypotension
    d. Vertigo
    e. Asthma

VIII. Dealing with Acute Situations

A. Objectives: Following the completion of this unit, the student radiographer will:

1. List the special considerations necessary when performing radiographic procedures on an infant or child.
2. List the special considerations necessary when performing radiographic procedures on a geriatric patient.
3. List the symptoms of a patient with a head injury.
4. List the precautions to be taken when working with a patient with a head injury.
5. List the symptoms of a patient with a spinal injury.
6. List the precautions to be taken when working with a patient with a spinal injury.
7. List the symptoms of a patient with an upper or lower extremity fracture.
8. List the precautions to be taken when working with a patient with an uppor or lower extremity fracture.
9. List the symptoms of a patient with massive wounds.
10. List the precautions to be taken when working with a patient with massive wounds.
11. List the symptoms of a patient with burns.
12. List the precautions to be taken when working with a patient with burns.
13. List the signs and symptoms of a patient having a reaction to contrast media.
14. Describe the medical intervention for a patient having a reaction to contrast media.

B. Content

1. Head injuries
   a. Four levels of consciousness
   b. Symptoms
   c. Medical intervention
   d. Adult versus pediatric
2. Spinal injuries
   a. Assessment
   b. Symptoms
   c. Medical intervention
   d. Transportation
3. Extremity fractures
   a. Types
   b. Symptoms
   c. Splints
   d. Casts
   e. Positioning
   f. Adult versus pediatric
4. Wounds
   a. Symptoms
   b. Medical intervention
5. Burns
   a. Symptoms
   b. Medical intervention
6. Reactions to contrast media

a. Signs and symptoms
b. Medical intervention

IX. Patient Care for Barium Studies

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Explain the role of the technologist in patient education.
2. Describe the different types of patient preparation for barium studies.
3. Describe the procedure to properly prepare a patient for a barium study.
4. Describe the purpose for using contrast agents.
5. Differentiate between positive and negative contrast agents.
6. Describe the purpose of performing the upper and lower gastrointestinal study.
7. Describe the post-examination care required for patients who have undergone an upper or lower gastrointestinal study.

B. Content
1. Patient education
   a. Technologists responsibility
   b. Standard procedure
2. Preparation for examination
   a. Diet
   b. Cathartics
   c. Enemas
      1) Saline
      2) Fleet
      3) Oil-retention
      4) Tap-water
      5) Soap suds
   d. Procedure
3. Types of contrast media
   a. Purpose
   b. Negative agents
      1) Carbon dioxide
      2) Air
      3) Oxygen
      4) Nitrous oxide
   c. Positive agents
      1) Barium sulfate
      2) Iodinated preparations
      3) Non-iodinated preparations
4. Examinations
   a. Upper gastrointestinal tract
   b. Lower gastrointestinal tract
   c. Double contrast studies
   d. Follow-up care

X. Care of Patient with Tubes

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Given specific tube management situations, explain the indication and procedure.
   2. Given specific tube management situations, identify the precautions involved.
   3. Identify the steps in the operation and maintenance of suction equipment.

B. Content
   1. Terminology
   2. Nasogastric and Nasointestinal
      a. Purpose
      b. Types
      c. Passage
      d. Location
      e. Removal
      f. Special precautions
   3. Suction
      a. Purpose
      b. Equipment
      c. Procedure
      d. Adult versus pediatric
      e. Special precautions
   4. Tracheostomy
      a. Purpose
      b. Equipment
      c. Procedure
      d. Removal
      e. Special precautions
      f. Suction techniques
      g. CPR
   5. Chest tube
      a. Purpose
      b. Equipment
      c. Procedure
      d. Removal
      e. Special precautions
   6. Tissue drains
      a. Purpose
      b. Equipment
      c. Procedure
      d. Removal
      e. Special precautions
   7. Oxygen administration
      a. Purpose
      b. Values
      c. Oxygen therapy

d. Oxygen delivery system
    1) Low flow systems
    2) High flow systems
e. Documentation
f. Special precautions

8. Urinary collection
    a. Purpose
    b. Equipment
    c. Procedure
        1) Male
        2) Female
    d. Removal
    e. Alternative methods of urinary drainage
    f. Documentation
    g. Special precautions
9. Other ostomies
    a. Ileostomy
    b. Ureteroileostomy

XI. Care of Patients During Special Procedures

A. Objectives: Following the completion of this unit, the student radiographer will:
    1. Given an EKG strip, determine a normal pattern from an abnormal pattern.
    2. Identify the patient education, patient care, drug administration and special precautions for a patient undergoing:
        a. Myelography
        b. Computerized tomography
        c. Urography
        d. Cardiovascular-interventional procedures.
        e. Magnetic resonance imaging
        f. Ultrasound

B. Content
    1. Cardiac monitoring
        a. Preparation for cardiac monitoring
        b. EKG rhythms
        c. Patient care considerations
            1) Adverse reactions
                a) Reactions to contrast media
                b) Other medical conditions
        d. Myelography
        e. Patient education
        f. Patient care
        g. Intrathecal drug administration
        h. Special precautions

2. Computerized tomography
    a. Patient education
    b. Patient care
    c. Drug administration
    d. Special precautions
3. Urography
    a. Patient education
    b. Patient care
    c. Drug administration
    d. Special precautions
4. Cardiovascular-interventional procedures
    a. Patient education
    b. Patient care
    c. Drug administration
    d. Special precautions
5. Magnetic resonance imaging
    a. Patient education
    b. Patient care
    c. Drug administration
    d. Special precautions
6. Ultrasound
    a. Patient education
    b. Patient care
    c. Special precautions

XII. Patient Care During Bedside Radiography

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Demonstrate the appropriate procedure for gathering information prior to performing a bedside radiographic examination.
2. List three situations in which bedside radiography may be preferable to examination in the radiology department.
3. List four important factors to be noted during initial survey prior to radiography in the intensive care unit.
4. Describe the initial steps in performing a bedside radiograph.
5. Describe the special precautions to be used when performing a radiography on a premature infant.
6. Explain the procedure for placing a cassette under a patient in an orthopedic bed frame.
7. Describe the special problems faced in performing radiographs on a patient with:
    a. Tracheostomy
    b. Nasogastric tubes
    c. Chest drainage tubes
    d. Swan-Ganz catheters
8. Describe the procedure for taking radiographs in the surgical suite.

9. Discuss the appropriate radiation protection required when doing bedside or surgical radiography.

B. Content
   1. Patient education
   2. Patient care
   3. Special precautions

XIII. Patient Education

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define communication.
   2. Identify methods of communication and discuss how each can be utilized in patient education.
   3. Identify patient communication problems and discuss how each can be overcome to provide patient education.
   4. Given clinical simulations, demonstrate explanations of radiographic examinations.
   5. Given clinical simulations, demonstrate explanations for patients with various communication problems.
   6. Discuss radiation safety and protection questions patients might ask in connection with radiologic examinations and the radiographer's response to each.
   7. Given specific patient conditions and profiles, analyze the moods, expectations and perceptions of the technologist-patient relationship.

B. Content
   1. Procedures
   2. Restrictions
   3. Duration
   4. Special instructions

XIV. Health Promotion

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define tertiary disease prevention.
   2. Describe available sources for patient education materials.
   3. Define secondary disease prevention.
   4. State the importance of the following:
      a. Breast self-exam
      b. Testicular self-exam
      c. Skin self-exam
      d. Mammography
      e. Physical examinations
      f. Pelvic examinations
      g. Colorectal examinations
   5. Describe the correlation of family history to:
      a. Breast cancer
      b. Testicular cancer

c. Colorectal cancer

B. Content
1. Tertiary disease prevention
a. Sources of educational materials
1) American Cancer Society
2) National Cancer Institute
3) American Heart Association
b. Program coordination
2. Secondary disease prevention
a. Early detection
1) Breast self-examination
2) Testicular self-examination
3) Skin self-examination
4) Mammography
5) Physical examinations
6) Pelvic examinations
7) Colorectal examinations
b. Family history

XV. Substance Abuse

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Define chemical dependence and differentiate among terms used to describe aspects of this illness.
2. Discuss specific signs and symptoms of those suffering from chemical dependence and identify specific strategies used in treating this illness.

B. Content
1. Terminology
2. Signs and symptoms
3. Treatment and rehabilitation

Human Structure and Function

Course Description

This unit will provide the student with a knowledge of anatomy and physiology. The components of the cell, tissue, organs and systems will be described. The individual parts that comprise the human body as a whole will be discussed.

Content

I. Anatomical Nomenclature and Body Cavities

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Given frontal and lateral diagrams of the human body, label components to identify terms of direction.
   2. Given frontal and lateral diagrams of the human body, draw and label various body planes.
   3. Discuss each of the body cavities in terms of structural limits, function and contents.

B. Content
   1. Terms of direction
      a. Anterior/posterior
      b. Ventral/dorsal
      c. Media/lateral
      d. Superior/inferior
      e. Proximal/distal
      f. Cephalad/caudad
   2. Body planes
      a. Median/mid-sagittal
      b. Sagittal
      c. Coronal
      d. Transverse
      e. Longitudinal
   3. Body cavities
      a. Cranial
         1) Structural limits
         2) Function
         3) Contents
      b. Thoracic
         1) Structural limits
         2) Function
         3) Contents
      c. Abdominal/pelvic
         1) Structural limits
         2) Function
         3) Contents

II. Chemical Composition of the Body

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Define the terms atom, ion, atomic number and atomic weight.
2. Describe the nature and different types of chemical bonds.
3. Discuss the pH scale and differentiate between acid and base substances.
4. Differentiate between polar and non-polar compounds, and relate these to water solubility.
5. Describe the different types of carbohydrates and give examples of each type.
6. Describe the different types of lipids and their common characteristics.
7. Explain the structure and functions of proteins.
8. Describe the structure of DNA and the law of complementary base pairing.
9. Describe the structure of RNA and name the different types of RNA.

B. Content

1. Atoms
2. Chemical bonds
3. Inorganic compounds
   a. Acids
   b. Bases
   c. Salts
   d. Acid-base balance
      1) Maintaining pH
4. Organic Compounds
   a. Carbohydrates
   b. Lipids
   c. Proteins
   d. Nucleic Acids
      1) DNA
      2) RNA
   e. Adenosine Triphosphate (ATP0
   f. Cyclic AMP (adenosine-3', 5'-monophosphate)

III. Cell Structure and Genetic Control

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Expl,ain the structure of the cell membrane and the cytoskeleton.
2. Define endocytosis and exocytosis.
3. Identify the structure and function of cilia and flagella.
4. Explain the replication of DNA
5. Describe the phases of the cell cycle.
6. Describe genetic transcription and the post-transcriptional modifications that change pre-mRNA into mRNA.
7. Describe the functions of mRNA, tRNA and rRNA
8. Explain the mechanisms of genetic translation of the RNA code into the synthesis of proteins.

9. Describe the functions of the rough endoplasmic reticulum and Golgi apparatus in post-transitional modifications of secretory proteins.
10. Describe the sequences of events that occur in the synthesis packaging and exocytosis of secretory proteins.
11. Differentiate between meiosis and mitosis and identify the stages of each process.

B. Content
   1. Cell membrane
      a. Chemistry
      b. Structure
      c. Physiology
      d. Types of transport processes
         1) Diffusion
         2) Osmosis
         3) Filtration
         4) Active transport/physiological pumps
         5) Phagiocytosis and pinocytosis
   2. Cytoplasm
   3. Organelles
      a. Nucleus
      b. Ribosomes
      c. Endoplasmic reticulum
      d. Golgi complex
      e. Mitochondria
      f. Lysosomes
      g. Peroxisomes
      h. Cytoskeleton
      i. Centrosome and centrioles
      j. Flagella and cilia
   4. Gene action
      a. Protein synthesis
      b. Transcription
      c. Translation
   5. Reproduction of cells
      a. Mitosis
      b. Meiosis
   6. Aberration/abnormal cell division

IV. Metabolism

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define the following:
      a. Anabolism
      b. Catabolism
      c. Metabolism
   2. Describe the role of enzymes in metabolism.

3. Describe carbohydrate metabolism.
4. Describe lipid metabolism.
5. Describe the Krebs cycle in general terms and explain its functional significance.
6. Describe protein metabolism.
7. State the significance of ketone.
8. List the factors which affect the basal metabolic rate.

B. Content
1. Anabolism
2. Catabolism
3. Enzymes and metabolism
4. Carbohydrate metabolism
5. Lipid metabolism
6. Protein metabolism
7. Regulation and homeostasis

V. Tissues

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Identify the germinal layers of the embryo.
2. List each type of tissue and give an example of a location where each type might be found.
3. Compare and contrast structural and functional characteristics of each of the tissue classifications.
4. Describe the following tissue types:
   a. Epithelial
   b. Connective
   c. Muscle
   d. Nerve
5. Name and locate types of body membranes.

B. Content
1. Embryonic layers
   a. Ectoderm
   b. Endoderm
   c. Mesoderm
2. Types of tissue
   a. Epithelial
   b. Connective
   c. Muscle
   d. Nerve
3. Tissue repair and homeostasis

VI. Skeletal System

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Given radiographs, diagrams and skeletal parts, identify and locate the bones of the axial skeleton.
2. Describe processes and depressions found on bones of the axial skeleton.
3. Describe articulations of the axial and appendicular skeleton.
4. Given radiographs, diagrams and skeleton, locate and identify structures of the skull.
5. Given radiographs, diagrams and skeleton, identify and discuss primary and secondary curves of the spine.
6. Given radiographs, diagrams and skeletal parts, identify and locate the bones of the appendicular skeleton.
7. Given radiographs, diagrams and skeletal parts, describe projections and depressions found on bones of the appendicular skeleton.
8. Describe sesamoid bones and locate examples on radiographs.
9. Discuss the functions of the skeletal system.
10. Define articulation.
11. Given diagrams, locate and label the different types of articulations.
12. Discuss each type of articulation, including a definition of the type of comparison with other types, locations and movement(s) permitted.

B. Content
   1. Osseous tissue
      a. Structural organization
         1) Medullary cavity/marrow
         2) Compact bone
         3) Cancellous bone
         4) Periosteum
         5) Cartilage
      b. Development and growth
         1) Physis
         2) Diaphysis
         3) Dpiphysis/epiphyseal line
         4) Metaphysis
      c. Classification and markings
         1) Long
         2) Short
         3) Flat
         4) Irregular
         5) Processes and bony projections
         6) Depressions/openings
   2. Divisions
      a. Axial
         1) Skull
         2) Hyoid bone
         3) Vertebral column
         4) Thorax

b. Appendicular
    1) Pectoral girdle
    2) Upper extremities
    3) Pelvic girdle
    4) Lower extremities
c. Sesamoids
d. Functions
    1) Support
    2) Protection
    3) Movement
    4) Hemopoiesis

3. Articulations
    a. Functional classification
        1) Synarthroses
        2) Amphiarthroses
        3) Diarthroses
            a) Joint classifications
            b) Movement
    b. Structural classification
        1) Fibrous
        2) Cartilaginous
        3) Synovial

VII. Muscular System

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Describe the organization of muscle at the gross and microscopic levels.
2. Describe the structure of each type of muscle tissue.
3. State the function of each type of muscle tissue.
4. Name and locate the major muscles of the axial skeleton.
5. Name and locate the major muscles of the appendicular skeleton.

B. Content
1. Types, characteristics and functions
    a. Smooth
    b. Cardiac
    c. Skeletal
2. Functions
    a. Motion/movement
    b. Maintenance of posture
    c. Heat production

VIII. Nervous System

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Describe the structure of the different types of nerve cells.
2. State the function of the different types of nerve cells.

3. Describe the structure of the brain and the relationship of its component parts.
4. Describe the brain functions.
5. List the meninges, describe and discuss the function of each.
6. Discuss the formation, circulation and function of cerebrospinal fluid.
7. Describe the structure and discuss the function of the spinal cord.
8. Discuss the distribution and function of cranial nerves.
9. Discuss the distribution and function of spinal nerves.
10. Discuss the structure and function of components of the autonomic nervous system.

B. Content
   1. Introduction
      a. Neural tissue
      b. Function
      c. Central nervous system
      d. Peripheral nervous system
   2. Neural tissue
      a. Neurons
         1) Types
         2) Location
         3) Functions
      b. Neuroglia
         1) Types
         2) Location
         3) Functions
      c. Physiology of neural tissue
      d. Information processing
   3. Central nervous system
      a. Anatomy
      b. Functions
   4. Peripheral nervous system
      a. Anatomy
      b. Functions

IX. Sensory System

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Describe the structure of the eye.
   2. Describe the structure of the components of the ear.
   3. Given diagrams, identify and locate com0onents of the:
      a. External ear
      b. Middle ear
      c. Inner ear
      d. Eustachian tubes
   4. Describe the components of body parts involved in the sense of smell.
   5. Describe the components and structure of body parts involved in the sense of taste.
   6. List the somatic senses.

B. Content
    1. General senses
        a. Nociperception
        b. Chemoreception
        c. Thermoreception
        d. Mechanoreception
    2. Special senses
        a. Vision
        b. Hearing and equilibrium
        c. Olfaction
        d. Gustation
        e. Tactile
            1) Structure
            2) Function

X. Endocrine System

A. Objectives: Following the completion of this unit, the student radiographer will:
    1. Define endocrine.
    2. Describe the characteristics and function of the endocrine system.
    3. Identify the location and describe the structure of each component of the endocrine system.
    4. Identify the major hormone(s) secreted by each component of the endocrine system.
    5. Explain the function of each component of the endocrine system.

B. Content
    1. Hormone structure and function
    2. Homeostatic control
    3. Endocrine tissue
        a. Pituitary (Hypophysis) gland
        b. Pineal gland
        c. Thyroid gland
        d. Parathyroid gland
        e. Adrenal (Suprarenal) glands
        f. Heart and kidneys
        g. Digestive system
        h. Pancreas
        i. Testes
        j. Ovaries
        k. Thymus
        l. Placenta

XI. Digestive System

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Describe the hard and soft palates.
2. Discuss deciduous and permanent teeth in terms of age for eruption and number.
3. Discuss types of teeth in terms of number, location within the jaws and function.
4. Given cross-sectional diagrams of teeth, label the components parts.
5. Describe the tongue in terms of structure and function.
6. Describe the salivary glands in terms of structure, function and locations.
7. List the primary organs of the digestive system.
8. Given diagrams and radiographs of primary organs comprising the digestive system, label the parts.
9. Describe the layers of tissue that comprise the esophagus, stomach, small intestine, large intestine and rectum.
10. Explain the functions of each primary organ of the digestive system.
11. Differentiate between peritoneum, omentum and mesentery.
12. List the accessory organs of the digestive system.
13. Given diagrams and radiographs of accessory organs of the digestive system, label the parts.
14. Discuss the secretions of accessory organs of the digestive system and the function of each.
15. Discuss the functions of the accessory organs of the digestive system.
16. Describe the purpose of digestion.
17. Discuss types of digestive changes that occur in the body.
18. Describe the process of absorption.

B. Content
   1. Primary organs
      a. Oral cavity
         1) Structure and location
         2) Functions
      b. Esophagus
         1) Structure and location
         2) Functions
      c. Stomach
         1) Structure and location
         2) Functions
      d. Small intestine
         1) Structure and location
         2) Functions
      e. Large intestine
         1) Structure and location
         2) Functions
      f. Rectum
         1) Structure and location
         2) Functions
   2. Accessory organs
      a. Salivary glands

1) Structure and location
2) Functions

b. Pancreas
1) Structure and location
2) Functions

c. Liver
1) Structure and location
2) Functions

d. Gallbladder
1) Structure and location
2) Functions

3. Digestive processes
a. Ingestion
b. Peristalsis
c. Digestion
d. Absorption
e. Defecation

XII. Cardiovascular System

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Describe the composition and functions of blood.
2. List the types of blood cells and state their functions.
3. Differentiate between blood plasma and serum
4. Explain the clotting mechanism
5. List the blood types
6. Explain the term Rh factor.
7. Explain the antigen/antibody relationship and its use in blood typing.
8. Given diagrams of the heart, label the parts.
9. Trace the flow of blood through the body, and identify the main vessels.
10. Describe the structure and function of arteries, veins and capillaries.
11. Differentiate between arterial blood in systemic circulation and arterial blood in pulmonary circulation.

B. Content
1. Blood
a. Composition
1) Cellular components
2) Plasma
b. Clotting system
c. Hemopoiesis
d. Function
2. Heart
a. Anatomy
b. Function
3. Vessels

a. Types
b. Structure
c. Function

XIII. Lymphatic System and Immunity

A. Objectives: Following the completion of this unit, the student radiographer will:
1. List the components of the lymphatic system and explain their function.
2. Given diagrams, label major pathways of lymphatic circulation.
3. Given diagrams, locate the major lymph node clusters.
4. Explain the difference between nonspecific defenses and specific immunity.
5. Explain antibody production and function.
6. List the different types of T-cells and explain their function.
7. Discuss the chemical mediation of the immune response.

B. Content
1. Lymphatic system
   a. Lymph vessels
   b. Lymphatic organs
      1) Thymus
      2) Lymph nodes
      3) Spleen
   c. Lymphatic tissue
      1) Tonsils
      2) Peyer's patches
2. Immune system
   a. Nonspecific defenses
      1) Physical barriers
      2) Phagocytic cells
      3) Immunological surveillance
      4) Complement
      5) Inflammation
   b. Humoral immunity
      1) Production
      2) Structure
      3) Function
   c. Types of immunoglobulins
      1) Cellular immunity
      2) Regulation of immune response
         a) Monokines
         b) Lymphokines
      3) Immunological competence

XIV. Respiratory System

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Given diagrams and radiographs of components of the respiratory system, label the parts.
2. Describe the mechanics of respiration.
3. Explain pulmonary ventilation.
4. Discuss alveolar exchange.
5. Describe the transport of blood gases.
6. Explain tissue gas exchange.
7. Describe how respiration is regulated.

B. Content
   1. Components, structure and function
      a. Nose and sinus cavities
      b. Pharynx
      c. Larynx
      d. Trachea
      e. Bronchi
      f. Lungs
      g. Thorax
   2. Physiology
      a. Pulmonary ventilation
      b. Alveolar gas exchange
      c. Transport of blood gases
      d. Tissue gas exchange
      e. Control and regulation of respiration

XV. Urinary System

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Given diagrams and radiographs, label the parts of the kidneys, ureters, bladder and urethra.
   2. Explain the function of each organ of the urinary system.
   3. Describe the composition of urine.
   4. Discuss how urine is formed.
   5. Explain micturition

B. Content
   1. Organs, structure and function of
      a. Kidneys
      b. Ureters
      c. Bladder
      d. Urethra
   2. Urine
      a. Physical characteristics
      b. Chemical composition
   3. Micturition

XVI. Reproductive System

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Name the male reproductive organs.
2. Given diagrams, label the parts of the male reproductive organs.
3. Explain the functions of each of the male reproductive organs.
4. Trace the flow of seminal fluid
5. Name the female reproductive organs.
6. Given diagrams, label the parts of the female reproductive organs.
7. Explain the functions of each of the female reproductive organs.
8. Locate and explain the functions of the mammary glands.
9. Describe the hormonal control of breast development.
10. Explain the human reproductive process.
11. Explain the ovarian and menstrual cycles.
12. Describe menopause.

B. Content
1. Male – location, structure and function
   a. External organs
   b. Internal organs
2. Female – location, structure and function
   a. External organs
   b. Internal organs
   c. Mammary glands
   d. Reproductive physiology
      1) Ovarian cycle
      2) Menstrual cycle
      3) Aging and menopause

XVII. Topography

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Given a phantom, identify topographical landmarks for various body areas.

B. Content
1. Landmarks
   a. Cranium
   b. Neck
   c. Spine
   d. Thorax
   e. Abdomen
   f. Pelvis
   g. Extremities
2. Underlying anatomy
   a. Cranium
   b. Neck
   c. Spine

d. Thorax
e. Abdomen
f. Pelvis
g. Extremities

XVIII. Sectional Anatomy

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Given diagrams, computed tomography and magnetic resonance images of the head, label the structures.
2. Given diagrams, computed tomography and magnetic resonance images of the thorax, label the structures.
3. Given diagrams, computed tomography and magnetic resonance images of the abdomen and pelvis, label the structures.
4. Given diagrams, computed tomography and magnetic resonance images of the vertebral column, label the structures.
5. Given diagrams, computed tomography and magnetic resonance images of the extremities, label the structures.
6. Identify imaging modalities that utilize sectional anatomy.

B. Content
1. Head and neck
   a. Structures and locations
   b. Imaging applications
2. Thorax
   a. Structures and locations
   b. Imaging applications
3. Abdomen and pelvis
   a. Structures and locations
   b. Imaging applications
4. Vertebral column
   a. Structures and locations
   b. Imaging applications
5. Extremities
   a. Structures and locations
   b. Imaging applications

Radiographic Procedures

Course Description

This unit is designed to provide the student with the knowledge and skills necessary to perform standard radiographic procedures and a summary knowledge of special studies. Consideration will be given to the production of radiographs of optimal diagnostic quality. Laboratory experience should be used to complement the didactic portion of the course.

Course Outline

1. Introduction to radiographic procedures
2. General considerations
3. Positioning considerations for routine radiographic procedures
4. Positioning considerations for routine contrast studies
5. Procedural considerations for routine special studies

I. Introduction to Radiographic Procedures

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Describe standard positioning terms.
   2. Describe positioning aids used in radiology.
   3. Describe accessory equipment and discuss each in terms of appropriate usage.

B. Content
   1. 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
      c. Erect and upright
         1) Anterior position
         2) Posterior position
         3) Oblique position
      d. General planes
         1) Sagittal or mid-sagittal
         2) Coronal or mid-coronal
         3) Transverse
         4) Longitudinal
      e. Skull lines
         1) Glabellomeatal line
         2) Interpupillary line

3) Orbitomeatal line
4) Infraorbitomeatal line
5) Acanthiomeatal line
6) Glabelloalveolar line

f. Skull points
1) Auricular point
2) Gonion (angle)
3) Mental point
4) Acanthion
5) Nasion
6) Glabella
7) Inne canthus
8) Outer canthus
9) Infraorbital margin

g. Terminology of movement and direction
1) Cephalad/caudad
2) Inferior/superior
3) Promximal/distal
4) Plantar/palmar
5) Pronate/supinate
6) Flexion/extension
7) Abduction/adduction
8) Inversion/eversion

2. Positioning aids
a. Sponges
b. Sandbags
c. Compression bands
d. Restraining devices

3. Accessory equipment
a. Calipers
b. Lead strips
c. Lead shields or shadow shields
d. Lead markers
e. Film holders

II. General Considerations

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Discuss general procedural considerations for radiographic exaministions.
2. Given simulated clinical situations, explain the specific considerations that would be involved.
3. Through role-playing, demonstrate the ability to use the appropriate general considerations in various radiographic procedures with various patient types.

B. Content
1. Evaluation of radiographic orders

a. Patient identification
b. Verification of procedure(s) ordered
c. Review of clinical history

2. 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
3. Establishment of patient rapport
   a. Procedure explanation
   b. Determination of pregnancy
4. Patient preparation
   a. Verification of appropriate dietary preparation
   b. Verification of appropriate medication preparation
   c. Appropriate disrobing and gowning
   d. Removal of potential artifacts
5. Room preparation
   a. Cleanliness, organization, appearance
   b. Necessary supplies and accessory equipment available
6. Patient assistance
7. Patient monitoring
8. Evaluation of radiograph(s)
9. Patient dismissal

III. Positioning Considerations for Routine Radiographic Procedures

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Describe the process for routine and special views for procedures listed below.
   2. Given the names of various procedures, explain what structures an functions are demonstrated.
   3. In the laboratory setting, simulate the radiographic procedure on a person or full body phantom.
   4. Given radiographs, evaluate in terms of: positioning, centering and overall image quality.
   5. Given radiographs, identify relevant anatomy.

B. Content
   1. Patient instructions
   2. Patient positioning
   3. Part placement

4. Film selection and placement
5. Beam alignment and angulation
6. Beam limitation and shielding
7. Special considerations
    a. Atypical patients
    b. Bedside procedures
    c. Surgical unit procedures
8. Application of considerations II.A – II.G and III.A – III.G positioning for the following studies:
    a. Skeletal system
        1) Upper extremity
            a) Phalanges
            b) Metacarpals
            c) Carpals
            d) Forearm (radius/ulna)
            e) Elbow
            f) Humerus
        2) Shoulder girdle
            a) Shoulder
            b) Scapula
            c) Clavicle
            d) Acromioclavicular articulations
        3) Lower extremity
            a) Phalanges
            b) Metatarsals
            c) Tarsals
            d) Calcaneus or os calcis
            e) Ankle
            f) Leg (tibia and fibula)
            g) Knee
            h) Femur
        4) Pelvic girdle
            a) Pelvis
            b) Hip
        5) Spine
            a) Cervical spine
            b) Thoracic spine
            c) Lumbar spine
            d) Sacrum and coccyx
            e) Sacroiliac articulations
        6) Bony thorax
            a) Ribs
            b) Sternum
            c) Sternoclavicular articulations
        7) Skull and facial bones

a) Skull
b) Sella turcica
c) Paranasal sinuses
d) Facial bones
e) Nasal bones
f) Orbits
g) Optic foramina
h) Zygomatic arches
i) Mandible
j) Temporomandibular articulations
k) Mastoids
l) Internal auditory canal

b. Respirator system
1) Chest
2) Lungs

c. Digestive system
1) Abdominal viscera
2) Mesentery

d. Reproductive system
1) Mammography
2) Pelvimetry (as needed)
3) Fetogram (as needed)

IV. Positioning Considerations for Routine Contrast Studies

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Discuss equipment and supplies necessary for each of the studies below.
2. Describe the patient preparation necessary for various contrast studies.
3. Describe the general procedure for each of the radiographic studioes below.
4. Describe the process for routine and special views for the procedures listed below.
5. Given the names of various contrast studies, indicate the contrast medica typically used, the usual dosage and route of administration.
6. In a laboratory setting, simulate the radiographic procedure on a person or full body phantom.
7. Given the names of various procedures, explain what structures and functions are demonstrated.
8. Given radiographs, evaluate in terms of: positioning, centering and overall image quality.
9. Given radiographs, identify relevant anatomy.

B. Content
1. Patient position
2. Part placement
3. Film selection and placement
4. Beam alignment and angulation
5. Beam limitation and shielding

6. Patient instructions
7. Special considerations
    a. Atypical patients
    b. Bedside procedures
    c. Surgical unit procedures
8. Contrast media
    a. Type
    b. Dosage
    c. Administration
9. Application of considerations II.A – II.G and IV.A – IV.H positioning for the following studies:
    a. Gastrointestinal tract
        1) Esophagus
        2) Upper G.I.
        3) Small bowel series
        4) Barium enema
    b. Biliary tract
        1) Oral cholecystogram
        2) T-tube cholangiogram
        3) Operative cholangiogram
        4) Endoscopic retrograde cholangiographic pancreatography (ERCP)
    c. Urinary system
        1) Intravenous pyelogram
        2) Retrograde pyelogram
        3) Retrograde cystogram
        4) Voiding cystourethrogram

V. Procedural Considerations for Routine Special Studies

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Discuss equipment and supplies necessary for each of the studies below.
2. Describe the patient preparation necessary for various special studies
3. Describe the general procedure for each of the radiographic studies below.
4. Given the names of various special studies, list their general purpose and what anatomy and function is demonstrated.
5. Given the names of various special studies, indicate the contrast media typically used, the usual dosage and route of administration.
6. Given various special study images, identify the specific study being done, the structure visualized and the function demonstrated.

B. Content
1. Equipment and materials needed
2. Contrast media
3. General procedure
4. Patient and body part positioning
5. Structures and functions demonstrated

6. Application of above considerations to the following studies:
   a. Arthrography
   b. Bronchography
   c. Dacryocyostography
   d. Hysterosalpingography
   e. Lymphangiography
   f. Myelography
   g. Sialography
   h. Venography

Medical Imaging and Processing

Course Description

This unit will provide the student with the knowledge of factors that govern and influence the production of the radiographic image on radiographic film. Requirements for the processing of radiographic film will be addressed. Film, film holders and intensifying screens will be discussed. Laboratory materials should be utilized to demonstrate clinical applications of the theoretical principles and concepts.

Course Outline

1. Imaging standards
2. Radiographic density
3. Radiographic contrast
4. Recorded detail
5. Distortion
6. Exposure latitude
7. Beam-limiting devices
8. Beam filtration
9. Scattered and secondary radiation
10. Control of exit radiation
11. Exposure systems
12. Exposure calculations
13. Processing are considerations
14. Handling and storage
15. Characteristics of
16. Film holders and
17. The automatic pro
18. Artifacts
19. Silver recovery

I. Imaging Standards

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Discuss practical considerations in setting imaging standards.
   2. Discuss acceptance limits.

B. Content
   1. Practical consideration
   2. Acceptance limits

II. Radiographic Density

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define radiographic density
   2. Identify the acceptable range of radiographic density.
   3. Analyze relationships of factors affecting radiographic density.

B. Content
   1. Definition
   2. Acceptable range
   3. Factors
      a. mAs
      b. kVp
      c. Distance
      d. Intensifying screens
      e. Grids
      f. Beam limitation
      g. Patient considerations
         1) Anatomic part
         2) Pathology
      h. Processing
      i. Contrast media
      j. Filtration
      k. Heel effect
   4. Assessing the quality of density

III. Radiographic Contrast

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define radiographic contrast.
   2. Differentiate between subject contrast and film contrast.
   3. Analyze relationships of factors affecting radiographic contrast.

B. Content
   1. Definition
      a. Scattered radiation
      b. Fog
   2. Types
      a. Long scale
      b. Short scale
   3. Components
      a. Subject
      b. Film
   4. Factors
      a. kVp
      b. mAs
      c. Grids
      d. Beam limitation
      e. Filtration
      f. Film or screen combinations
      g. Patient considerations
         1) Anatomic part
         2) Pathology

h. Distance
i. Processing
j. Contrast Media

IV. Recorded Detail

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Define recorded detail.
2. Differential between umbra and penumbra.
3. Analyze relationships of factors affecting recorded detail.

B. Content
1. Definition
2. Components
   a. Umbra
   b. Penumbra
3. Factors
   a. Geometric unsharpness
      1) Source image distance (SID)
      2) Object image distance (OID)
      3) Focal spot
   b. Materials unsharpness
      1) Intensifying screens
      2) Film
      3) Film – screen contact
      4) Structural shape
   c. Motion unsharpness
      1) Voluntary
      2) Involuntary
      3) Equipment

V. Distortion

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Define distortion.
2. Differentiate between shape distortion and size distortion.
3. Analyze relationships of factors affecting distortion.

B. Content
1. Definition
2. Types
   a. Shape
      1) Foreshortening (alignment)
      2) Elongation (angulation)
3. Size (magnification)
4. Factors
   a. Distance

b. Tube/part/film relationship

VI. Exposure Latitude

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define exposure latitude.
   2. Analyze relationships of factors affecting exposure latitude.

B. Content
   1. Definition
   2. Factors
      a. kVp
      b. Intensifying screens
      c. Film

VII. Beam-Limiting Devices

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. List the types of beam limiting devices and describe the operation and applications for each.
   2. Explain purposes of beam limiting devices in terms of patient dosage, scattered radiation production, radiographic density and contrast.

B. Content
   1. Definition
   2. Purposes
   3. Types
      a. Collimators
         1) Function
         2) Applications
      b. Apertures and diaphragms
         1) Function
         2) Applications
      c. Cones
         1) Function
         2) Applications
      d. Positive beam limitation (PBL)
         1) Function
         2) Applications
      e. Lead blockers and masks
         1) Function
         2) Applications

VIII. Beam Filtration

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define beam filtration.

2. Explain purposes of beam filtration in terms of patient dosage, scattered radiation production, radiographic density and contrast.

B. Content
   1. Definition
   2. Rational
   3. Composition
   4. Types
      a. Inherent
      b. Additional
      c. Total
      d. Compensatory
         1) Construction
         2) Applications
   5. Half Value Layer (HVL)
      a. Definition
      b. Applications
   6. Tenth Value Layer (TVL)
      a. Definition
      b. Applications

IX. Scattered and Secondary Radiation

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define scattered and secondary radiation.
   2. Describe interactions of x-rays with matter that produce scattered and secondary radiation.
   3. Analyze relationships of factors affecting scattered and secondary radiation.
   4. Discuss effects of scattered and secondary radiation in terms of patient dosage, image quality and occupational exposure.

B. Content
   1. Definition
   2. Interactions
   3. Factors
      a. kVp
      b. Patient considerations
      c. Beam limitation
      d. Grids
      e. Distance
      f. Contrast media
   4. Effects
      a. Patient dose
      b. Image quality
      c. Occupational exposure

X. Control of Exit Radiation

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Explain the relationship between kVp and scattered and secondary radiation.
2. Describe a grid in terms of its purpose, components, and construction.
3. Differentiate among types of grids.
4. Analyze grid efficiency in terms of grid ratio and frequency.
5. Given technical information, select an appropriate grid.
6. Define grid cut off.
7. Describe factors influencing grid cut off.
8. Describe various grid artifacts.
9. Explain the relationship between beam limitation and scattered or secondary radiation.

B. Content
1. kVp Section
2. Grids
   a. Purpose
   b. Components
   c. Construction
      1) Canting
      2) Interspace material
   d. Types
      1) Focused
      2) Unfocused (parallel)
   e. Patterns
      1) Linear
      2) Cross hatch
   f. Terms and definitions
      1) Grid focusing distance
      2) Focal distance
      3) Focal range
      4) Convergent line
      5) Convergent point
   g. Efficiency
      1) Radio
      2) Frequency (lines/inch)
   h. Selection
      1) kVp
      2) Patient considerations
      3) Distance
      4) Beam alignment
      5) Latitude
   i. Cut off
      1) Definition
      2) Factors

j. Artifacts
3. Beam limitation

XI. Exposure Systems

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Explain the purpose of an exposure system in terms of standardization of exposure and image consistency.
2. Discuss considerations involved in exposure selection.
3. Distinguish among various types of exposure systems.
4. Given clinical simulations, demonstrate patient measurement and exposure selection.

B. Content
1. Purpose
a. Standardization of exposure
b. Image consistency
2. Considerations
a. Choice of exposure system
b. Patient measurement
c. Processing
3. Types
a. Optimum kVp
b. Variable kVp
c. Automatic exposure control (AEC)
d. Proportional anatomy system
4. Applications

XII. Exposure Calculations

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Analyze relationships of exposure factors and their effects on exposure calculations.
2. Given exposure factors, calculate the photographic effect.
3. Given exposure problems, calculate penumbra, magnification factor, and percent magnification
4. Apply mAs reciprocity to clinical simulations.

B. Content
1. Factors
a. Distance
b. mAs
c. kVp
d. Grids
e. Film and screen combinations
f. Focal spots
2. Calculations

a. Density and contrast
    1) Photographic effect
    2) Visual effect
b. Penumbra
    1) Average gradient
    2) Definition
c. Distortion
    1) Magnification factor
    2) Percent magnification
d. mAs reciprocity
e. Patient dose calculations
    1) Estimating entrance skin exposure (ESE)
    2) Reducing entrance skin exposure
        a) Communication
        b) Positioning
        c) Exposure factors
    3) Discussing benefit versus risk

XIII. Processing Area Considerations

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Discuss aspects of processing area location, construction and function.
2. Explain safe light illumination in terms of definition, filters, bulb size and color and testing for both blue and green sensitive film emulsions.
3. Describe the operation and utilization of day light processing.
4. Discuss processing area ventilation including consideration of temperature control and light proofing.
5. Discuss the location, purpose, function and operation of each piece of processing area equipment and furnishings.

B. Content
1. Location, construction and function
    a. Centralized and decentralized
        1) Size
        2) Location
        3) Convenience
    b. Day light processing
        1) Function and operation
        2) Purpose
    c. Access
        1) Maze
        2) Rotex
        3) Conventional
    d. Staffing
        1) Darkroom assistant
        2) Technologists

e. Ease of operation
    1) Layout
    2) Counter height
    3) Storage

2. Lighting
    a. Safe light illumination
        1) Definition
        2) Filters
        3) Bulb size and color
        4) Testing
    b. Warning lights
    c. Day light processing
        1) Location
        2) Purpose
        3) Function and operation

XIV. Handling and Storage of Film

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Analyze the effects of processing considerations on film quality.
2. Analyze the effects of storage considerations on film quality.

B. Content
1. Processing considerations
    a. Temperature
    b. Humidity
    c. Light
    d. Radiation
    e. Handling
2. Storage considerations
    a. Temperature
    b. Humidity
    c. Light
    d. Radiation
    e. Gases and fumes
    f. Handling
    g. Pressure
    h. Expiration date
        1) Purchase consideration
        2) Maximum storage time

XV. Characteristics of Films Utilized in Radiographic Procedures

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Given cross-sectional diagrams of radiographic film, label the components, and describe the structure and function of each component.

2. Define properties of radiographic film and analyze the influence of each on the resultant image.
3. Relate properties of radiographic film to specific procedure applications.
4. Define latent image formation.
5. Explain how sensitization specks contribute to latent image formation.
6. Define characteristic curve and explain its purpose.
7. Given density values, graph characteristic curves for radiographic film.
8. Given characteristic curves for radiographic film, interpret them.
9. Given characteristic curves for various radiographic film, analyze the curves and evaluate various films for specific procedures.

B. Content
   1. Composition
      a. Components
      b. Structure
      c. Function
   2. Types
      a. Construction
      b. Applications
   3. Properties
      a. Contrast
         1) Definition
         2) Influence
         3) Application
      b. Speed
         1) Definition
         2) Influence
         3) Application
      c. Latitude
         1) Definition
         2) Influence
         3) Application
      d. Recorded detail
         1) Definition
         2) Influence
         3) Application
      e. Latent image formation
         1) Definition
         2) Sensitization specks
            a) Definition
            b) Location
      f. Characteristic curve
         1) Definition and purpose
         2) Sensitometric equipment
         3) Graphing

4) Interpretation
5) Curve construction and graphing
6) Evaluation

XVI. Film Holders and Intensifying Screens

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Discuss various film holders in terms of purpose, construction, application, patient dosage, loading, unloading and maintenance.
2. Explain the construction and purpose of intensifying screens.
3. Describe the principles and function of intensifying screens.
4. Explain classifications of intensifying screens and the applications of each.
5. Discuss the maintenance of intensifying screens in terms of handling, cleaning, testing and evaluation.

B. Content
1. Film holders
   a. Cassettes
      1) Purpose
      2) Construction
      3) Application
      4) Loading and unloading
      5) Maintenance
   b. Disposable
      1) Purpose
      2) Construction
      3) Application
2. Intensifying screens
   a. Purpose
   b. Construction and composition
   c. Principles of function
      1) Fluorescence
      2) Phosphorescence
      3) Quantum mottle
      4) Film and screen contact
      5) Technical influences
   d. Classifications and application
      1) Phosphor
      2) Speed
      3) Patient dosage
   e. Maintenance
      1) Handling
      2) Cleaning
      3) Testing
      4) Evaluation

XVII. The Automatic Processor

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Discuss the purpose of the automatic processor.
2. Given cross-sectional diagrams of automatic processors, label the components and explain the function of each.
3. Describe systems of the automatic processor and functions of each.
4. Given various types and sizes of film, demonstrate how each is fed into the processor.
5. Explain the components of the processing cycle providing the specific action and duration of time for each component.
6. Discuss daily and periodic aspects of processor maintenance and cleaning.
7. Describe the types of artifacts including the cause and effect on a radiograph and methods of preventing each.
8. Given radiographs containing artifacts, identify the type, cause and methods of preventing each.

B. Content

1. Unit
   a. Purpose
   b. Structure
      1) Components
      2) Function
   c. Systems and functions
      1) Chemical
      2) Transport
      3) Replenishment
      4) Recirculation
      5) Temperature control
      6) Wash
      7) Dry
2. Processing cycle
   a. Film feed
      1) Sheet
      2) Roll
   b. Development
      1) Action
      2) Time
   c. Fixer
      1) Action
      2) Time
   d. Wash
      1) Action
      2) Time
   e. Dry
      1) Action

2) Time
f. Film exit
3. Maintenance and cleaning
a. Transport system
b. Replenishment system
c. Circulation
4. Quality control
5. Documentation

XVIII. Artifacts

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Define the term artifact.
2. Describe types of artifacts including the cause and effect on a radiograph and method of prevention for each.
3. Given radiographs containing artifacts, identify the type, cause and methods of prevention for each.

B. Content
1. Definition
2. Types
3. Causes
4. Effects
5. Preventive measures

XIX. Silver Recovery

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Define silver recovery.
2. Explain the rationale for silver recovery.
3. Discuss methods of reclamation including process, advantages and disadvantages of each method.
4. Discuss silver recovery security as it relates to control, theft and misappropriation.

B. Content
1. Definition
2. Rationale
3. Methods
a. Electrolytic
1) Process
2) Advantages
3) Disadvantages
b. Metallic replacement exchange
1) Process
2) Advantages
3) Disadvantages
c. Chemical precipitation

1) Process
2) Advantages
3) Disadvantages

d. Resin
1) Process
2) Advantages
3) Disadvantages

e. Discarded film
1) Unexposed
2) Exposed

4. Security
a. Control
b. Theft
c. Misappropriation

Imaging Equipment

Course Description

This unit will provide the student with knowledge of equipment routinely used to produce diagnostic images. Various recording media and techniques are discussed. Other imaging equipment is described.

Course Outline

1. Radiographic Equipment
2. Image Intensified Fluoroscopy
3. Recording Media and Techniques
4. Specialized Imaging Equipment

I. Radiographic Equipment

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Discuss permanent installation of radiographic equipment in terms of purpose, components, types and applications.
   2. Demonstrate operation of various types of permanently installed radiographic equipment.
   3. Discuss mobile units in terms of purpose, components types and applications.
   4. Demonstrate operation of various types of mobile unit radiographic equipment.
   5. Identify general radiation protection rules related to installation of new radiographic equipment.

B. Content
   1. Permanent installation
      a. Tubes
      b. Collimators
      c. Tables
      d. Control panels
      e. Tube stands
      f. Wall units
      g. Manipulation of equipment
   2. Mobile units
      a. Types
      b. Components
      c. Purpose
      d. Applications

II. Image Intensified Fluoroscopy

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define image intensified fluoroscopy.
   2. Diagram the components of an image intensifier.
   3. Explain the function of an image intensifier.
   4. Discuss gain and conversion factors as related to intensification.

5. Describe the optical system of an image intensifier.
6. Discuss image formation in terms of image size, framing and brightness.
7. Discuss applications of image intensified fluoroscopy and brightness.

B. Content
   1. Definition
   2. Components
      a. Input phosphor
      b. Photocathode
      c. Electron lens
      d. Accerating anode
      e. Output phosphor
   3. Function
   4. Intensification principles
      a. Gain
      b. Brightness
      c. Conversion factor
      d. Automatic brightness control
      e. Resolution
      f. Distortion
      g. Quantum mottle
      h. Noise
      i. Magnification
      j. Minification
      k. Dose
   5. Recording systems
      a. Optical viewing
      b. Video camera and recorder
      c. Spot film
   6. Applications
   7. Operations and technique*

* Fluoroscopy by radiographers shall follow state statues. In states and institutions where it is a standard of practice for the radiographer to perform fluoroscopy, this technique must be taught. Where this subject area is included in the curriculum, the program has specific ethical and legal responsibilities to the patient and student. The student shall be assured that:

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

III. Recording Media and Techniques

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Discuss the purpose, construction and application of video tubes.
2. Describe the purpose, construction and application of video recorders.
3. Discuss the purpose, construction and application of cine radiographic equipment and processor.
4. Describe the purpose, construction and application of strip and cut film cameras.
5. Discuss the purpose, construction and application of automatic film changers.
6. Describe the purpose, equipment, film and procedures of duplication and subtraction.
7. Discuss the purpose and procedure of radiographic magnification.
8. Discuss the purpose, principles, motions, equipment, procedure and application of conventional tomography.

B. Content

1. Video tubes
   a. Purpose
   b. Construction
   c. Applications
2. Video recorders
   a. Purpose
   b. Construction
   c. Applications
3. Strip and cut film and cameras
   a. Purpose
   b. Construction
   c. Applications
4. Cline radiography
   a. Purpose
   b. Construction
   c. Applications
   d. Processor
5. Automatic Film Changers
   a. Purpose
   b. Types
   c. Construction
   d. Applications
6. Duplication and subtraction
   a. Purpose
   b. Equipment and film
   c. Procedures
7. Conventional tomography
   a. Purpose
   b. Principles
   c. Motions

d. Equipment
e. Procedure
f. Application

8. Radiographic magnification
   a. Purpose
   b. Procedure

IV. Specialized Imaging Equipment

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Discuss specialized imaging equipment in terms of its purpose, principles of operation, equipment and material required and procedures.

B. Content
   1. Computed tomography
      a. Purpose
      b. Principles
      c. Equipment and material
      d. Procedure
   2. Computed (digital) imaging
      a. Purpose
      b. Principles
      c. Equipment and material
      d. Procedure
   3. Magnetic resonance imaging
      a. Purpose
      b. Principles
      c. Equipment and material
      d. Procedure

Evaluation of Radiographs

Course Description

Throughout the educational period, students should participate in regular, formal sessions for radiographic film evaluation. These sessions should be conducted under the supervision of the faculty. As the student progresses through the curriculum, the complexity of radiographs to be evaluated and the level of critique should increase.

Course Outline

1. Implementing Imaging Standards
2. Technical Factors
3. Procedural Factors
4. Equipment Malfunctions

I. Implementing Imaging Standards

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Discuss the elements of a diagnostic image as related to film critique.
   2. Identify the steps in the decision-making process.
   3. Describe an effective film critique method.
   4. Describe the role of the radiographer in film critiquing.

B. Content
   1. Purpose
   2. Factors affecting quality
   3. Effective film critique method
      a. Classification of image
      b. Determination of the cause of the problem
      c. Recommendations for corrective actions
   4. Radiographers role in film critique

II. Technical Factors

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Explain the process for evaluating radiographs for adequate density, contrast and scale of contrast.
   2. Explain how the radiographers determines if adequate penetration is present along with subject contrast.
   3. List the parameters for evaluating visibility of detail on radiographs.
   4. Describe how the degree of image distortion may be evaluated.
   5. Explain possible causes for image distortion.

B. Content
   1. Density
   2. Contrast
   3. Recorded detail
   4. Distortion

III. Procedural Factors

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Describe the importance of proper positioning.
2. Describe how properly preparing a patient affects the quality of the image.
3. Describe the method for assessing beam restriction.

B. Content
1. Film identification
   a. Patient information
   b. Date of examination
   c. Procedure(s) performed
   d. Proper use of identification makers
2. Positioning
   a. Anatomy
   b. Anatomical variations
   c. Body habitus
   d. Positioning aids
   e. Factors
      1) Central ray placement
      2) Beam alignment and angulation
      3) Body part rotation
      4) Plane and baseline reference
3. Patient preparation
4. Radiation protection
   a. Film size
   b. Film and screen combination
   c. Collimation
   d. Shielding
   e. Repeats

IV. Equipment Malfunctions

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Describe common equipment malfunctions that affect image quality.
2. Describe the corrective actions necessary for common equipment malfunctions.
3. Explain the differences between technical factor problems, procedural factor problems and equipment malfunctions.

B. Content
1. Radiographic and fluoroscopic unit
2. Film processor

Radiation Physics

Course Description

This unit will provide the student with knowledge of basic physics. Fundamentals of x-ray generating equipment are discussed. Information on s-ray production, beam characteristics and units of measurement is provided.

Course Outline

1. Units of Measurement
2. General Principles
3. Structure of Matter
4. Structure of the Atom
5. Nature of Radiation
6. Electrostatics
7. Electrodynamics
8. Magnetism
9. Electromagnetism
10. Rectification
11. Diagnostic X-Ray Tubes
12. X-Ray Circuits
13. Production and Characteristics of Radiation

I. Units of Measurement

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. State the fundamental units of the English, Metric and SI systems.
   2. Define derived units of the English, Metric and SI systems.
   3. Given problems, covert units from one system to the other.

B. Content
   1. Fundamental units
      a. Length
      b. Mass
      c. Time
   2. Derived units
      a. Area
      b. Volume
      c. Density
      d. Specific gravity
      e. Velocity
   3. Systems of measurement
      a. English
      b. Metric
      c. SI

II. General Principles

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define and describe the general principles that relate to inertia, work, energy and momentum.
   2. Define derived units of the English and Metric systems.
   3. Given problems, convert units from one system to the other.

B. Content
   1. Mass
      a. Inertia
      b. Momentum
   2. Force
      a. Work
      b. Power
   3. Energy
      a. Definition
      b. Types
         1) Mechanical
            a) Potential
            b) Kinetic
         2) Chemical
         3) Thermal
         4) Electrical
         5) Nuclear
         6) Electromagnetic
   4. Relationship between matter
   5. Forces of nature
      a. Gravitational
      b. Electrical
      c. Magnetic
      d. Nuclear

III. Structure of Matter

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define mixture.
   2. Describe the characteristics and give an example of a mixture.
   3. Define substance and give an example of a substance.
   4. Define element.
   5. Describe the characteristics of an element using the periodic table.
   6. Define compound and give an example of a compound.
   7. Describe the characteristics of a molecule.

B. Content
   1. Mixtures
      a. Definition
      b. Examples

2. Substance
    a. Definition
    b. Examples
3. Compound
    a. Definition
    b. Examples
4. Elements
    a. Definition
    b. Periodic table
    c. Nuclides

IV. Structure of the Atom

A. Objectives: Following the completion of this unit, the student radiographer will:
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. Define the terms relating to atomic nomenclature.
5. Compare covalent bonding to ionic bonding.
6. Explain the process of ionization.

B. Content
1. Atom
    a. Size
    b. Atomic mass
    c. Atomic energy
2. Nucleus
    a. Components
        1) Proton
        2) Neutron
        3) Other
    b. Structure
        1) Size
        2) Neutron and proton ratio
        3) Binding energy
3. Electron shells
    a. Components
    b. Arrangements
        1) Binding energy
        2) Movement
        3) Ionization
        4) Excitation
4. Nomenclature
    a. Atomic number
    b. Mass number
    c. Isotope

d. Isobar
e. Isomer
f. Isotone
g. Ion

V. Nature of Radiation

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Describe the nature of light.
2. Define and describe wavelength and frequency and how they are related to velocity.
3. Describe the electromagnetic spectrum.
4. Explain the relationship of energy and frequency to Planck's Constant.

B. Content
1. Radiation
   a. Electromagnetic
      1) Spectrum
      2) Wave theory
      3) Particle theory
      4) Properties
      5) Ionization and excitation
   b. Particulate
      1) Types
      2) Characteristics
   c. Non-ionizing versus ionizing
      1) Z#
      2) Energy
      3) Probability
2. Radioactivity
   a. Historical introduction
   b. Half-life (T½)
   c. Units
      1) Curie (Ci)
      2) Becquerel (Bq)
   d. Line of stability

VI. Electrostatics

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Define electrical charge and describe its source.
2. Define electrical field and describe its source.
3. Explain methods of electrification.
4. Explain the Laws of Electrostatics and their application.

B. Content
1. Electrical charge

a. Definition
b. Source
c. Unit of charge (Coulomb)

2. Electrical field
   a. Definition
   b. Source
3. Methods of electrification
   a. Friction
   b. Contact
   c. Induction
4. Laws of Electrostatics

VII. Electrodynamics

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Define potential difference, current, resistance, circuit and electric power.
2. Describe the characteristics of direct and alternating currents.
3. Given a schematic diagram of a resistance circuit, label the parts.
4. Identify and apply Ohm's Law to resolve direct current problems.
5. Identify and apply power formulas to determine power consumed.
6. Describe electrical measuring devices.
7. Given a schematic diagram of a circuit, label the electrical measuring devices.
8. Describe electrical protective devices.

B. Content
1. Moving charges
   a. Potential differences
   b. Current
      1) Direct
      2) Alternating
   c. Resistance
   d. Circuit
2. Measuring devices
   a. Galvanometer
   b. Ammeter
   c. Voltmeter
   d. Electrometer
   e. Other
3. Protective Devices
   a. Fuse
   b. Ground
   c. Circuit breaker
   d. Other

VIII. Magnetism

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Discuss the properties of magnetism.
2. Discuss the laws of magnetism.
3. Discuss the domain theory.
4. Relate the electronic spin of an element to its potential magnetic properties.
5. Explain the principle of magnetic induction.
6. Given the list of materials, classify according to magnetic characteristics.

B. Content
   1. Properties
      a. Poles
      b. Fields
      c. Laws
   2. Domain Theory
      a. Electron spin
      b. Arrangement
   3. Induction
      a. Principle
      b. Methods
      c. Material classification

IX. Electromagnetism

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Explain the interaction between electric and magnetic fields.
   2. Discuss types of electronmagnetic induction.
   3. Describe types and functions of generators, motors, transformers and rectification systems.
   4. Compare single phase, three phase, high frequency and falling load generators in terms of radiation production and efficiency.

B. Content
   1. Interaction between electric and magnetic fields
   2. Induction
      a. Self
      b. Mutual
   3. Applications
      a. Generators
         1) Types
         2) Function
      b. Motors
         1) Types
         2) Function
      c. Transformers
         1) Types
         2) Function
      d. Coils

1) Types
2) Function

X. Rectification

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Define rectification.
2. Explain the purpose of rectification.
3. Compare solid state and vacuum tube rectification in terms of function and advantages and disadvantages.

B. Content
1. Definition
2. Purpose
3. Solid State
   a. Function
   b. Advantages and disadvantages
4. Types
   a. Full wave
   b. Three phase

XI. Diagnostic X-Ray Tubes

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Discuss the characteristics of a rotating anode in terms of description and function.
2. Discuss the characteristics of a cathode in terms of description and function.
3. Discuss the construction characteristics of tube housing in terms of description and function.
4. Discuss the characteristics of cables in terms of description and function.
5. Given a diagram of an x-ray tube, label the parts.
6. Given tube rating charts, determine maximum allowable exposure factors for various radiographic procedures.
7. Given simulated exposure factors, use an anode cooling chart to determine the anode cooling rate.
8. Given simulated exposure factors and a cooling chart, determine heat units and cooling characteristics of x-ray tube housings.
9. Describe methods to extend tube life.

B. Content
1. Construction
   a. Anode
      1) Description
      2) Function
      3) Stationary and rotating
   b. Cathode
      1) Description
      2) Function

c. Tube housing
    1) Description
    2) Function
2. Thermal capacity
    a. Tube rating
    b. Anode cooling
    c. Housing cooling
3. Extending tube life
    a. Warm-up procedures
    b. Rotor considerations
    c. Filament considerations
    d. Tube loading
    e. Tube movement

XII. X-Ray Circuits

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Describe the components of a primary x-ray circuit and explain the function of each component.
2. Describe the components of a secondary x-ray circuit and explain the function of each component.
3. Describe the components of an x-ray filament circuit and explain the function of each component.
4. Given a simple diagram of a complete x-ray circuit, label the parts.
5. Discuss the components and application of automatic exposure devices.

B. Content
1. Primary circuit
    a. Components
    b. Function
2. Secondary circuit
    a. Components
    b. Function
3. Filament circuit
    a. Components
    b. Function
4. Three-phase circuit
    a. Components
    b. Function
5. Automatic exposure devices
    a. Ionization chambers
    b. Maximum reaction time
    c. Back-up time
    d. Positioning considerations
        1) Cell location
        2) Cell size

3) Cell sensitivity

XIII. Production and Characteristics of Radiation

A. Objectives: Following the completion of this unit, the student radiographer will:

1. State the principles of x-ray production.
2. Compare the production of brensstrahlung with the production of characteristic radiations.
3. Describe the conditions necessary to produce x-radiation.
4. Discuss various photon interactions in terms of description of interaction, relation to atomic number and applications.
5. Define photodisintegration.
6. Discuss relationships of wavelength and frequency to beam characteristics.
7. Define units of radiation measurement and provide an example of its application.

B. Content

1. X-ray production
   a. Historical introduction
   b. Principles
   c. Processes
      1) Brensstrahlung
      2) Characteristics
      3) Percentage relationship with energy
   d. Necessary conditions
      1) Source
      2) Acceleration
      3) Deceleration
   e. X-ray energy spectra
      1) Unfiltered
      2) Filtration
         a) Inherent
         b) Added
      3) Effect in output
   f. Factors affecting x-ray exposure rate
      1) Tube potential
      2) Tube current
      3) Filament current
      4) Time
      5) Distance
      6) Filtration
   g. Efficiency in production.
2. Interactions of photons with matter
   a. Transmission
   b. Unmodified scattering (coherent)
      1) Description of interaction
      2) Relation to atomic number

3) Energy of incident photon and resulting product
4) Probability
5) Application

c. Photoelectric effect
1) Description of interaction
2) Relation to atomic number
3) Energy of incident photon and resulting product
4) Probability
5) Application

d. Compton scattering
1) Description of interaction
2) Relation to atomic number
3) Energy
4) Probability
5) Application

e. Pair production
1) Description of interaction
2) Relation to atomic number
3) Energy
4) Probability
5) Application
6) Annihilation reaction

f. Photodisintegration
1) Description of interaction
2) Energy
3) Products
4) Application

3. Clinical significance and relative importance of the various types of interactions
4. Beam characteristics
a. Energy
b. Attenuation
5. Measurement of radiation
a. Absorbed dose
1) Definition
2) SI unit

b. Dose equivalent
1) Definition
2) SI unity

c. Exposure (quality)
1) Definition
2) SI unit

d. Instruments
1) Free air ionization chamber
2) Thimble chamber
3) Condenser chamber

4) Electrometers
5) Other chambers

Radiation Protection

Course Description

This unit will provide the student with an overview of the principles of radiation protection. Radiation protection responsibilities of the radiographer for patients, personnel and the public is presented. The concepts of As Low As Reasonably Achievable (ALARA), Negligible Individual Risk Level (NIRL) and stochastic and non-stochastic effects will be discussed. Regulatory agencies will be identified and agency involvement in radiation protection will be discussed.

Course Outline

1. Introduction
2. Units for Detection and Measurement
3. Surveys, Regulatory Agencies and Regulations
4. Personnel Monitoring and Occupational Exposures
5. Patient Protection
6. Practical Radiation Protection

I. Introduction

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Identify and justify the need to minimize unproductive radiation exposure of humans.
2. Define and distinguish between somatic and genetic radiation effects (immediate and latent), provide examples.
3. Differentiate between the stochastic and non-stochastic effects of radiation exposure, provide examples.
4. List the objectives of a radiation protection program and demonstrate the ability to document same.
5. Identify effective dose equivalent limits for occupational and nonoccupational radiation exposure.
6. Identify the acronym "ALARA" and describe the concept (optimization).
7. Identify the basis for occupational exposure limits: comparable risk
8. Describe the concept of negligible individual risk level (NIRL).
9. Identify ionizing radiations from natural and man-made sources and list their approximate dose equivalent contribution.
10. Identify legal and ethical radiation protection responsibilities of radiation workers.

B. Content

1. Justification for radiation protection
2. Biologic damage potential of ionizing radiation
   a. Somatic effects
   b. Genetic effects
   c. Stochastic and non-stochastic effects
3. Objectives of a radiation protection program
   a. Documentation
   b. Occupational and nonoccupational dose equivalent limits

c. ALARA concept (optimization)
d. Comparable risk
e. Negligible individual risk level (NIRL)

4. Sources of radiation
   a. Natural
   b. Man-made (artificial)
5. Legal and ethical responsibilities

II. Units for Detection and Measurement

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Identify and define units of radiation for exposure, absorbed dose, dose equivalent and radioactivity.
2. Define and describe the interrelationship between relative biological effectiveness and quality factors.
3. Describe how the quality factor is used to determine dose equivalent.
4. State why the Sievert is the appropriate unit for radiation protection work.
5. Describe the theory and operation of the following radiation detection devices:
   a. Ion-chambers
   b. Proportional counters
   c. Thermoluminescent dosimeters (TLD's)
6. List appropriate applications and limitations for each radiation detection device above.

B. Content

1. Physical unit of exposure
2. Biologic unit of dose
3. Unit of dose equivalent
   a. Recommendations for effective dose equivalent limits
   b. Quality factors
4. Physical unit of radioactivity
5. Measurement devices: (principle, application and types)
   a. Ion chambers
   b. Proportional counters
   c. Thermoluminescent dosimeter
   d. Other

III. Surveys, Regulatory Agencies and Regulations

A. Objectives: Following the completion of this unit, the student radiographer will:

1. State when a radiation protection survey should be conducted.
2. Identify who should conduct the survey.
3. Describe the conditions under which radiation protection surveys of equipment are made.
4. Identify various performance standards for beam directing, beam defining and beam limiting devices which are evaluated in a radiation protection equipment survey of the following:

a. Radiographic equipment
b. Fluoroscopic equipment

5. Describe procedures used to verify performance standards for equipment in #4, indicate potential consequences of performance standards failure.
6. Describe the operation of various interlocking systems for equipment in #4, indicate potential consequences of interlock system failure.
7. List conditions and locations evaluated in an area survey for radiation protection.
8. Distinguish between controlled and non-controlled areas ad list acceptable exposure levels.
9. Describe "RADIATIION AREA" signs and identify appropriate placement sites.
10. Identify the functions of the following agencies:
    a. International Council on Radiation Protection and Measurements (ICRP)
    b. National Council on Radiation Protection and Measurements (NCRP)
    c. Nuclear Regulatory Commission (NRC)
11. Discuss the Consumer-Patient Radiation Health and Safety Act of 1981.
12. Describe the function of various state and local regulations governing radiation protection practices.
13. Describe the requirements and responsibilities for a radiation protection officer.

B. Content
1. General survey procedures
    a. Qualified expert
    b. Records
2. Equipment survey
    a. Conditions
    b. Radiographic and fluoroscopic equipment
3. Area survey
    a. Controlled and uncontrolled areas
    b. Conditions
    c. Recommendations
    d. "RADIATION AREA" sign posting
4. Regulatory agencies
    a. International Council on Radiation Protection and Measurements (ICRP)
    b. National Council on Radiation Protection and Measurements (NCRP)
    c. Nuclear Regulatory Commission (NRC)
    d. The Consumer-Patient Radiation Health and Safety Act of 1981
    e. State agencies
5. Radiation protection officer
    a. Requirement
    b. Responsibilities

IV. Personnel Monitoring and Occupational Exposures

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Identify the need and importance of personnel monitoring for radiation workers.
2. Identify and describe the following monitoring devices:

a. Body badge, ring badge
b. Thermoluminescent dosimeters (TLD's)
c. Pocket ionization chambers

3. List applications, advantages and limitations for each device in #2.
4. Interpret personnel monitoring reports.
5. List values for maximum permissible dose equivalent limits for occupational radiation exposures (annual and lifetime).
6. Identify those structures that are considered critical for potential late effects for whole body irradiation exposure.
7. Identify dose equivalent limits for embryo and fetus in occupationally exposed women.
8. State the age proration formula for the determination of a maximum accumulated dose equivalent.

B. Content

1. Historical perspective
   a. Evolution of standards
   b. Public Law 97-35 (The Patient Consumer Radiation Health and Safety Act of 1981)
   c. Public awareness
   d. NCRP recommendations
   e. ICRP recommendations
2. Requirements for personnel monitoring
3. Methods and types of personnel monitors
   a. Film badge
      1) Body badge
      2) Ring badge
   b. Thermoluminescent dosimeters (TLD's)
      1) Components
      2) Advantages and disadvantages
   c. Pocket ionization chambers
      1) Components
      2) Advantages and disadvantages
   d. Other
4. Records of accumulated dose
   a. Purpose
   b. Content
5. Dose equivalents
   a. Occupational
   b. Nonoccupational limits
   c. Critical organ sites
   d. Embryo-fetus
   e. Age proration formula
6. Responsibilities for radiation protection
   a. Radiographer

b. Radiation safety officer
c. Facility

V. Patient Protection

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Explain the relationship of beam limiting devices to patient radiaition protection.
2. Discuss added and inherent filtration in terms of the effect on patient dosage.
3. Explain the purpose and importance of patient shielding.
4. Given a list of patient shielding devices and radiographic procedures, correlate the method of shielding to the radiographic procedure.
5. Explain the ten-day rule and its application to female patients of childbearing age.
6. Explain the relationship of exposure factors to patient dosage.
7. Given various radiographic procedures, state the desired film and screen combination that will result in an optimum diagnostic image with the minimum radiation exposure to the patient.
8. Discuss methods to avoid repeat radiographs.
9. Discuss the importance of clear, concise instructions (effective communication skills) as a method of radiation protection.
10. Discuss the effect(s) of immobilization techniques to eliminate voluntary motion.
11. Describe the minimum source-to-tabletop distances for fixed and mobile fluoroscopes
12. Discuss safety factors for the patient (and other patients) in the room during mobile radiographic procedures.

B. Content

1. Effective communication
   a. Radiographer
   b. Patient
2. Beam limiting devices
   a. Collimators
   b. Cones
   c. Diaphragms
3. Filtration
4. Shielding (gonadal)
   a. Flat contact shields
   b. Shadow shields
   c. Shaped contact shields
5. Ten-day rule
6. Exposure factors
7. Film and screen combinations
8. Repeat radiographs
   a. Motion
   b. Radiographic processing
   c. Carelessness or poor judgment
9. Immobilization

10. Fluoroscopic procedures
11. Mobile radiography

VI. Practical Radiation Protection

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Identify barrier materials and their use in specific x-ray installations.
2. Distinguish between primary and secondary barriers.
3. Describe how the following factors influence the design of x-ray installations:
   a. Use (U)
   b. Workload (W)
   c. Occupancy (T)
   d. Distance (d)
   e. Material
4. Describe how the operation of various ancillary equipment influences radiation safety and describe the potential consequences of failure of this equipment.
5. Describe how the operation of various x-ray equipment influences radiation safety and describe the potential consequences of failure of this equipment.
6. Identify who should evaluate the ancillary and x-ray equipment and indicate the frequency with which these evaluations should be made, indicate how this is related to the Quality Assurance Program for radiation safety.
7. Demonstrate how time, distance and shielding can be manipulated to keep radiation exposures to a minimum.
8. Perform calculations of exposure with varying time, distance and shielding.
9. Discuss the relationship between half-value layer and shielding design.
10. Identify emergency procedures to be followed during failures o x-ray mechanisms.

B. Content
1. Design
   a. Barriers
      1) Materials
      2) Primary
      3) Secondary (scatter and leakage)
      4) Mazes, doors, conduits and ducts
   b. Factors
      1) Use (U) controlled and uncontrolled
      2) Workload (W)
      3) Occupancy (T)
      4) Distance (d)
   c. Safety (ancillary equipment)
      1) Interlocks
      2) Visual monitors
      3) Audio monitors
      4) Emergency controls
      5) Quality assurance
   d. X-ray equipment safety

1) Beam defining equipment
    a) Collimators
    b) Cones
    c) Diaphragms
    d) Lead markers and blockers
2) Exposure control devices
3) On and off switches
4) Performance standards per design specifications
5) Calibrations
6) Quality assurance.

2. Regulations and recommendations

   Note: NRC regulations and NCRP recommendations identify numerous practical items that are appropriate, in content, to this outline. These items are too numerous, for individual inclusion. These items can be found in the Nuclear Regulatory Commission, Code of Federal Regulations (10 CFR Parts 19, 20, 21, 30, 36, 40, 51, 70 and 170) in NCRP reports #37, 40, 49, 53, 54, 57, 64, 69, 82, 91, 102 and 105.

3. Cardinal principles in protection
   a. Time
   b. Distance
   c. Shielding
4. Emergency procedures

Radiation Biology

Course Description

This unit will provide the student with an overview of the principles of the interaction of radiation with the living systems. Radiation effects on biological molecules and organisms and factors affecting biological response are presented. Acute and chronic effects of radiation are discussed.

Course Outline

1. Introduction
2. Biophysical Events
3. Radiation Effects
4. Radiosensitivity and Response

I. Introduction

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Identify important functions of organic and inorganic cell constitutents.
   2. List and describe the function of various cell structures and organelles.
   3. Describe the structure and function of the nucleus.
   4. Identify events occurring in mitosis and meiosis and describe each process.
   5. List the sequence of events in the cell cycle.
   6. Define differentiation.
   7. Distinguish between ionizing and non-ionizing radiations.
   8. Identify sources of electromagnetic and particulate ionizing radiations.
   9. Define directly ionizing radiations.
   10. Define indirectly ionizing radiations.
   11. Identify sources of radiation exposure.

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

2. Types of ionizing radiations
    a. Electromagnetic radiations
        1) X-rays
        2) Gamma rays
    b. Particulate radiations
        1) Electrons
        2) Neutrons
        3) Protons
    c. Absorption and ionization
        1) Directly ionizing radiations
        2) Indirectly ionizing radiations
3. Sources of medical radiation exposure
    a. Diagnostic radiology
    b. Dental radiology
    c. Therapeutic radiology
    d. Nuclear medicine

II. Biophysical Events

A. Objectives: Following the completion of this unit, the student radiographer will:
1. Identify and distinguish between the physical and biologic units of radiation dose.
2. Identify radiation induced chemical reactions resulting in the production of free radicals.
3. Describe how free radical production causes biologic damage.
4. Define LET and RBE.
5. List and describe factors that influence RBE.

B. Content
1. Specification of radiation quantities
    a. Physical units
    b. Biologic units
        1) Gray (Gy)
        2) Sievert (Sv)
2. Molecular effects of radiation
    a. Radiololysis of water
    b. Target theory
        1) Target molecules
        2) Cell death
3. The deposition of radiant energy
    a. Linear energy transfer (LET)
    b. Relative biological effectiveness (RBE)
    c. Factors influencing RBE
        1) LET
        2) Oxygen

III. Radiation Effects

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Identify and describe types of biologic effects from radiation at the subcellular level.
2. State how subcellular radiation effects are expressed in humans.
3. Identify and describe types of biologic effects from radiation at the cellular level.
4. State how cellular radiation effects are expressed in humans.
5. Define somatic, stochastic and genetic radiation effects.
6. Identify specific diseases or syndromes associated with the effects in #5.
7. Identify methods to measure radiation response.
8. List physical, chemical and biologic factors influencing response.
9. Distinguish between lethal and sublethal response and identify factors which influence response.

B. Content

1. Subcellular radiation effects
   a. Radiation effects of DNA
      1) Types of damage
      2) Implications in humans
   b. Radiation effects of chromosomes
      1) Types of damage
      2) Implications in humans
2. Cellular radiation effects
   a. Types of cell death
      1) Interphase death
      2) Mitotic (genetic) death
   b. Other effects
      1) Mitotic delay
      2) Reproductive failure
      3) Interference of function
3. Individual radiation effects
   a. Somatic effects
      1) Short term
      2) Long term
      3) Stochastsic effects
   b. Genetic effects
      1) Mutagenesis
4. Factors influencing radiation response
   a. Determining response
   b. Factors influencing response
   c. Lethal and sublethal response

IV. Radiosensitivity and Response

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Define radiosensitivity.

2. Describe how the radiosensitivity of tissues relate to mitotic rate and degree of differentiations.
3. List factors influencing radiosensitivity.
4. Identify various survival curve parameters.
5. State how LET, oxygen and fractionation influence the shape of survival curves.
6. Describe the clinical implications of those factors that influence survival curves.
7. Associate the expected responses to radiation with the appropriate dose levels for the various systems listed above.
8. Identify the factors influencing the degree of response.
9. Define and distinguish between the different levels of tolerance above.
10. State the clinical significance of $LD_{30/50}$ and LD_{30}.
11. Identify factors influencing tolerance at various tissue.
12. Given specific tissue sites, state the tolerance dose.
13. Describe conditions which result in a radiation syndrome.
14. Associate the various stages of a radiation syndrome with the appropriate dose levels.
15. Describe factors which influence responses in a radiation syndrome.
16. Identify possible medical interventions used to modify a radiation syndrome.
17. Define and identify possible radiation induced somatic effects.
18. Define and identify possible radiation induced stochastic effects.
19. Define and identify possible radiation induced genetic effects.

B. Content
   1. Law of Bergonie and Tribondeau
      a. Differentiation
      b. Mitotic rate
      c. Metabolic rate
   2. Cell survival curves
      a. Typical survival parameters
         1) Slope
         2) Shoulder
         3) Quasi-threshold
      b. Factors influencing survival curves
         1) LET
         2) Oxygen
         3) Franctionation
   3. Systemic response to radiation
      a. Hemopoietic system
      b. Skin
      c. Digestive
      d. Urinary
      e. Respiratory
      f. Reproductive
      g. Nervous
      h. Other

4. Tolerance dose
    a. Minimum
    b. Maximal
    c. Mean
5. Total body irradiation
    a. Radiation syndromes
        1) Acute
        2) Hemopoietic
        3) Gastrointestinal
        4) Central nervous system
    b. Stages of response and dose levels
    c. Factors influencing response
    d. Medical interventions of response
6. Late effects of radiation
    a. Somatic responses
        1) Mutagenesis
        2) Carcinogenesis
    b. Stochastic effects
    c. Genetic effects
    d. Occupational risks of radiation workers
    e. Carcinogenesis

Radiographic Pathology

Course Description

This unit will provide the student with an introduction to the concepts of disease. Pathology and disease, as it relates to various radiographic procedures, will be discussed.

Course Outline

1. Introduction to Pathology
2. Trauma and Physical Injury
3. Systemic classifications of Disease
4. Repair and Replacement of Tissue

I. Introduction to Pathology

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define terms related to pathology.
   2. Discuss manifestations of pathological conditions and their relevance to radiolographic procedures.

B. Content
   1. Definitions
      a. Pathology
      b. Disease
         1) Acute
         2) Chronic
      c. Pathogenesis
      d. Etiology
      e. Trauma
      f. Syndrome
      g. Diagnosis
         1) Signs (objective)
         2) Symptoms (subjective)
      h. Prognosis
   2. Purpose of study
      a. Manifestations of pathology
      b. Relevance to radiographic procedures

II. Trauma and Physical Injury

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. List the classifications of trauma and define each.
   2. Describe examples, sites, complications and prognosis for classifications of trauma.
   3. Discuss radiographic diagnosis for classifications of trauma.

B. Content
   1. Definition
   2. Classifications

a. Mechanical
    1) Definition
    2) Examples and sites
    3) Complications
    4) Prognosis
b. Chemical
    1) Definition
    2) Examples and sites
    3) Complications
    4) Prognosis
c. Thermal
    1) Definition
    2) Examples and sites
    3) Complications
    4) Prognosis
d. Radiation
    1) Definition
    2) Examples and sites
    3) Complications
    4) Prognosis
e. Other
    1) Definition
    2) Examples and sites
    3) Complications
    4) Prognosis

3. Radiographic diagnosis

III. Systemic Classifications of Disease

A. Objectives: Following the completion of this unit, the student radiographer will:
1. List the systemic classifications of disease and define each.
2. For each of the systemic classifications of disease, describe etiology, examples and sites, complications and prognosis
3. Describe radiographic procedures and techniques appropriate for different examples of disease in each of the systemic classifications.

B. Content
1. Skeletal and articular
    a. Definition
    b. Etiology
    c. Examples and sites
    d. Complications
    e. Prognosis
    f. Radiographic procedures
    g. Effects on radiographic technique
2. Muscular

a. Definition
b. Etiology
c. Examples and sites
d. Complications
e. Prognosis
f. Radiographic procedures
g. Effects on radiographic technique

3. Digestive
   a. Definition
   b. Etiology
   c. Examples and sites
   d. Complications
   e. Prognosis
   f. Radiographic procedures
   g. Effects on radiographic technique
4. Respiratory
   a. Definition
   b. Etiology
   c. Examples and sites
   d. Complications
   e. Prognosis
   f. Radiographic procedures
   g. Effects on radiographic technique
5. Urinary
   a. Definition
   b. Etiology
   c. Examples and sites
   d. Complications
   e. Prognosis
   f. Radiographic procedures
   g. Effects on radiographic technique
6. Reproductive
   a. Definition
   b. Etiology
   c. Examples and sites
   d. Complications
   e. Prognosis
   f. Radiographic procedures
   g. Effects on radiographic technique
7. Circulatory
   a. Definition
   b. Etiology
   c. Examples and sites
   d. Complications
   e. Prognosis

f. Radiographic procedures
g. Effects on radiographic technique

8. Lymphatic
   a. Definition
   b. Etiology
   c. Examples and sites
   d. Complications
   e. Prognosis
   f. Radiographic procedures
   g. Effects on radiographic technique
9. Endocrine
   a. Definition
   b. Etiology
   c. Examples and sites
   d. Complications
   e. Prognosis
   f. Radiographic procedures
   g. Effects on radiographic technique
10. Nervous
    a. Definition
    b. Etiology
    c. Examples and sites
    d. Complications
    e. Prognosis
    f. Radiographic procedures
    g. Effects on radiographic technique
11. Sensor Organs
    a. Definition
    b. Etiology
    c. Examples and sites
    d. Complications
    e. Prognosis
    f. Radiographic procedures
    g. Effects on radiographic technique

IV. Repair and Replacement of Tissue

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Discuss the causes of tissue disruption and for the different causes, describe the process and give examples.
   2. Describe the healing process.
   3. Discuss complications connected with the repair and replacement tissue.

B. Content
   1. Causes
      a. Pathological

        1) Process
        2) Examples
    b. Traumatic
        1) Process
        2) Examples
    c. Surgical
        1) Process
        2) Examples
2. The healing process
3. Complications

Introduction to Quality Improvement

Course Description

This unit will provide the student with an introduction to the evaluation of radiographic systems to assure quality in the delivery of all aspects of radiologic services. The components involved in the quality improvement system will be identified. State, federal and professional impacts will be described. Equipment quality control will be discussed including tests to evaluate specific components.

Course Outline

1. Quality Improvement Concepts
2. State, Federal and Professional Standards and Regulations
3. Equipment Quality Control

I. Quality Improvement Concepts

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define quality improvement, quality assurance and quality control.
   2. Discuss the benefits of a quality improvement program to the patient and to the department.
   3. List elements of a quality improvement program and discuss how each is related to the quality improvement program.
   4. Discuss the importance of continuing education in regard to the rapid advancement of technology.
   5. Identify and describe each of the steps used in the JCAHO 10-step model as applied to quality improvement.

B. Content
   1. Definitions
      a. Quality improvement
      b. Quality assurance
      c. Quality control
   2. Benefits
      a. Patient
         1) Reduction in radiation exposure
         2) Efficacy of patient care
      b. Department
         1) Consistency in production of quality diagnostic images
         2) Cost effectiveness
   3. Elements
   4. Standards for quality
      a. Communications
      b. Quality improvement manual
      c. Responsibility and administration
      d. Test equipment, procedures and training
      e. Record keeping

f. Test review
g. Evaluation
h. Continuing education

5. JCAHO 10-step model of quality improvement.

II. State, Federal and Professional Standards and Regulations

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Identify state agencies involved with quality improvement aspects of radiographic systems.
2. Discuss state agency regulations, inspections and enforcement as they relate to quality improvement.
3. Identify federal agencies involved with quality improvement aspects of radiographic systems.
4. Discuss federal regulations and enforcement and consultation service as they relate to quality improvement.
5. Discuss professional standards involved with quality improvement aspects of radiographic systems.

B. Content

1. State
   a. Agency involvement
   b. Regulations
   c. Inspections
   d. Enforcement
2. Federal
   a. Agency involvement
   b. Regulations
   c. Information and consultation service
3. Profession
   a. Standards
      1) Departmental
      2) American College of Radiology

III. Equipment Quality Control

A. Objectives: Following the completion of this unit, the student radiographer will:

1. List categories of departmental personnel involved in a quality improvement program and discuss the responsibili5ties of each to the effective operation of the program.
2. List components of the radiographic system.
3. Describe test material and equipment, test procedures and test evaluations and interpretation relating to quality improvement for components of the radiographic system.
4. Discuss aspects of preventive and corrective maintenance for components of the radiographic system.
5. Define reject analysis and describe objectives of a reject analysis program.

6. Explain the procedure, evaluation and follow-up for a retake analysis program.
7. Identify the necessary equipment to perform quality control tests.

B. Content
   1. Responsibility
      a. Radiographer
      b. Quality control and quality assurance technologists
      c. Physicist
      d. Service engineer
      e. Radiologist
   2. Components of radiographic system
      a. Radiographic units
         1) Test material and equipment
         2) Test procedures
         3) Evaluation and interpretation
         4) Preventive maintenance
         5) Corrective maintenance
      b. Fluoroscopic units
         1) Test material and equipment
         2) Test procedures
         3) Evaluation and interpretation
         4) Preventive maintenance
         5) Corrective maintenance
      c. Tomographic units
         1) Test material and equipment
         2) Test procedures
         3) Evaluation and interpretation
         4) Preventive maintenance
         5) Corrective maintenance
      d. Processors and darkrooms
         1) Test material and equipment
         2) Test procedures
         3) Evaluation and interpretation
         4) Preventive maintenance
         5) Corrective maintenance
      e. Illuminators
         1) Test material and equipment
         2) Test procedures
         3) Evaluation and interpretation
         4) Preventive maintenance
         5) Corrective maintenance
      f. Cassettes and intensifying screens
         1) Test material and equipment
         2) Test procedures
         3) Evaluation and interpretation

4) Preventive maintenance
5) Corrective maintenance

g. Grids
1) Test material and equipment
2) Test procedures
3) Evaluation and interpretation
4) Preventive maintenance
5) Corrective maintenance

h. Protective devices
1) Test material and equipment
2) Test procedures
3) Evaluation and interpretation
4) Preventive maintenance
5) Corrective maintenance

3. Retake analysis
a. Definition
b. Objectives
c. Procedures
d. Evaluation
e. Follow-up

Computers in the Radiologic Sciences

Course Description

This unit will introduce the student to fundamental principles of computer technology. Computer concepts and terminology will be discussed. Computer applications in radiology will be discussed.

Course Outline

1. History
2. Fundamentals
3. Components
4. Operations
5. Computer Applications in Radiology
6. Practicum

I. History

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Discuss the history and development of computers

B. Content
   1. Abacus
   2. Mechanical
   3. Electric
   4. Electronic

II. Fundamentals

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define computer.
   2. Define various terms related to computer fundamentals.
   3. Identify types of computers.

B. Content
   1. Terminology
   2. Types of computers
      a. General purpose and mainframe
      b. Minicomputer
      c. Microcomputer

III. Components

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Define various terms related to components of computers.
   2. List major functions of Central Processing Unit (CPU).
   3. Given a list of input and output devices, differentiate among them.
   4. Define memory and describe the types.
   5. Describe the care and preventive maintenance for the computer system.

B. Content
    1. Central processing unit (CPU)
        a. Arithmetic logic unit (ALU)
        b. Control unit (CU)
        c. Internal memory
    2. Input and output devices (I/O) (peripherals)
        a. Input
            1) Punch card
            2) Punch paper tape
            3) Keyboards
            4) Video terminals
            5) The mouse
            6) The light pen
            7) Voice entry
            8) Digitizing cameras
            9) Image scanner
        b. Output
            1) Printers and plotters
            2) Cathode ray tube (CRT) – terminal
            3) Graphic displays
            4) Voice output microform
            5) Computer output microform
    3. Primary memory and secondary data storage
        a. Primary memory
            1) Random access memory (RAM)
            2) Read only memory (ROM)
        b. Secondary storage
            1) Floppy disks
            2) Hard disks
            3) Tape
            4) Optical disks
            5) Optical tapes
    4. Computer care and maintenance
        a. Computer environment
        b. Computer catastrophes
        c. Preventive maintenance

IV. Operations

A. Objectives: Following the completion of this unit, the student radiographer will:
    1. Define various terms related to computer operation.
    2. Discuss analog to digital conversion, distinguish between analog computers and digital computers.
    3. Explain the binary function.
    4. Define programming and describe its purpose.
    5. Discuss application of various types of software.

B. Content
   1. Terminology
   2. Analog computers
   3. Digital computers
   4. Binary computers
   5. Programming
      a. Definition
      b. Purpose
      c. Languages
         1) MUMPS
         2) ALGOL
         3) APL
         4) BASIC
         5) COBOL
         6) FORTRAN
         7) PASCAL
         8) PL/1
      d. Software
         1) Word processors
         2) Data base
         3) Spread sheet
         4) Desktop publishers
         5) Graphics
         6) Integrated application programs

V. Computer Applications in Radiology

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Identify various types of computer imaging in radiology (these techniques are fully described under imaging equipment of specialized curricula areas).

B. Content
   1. Applications
      a. Ethical and legal issues
      b. Computed tomography (CT)
      c. Digital radiology
      d. Magnetic resonance imaging (MRI) hardware and software
      e. Nuclear medicine applications
      f. Radiation therapy treatment planning
      g. Ultrasound applications
      h. Literature search
      i. Patient information and systems scheduling
      j. Quality control and quality assurance
      k. 3-D

VI. Practicum

Pharmacology and Drug Administration

Course Description

This unit will provide the student with the basic concepts of pharmacology. The theory and practice of basic techniques of venipuncture and the administration of diagnostic contrast agents and intravenous medications is included. The appropriate delivery of patient care during these procedures is emphasized.

Course Outline

1. Pharmacology
2. Diagnostic Contrast Agents
3. Drug Administration
4. Legal and Ethical Issues of Medication Administration

Notes:

It is recommended that educational units on patient care (with CPR/BLS certification), anatomy and physiology of the excretory and circulatory system be satisfactorily completed prior to the start of this unit.

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 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 total competency occurs before this task is performed unsupervised.

I. Pharmacology

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Recognize various categories of drugs.
   2. Recognize common drug nomenclature and basic concepts of pharmacology.
   3. Discuss specific drugs in each category, particularly those associated with CPR procedures.
   4. Discuss each drug's expected action, reactions and possible interactions.

5. Discuss drugs used for premedication including recognition of initial and peak response times.

B. Content
   1. Drug nomenclature
      a. Chemical name
      b. Generic name
      c. Brand name
   2. Methods of drug classification
      a. Chemical group
      b. Mechanism and site of action
      c. Primary effect
   3. General pharmacologic principles
      a. Pharmacokinetics
         1) Absorption
         2) Distribution
         3) Metabolism
         4) Elimination
      b. Pharmacodynamics
         1) Indications, actions and effects
         2) Dosage and dose response
         3) Interactions
   4. Four rights of drug safety
   5. Drug categories of relevance to radiography
      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 antidiarreal drugs
      r. Diagnostic contrast agents

II. Diagnostic Contrast Agents

A. Objectives: Following the completion of this unit, the student radiographer will:

1. Define the categories of contrast agents and give specific examples for each category.
2. Discuss the pharmacology of barium and iodine compounds.
3. Describe methods and techniques for the administration of various types of contrast agents.

B. Content
   1. Classification of contrast agents
      a. Types of compound
         1) Heavy metal salt
         2) Organic iodides
            a) Conventional ionic contrast material (ionic)
            b) Low-osmolar (non-ionic)
         3) Iodized oils
         4) Gaseous
      b. Beam attenuation characteristics
         1) Radiolucent (negative)
         2) Radiopaque (positive
      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
      f. Methods of administration

III. Drug Administration

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Identify and describe the routes of drug administration.
   2. Discuss the purposes and advantages of intravenous drug administration over other routes.
   3. Differentiate between the two major sites of intravenous drug administration.
   4. Identify, describe and document complications associated with intravenous drug therapy and appropriate actions to resolve these complications.
   5. Discuss the various elements of initiating and discontinuing intravenous drug therapy.
   6. Differentiate and document dose calculations for adult and pediatric patients.
   7. Prepare for injection, contrast agents and intravenous medications, utilizing aseptic technique.

B. Content
1. Routes of drug administration
a. Systemic
1) Oral
2) Rectal
3) Tube
4) Catheter
5) Inhalation
b. Parenteral
1) Intravenous
2) Intra-arterial
3) Intrathecal
2. Intravenous drug therapy
a. Purposes
b. Advantages
c. Methods
1) Continuous infusion
2) Intermittent infusion
3) Direct injection
d. Sites of administration
1) Peripheral
2) Central
e. Typical 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 and venipuncture equipment
2) Patient identification, assessment and instructions
3) Dose, dose calculations and dose response.
a) Adults
b) Pediatrics
4) Patient preparation
5) Application of Universal Precautions
6) Procedure for intravenous infusion and 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

9) Emergency medical treatment follow-up tasks

g. Discontinuation of intravenous therapy
   1) Equipment and supplies for withdrawal
   2) Patient preparation
   3) Application of Universal Precautions
   4) Procedure of withdrawal
   5) Site observation
   6) Patient observation
   7) Post-procedural tasks

h. Documentation of administration

i. Documentation of complication and reaction

IV. Legal and Ethical Issues of Medication Administration

A. Objectives: Following the completion of this unit, the student radiographer will:
   1. Discuss the current legal and ethical status of the radiographer's role in drug administration.
   2. Discuss a radiographer's professional liability concerning drug administration.

B. Content
   1. Current status
      a. Professional standards
      b. State statutes
      c. Employer prerogative
   2. Informed consent
   3. ASRT scopes of practice
   4. Professional liability

Clinical Practicum

Suggested Credit
Hours variable length (suggest 3 hours of clinic for every hour of didactic lecture).

Course Format
1. Cooperative clinical experience, preferably with clinical competencies
2. Lab/simulations
3. Film review sessions

Course Description
1. Clinical experience in mammography and related activities
2. Individual research project

Syllabus Course Content
1. Clinical time (attendance)
2. Clinical examination record
3. Competency evaluation
4. Personal/professional evaluation
5. Clinic objective
6. Miscellaneous

Because there are no essentials that govern the educational activities in mammography education, there are no mandatory clinical requirements. However, the clinical education experience should be conducted on sound educational principals based on a competency evaluation system and should reflect both personal and professional growth of the student.

Suggestions include: 1) observations in the areas related to patient screening; 2) imaging; 3) film processing; 4) quality control and 5) assisting the mammographer in the areas listed. The final section should be in the area of standardized clinical competencies with a mammographer present. The student completes the entire exam from request and chart review to patient screening, explaining the procedure to the patient, positioning the patient, using required accessories, setting the equipment, completing the image, releasing the patient, finalizing paperwork, storing the data and maintaining quality controls.

Introduction to Radiography Practice Standards

The complex nature of disease processes involves multiple imaging modalities. Although an interdisciplinary team of radiologists, radiographers and support staff plays a critical role in the delivery of health services, it is the radiographer who performs the radiographic examination that creates the images needed for diagnosis. Radiography integrates scientific knowledge and technical skills with effective patient interaction to provide quality patient care and useful diagnostic information.

Radiographer

Radiographers must demonstrate an understanding of human anatomy, physiology, pathology and medical terminology.

Radiographers must maintain a high degree of accuracy in radiographic positioning and exposure technique. He or she must maintain knowledge about radiation protection and safety. Radiographers prepare for and assist the radiologist in the completion of intricate radiographic examinations. They prepare and administer contrast media and medications in accordance with state and federal regulations.

Radiographers are the primary liaison between patients and radiologists and other members of the support team. They must remain sensitive to the physical and emotional needs of the patient through good communication, patient assessment, patient monitoring and patient care skills.

Radiographers use professional and ethical judgment and critical thinking when performing their duties. Quality improvement and customer service allow the radiographer to be a responsible member of the health care team by continually assessing professional performance. Radiographers embrace continuing education for optimal patient care, public education and enhanced knowledge and technical competence.

Education and Certification

Radiographers prepare for their role on the interdisciplinary team by satisfactorily completing an accredited educational program in radiologic technology. Two-year certificate, associate degree and four-year baccalaureate degree programs exist throughout the United States.

Accredited programs must meet specific curricular and educational standards. The Joint Review Committee on Education in Radiologic Technology (JRCERT) is the accrediting agency for radiologic technology programs recognized by the U.S. Department of Education.

Upon completion of a course of study in radiologic technology, individuals may apply to take the national certification examination. The American Registry of Radiologic Technologists (ARRT) is the recognized certifying agency for radiographers and offers examinations three times per year. Those who successfully complete the certification examination in radiography may use the credential R.T.(R) following their name; the R.T. signifies registered technologist and the (R) indicates radiography.

To maintain ARRT certification, a level of expertise and awareness of changes and advances in practice, radiographers must complete 24 hours of appropriate continuing education every two years.

Practice Standards

The practice standards define the practice and establish general criteria to determine compliance. Practice standards are authoritative statements enunciated and promulgated by the profession for judging the quality of practice, service and education. They include desired and achievable levels of performance against which actual performance can be measured.

Professional practice constantly changes and actual practice varies from state to state as determined by local law and community custom. Recognizing this, the profession has adopted standards that are general in nature. The general format was favored over a "cookbook" style or "step-by-step" approach that would be difficult to maintain in a changing environment and confining for those practitioners with an expanded practice.

The standards focus on the dynamic nature of the health care delivery system. The standards are adaptable not only to the area of practice but also the locality of practice and institutional needs. While a minimum standard of acceptable performance is appropriate and should be followed by all practitioners in a specific area, it is unrealistic and highly inappropriate to assume that professional practice is the same in all regions of the United States. State statue or regulation may dictate practice parameters. To conduct an appropriate review of the standards, one must look to the professional standard as well as local or state law that my impact the nature and scope of practice.

Format

The cohesive nature and inherent differences of medical imagining and radiation therapy are recognized in the general format of the standards. The standards are divided into three sections: clinical practice, quality performance and professional performance.

> *Clinical Practice Standards.* The clinical practice standards define the activities of the practitioner in the care of patients and delivery of diagnostic or therapeutic procedures and treatments. The section incorporates patient assessment and management with procedural analysis, performance and evaluation.
>
> *Quality Performance Standards.* The quality performance standards define the activities of the practitioner in the technical areas of performance including equipment and material assessment, safety standards and total quality management.
>
> *Professional Performance Standards.* The professional performance standards define the activities of the practitioner in the areas of education, interpersonal relationships, personal and professional self-assessment and ethical behavior.

Each section of the standards is subdivided into individual standards. The standards are numbered and followed by a term or set of terms that identify the standards, such as "assessment" or "analysis/determination of action plan." The next statement is the expected

performance of the practitioner when performing the procedure or treatment. A rationale statement follows and explains why a practitioner should adhere to the particular standard of performance.

> *Criteria*. Criteria are used in evaluating a practitioner's performance. Each set of criteria is divided into two parts, the general criteria and the specific criteria. Both the measurement and specific criteria should be used when evaluating performance.
>
> *General Criteria.* General criteria are written in a general style that applies to either medical imaging or radiation therapy practitioners. These criteria are the same in all sections of the standards and should be used for the appropriate area of practice. For example, a radiographer should use good professional judgment to make decisions concerning the adaptation of equipment and technical variables for a diagnostic procedure. Under these circumstances, the evaluation of the decision-making process concerning radiation therapy procedures would not be appropriate and should not be applied unless the procedure is diagnostic in nature, such as simulation.
>
> *Specific Criteria.* Specific criteria meet the needs of the practitioners in the various areas of professional performance. While many areas of performance within medical imaging and radiation therapy are similar, others are not. The specific criteria are drafted with these differences in mind. For example, a criterion that calls for daily review of patient treatment records and doses to ensure that treatment does not exceed prescribed dose or normal tissue tolerance is imperative for those who practice in radiation therapy yet is not applicable to those who practice in the imaging professions.

A profession's practice standards serve as a guide for appropriate practice. Standards provide role definition for practitioners that can be used by individual facilities to develop job descriptions and practice parameters. Those outside the medical imaging and radiation therapy community can use the standards as an overview of the role and responsibilities of the practitioner as defined by the profession.

Radiography Clinical Practice Standards

Standard One - Assessment
/the practitioner collects pertinent data about the patient and about the procedure.

Rationale
Information about the patient's health status is essential in providing appropriate imaging and therapeutic services.

General Criteria
The practitioner:

1. Uses consistent and appropriate techniques to gather relevant information from the medical record, significant others and health care providers. The collection of information is determined by the patient's needs or condition.
2. Reconfirms patient identification and verifies the procedure requested or prescribed.
3. Verifies the patient's pregnancy status when appropriate.
4. Determines whether the patient has been appropriately prepared for the procedure.
5. Assesses factors that may contraindicate the procedure, such as medications, insufficient patient preparation or artifacts.

Specific Criteria
The practitioner:

1. Identifies artifact-producing objects such as dentures, chest leads, jewelry and hear aids.

Standard Two - Analysis/Determination
The practitioner analyzes the information obtained during the assessment phase and develops an action plan for completing the procedure.

Rationale
Determining the most appropriate action plan enhances patient safety and comfort, optimizes diagnostic and therapeutic quality and improves cost effectiveness.

General Criteria
The practitioner:

1. Selects the most appropriate and cost-effective action plan after reviewing all pertinent data and assessing the patient's abilities and condition.
2. Uses his or her professional judgment to adapt imaging and therapeutic procedures to improve diagnostic quality and therapeutic outcome.
3. Consults appropriate medical personnel to determine a modified action plan when necessary.
4. Determines the needs for accessory equipment.

Specific Criteria
The practitioner:

1. Evaluates lab values prior to administering contrast media and begi8nnning interventional procedures.
2. Selects appropriate shielding devices.
3. Selects appropriate patient immobilization devices.
4. Determines appropriate type and dose of contrast agent to be administered, based on the patient's age, weight and medical/physical status.
5. Reviews the patient's chart and the physician's request to determine optimal imaging procedure for suspected pathology.

Standard Three - Patient Education
The practitioner provides information about the procedure to the patient, significant others and health care providers.

Rationale
Communication and education are necessary to establish a positive relationship with the patient, significant others and health care providers.

General Criteria
The practitioner:
1. Verifies that the patient has consented to the procedure and fully understands its risks, benefits, alternatives and follow-up. Verifies that written consent has been obtained when appropriate.
2. Provides accurate explanations and instructions at an appropriate time and at a level the patient can understand. Addresses and documents patient questions and concerns regarding the procedure when appropriate.
3. Refers questions about diagnosis, treatment or prognosis to the patient's physician.
4. Provides appropriate information to any individual involved in the patient's care.

Specific Criteria
The practitioner:
1. Consults with other departments, such as patient transportation and anesthesia, for patient services.
2. Instructs patients regarding preparation prior to imaging procedures, including providing information about oral or bowel preparation and allergy preparation.
3. Ensures that all procedural requirements are in place to achieve a quality diagnostic examination.
4. Explains precautions regarding administration of contrast agents to nursing mothers.

Standard Four – Implementation
The practitioner implements the action plan.

Rationale
Quality patient services are provided through the safe and accurate implementation of a deliberate plan of action.

General Criteria

The practitioner:

1. Implements an action plan that falls within established protocols and guidelines.
2. Elicits the cooperation of the patient to carry out the action plan.
3. Uses an integrated team approach as needed.
4. Modifies the action plan according to changes in the clinical situation.
5. Administers first aid or provides life support in emergency situations.
6. Uses accessory equipment when appropriate
7. Assesses and monitors the patient's physical and mental state.

Specific Criteria
The practitioner:

1. Performs venipuncture, IV patency and maintenance procedures according to established guidelines.
2. Administers contrast agents according to established guidelines.
3. Monitors the patient for reactions to contrast agent.
4. Uses appropriate radiation safety devices.
5. Monitors the patient's physical condition during the procedure.
6. Applies appropriate patient immobilization devices when necessary.

Standard Five – Evaluation
The practitioner determines whether the goals of the action plan have been achieved.

Rationale
Careful examination of the procedure is necessary to determine that all goals have been met.

General criteria
The practitioner:

1. Evaluates the patient and the procedure to identify variances that may affect patient outcome. The evaluation process should be timely, accurate and comprehensive.
2. Measure the procedure against established protocols and guidelines.
3. Identifies any exceptions to the expected outcome.
4. Documents any exceptions clearly and completely.

Develops a revised action plan to achieve the intended outcome if necessary.

Specific Criteria
The practitioner:

1. Reviews images to determine if additional images will enhance the diagnostic value of the procedure.

Standard Six – Implementation
The practitioner implements the revised action plan.

Rationale
It may be necessary to make changes to the action plan to achieve the intended outcome.

General Criteria

The practitioner:

1. Bases the revised action plan on the patient's condition and the most appropriate means of achieving the intended outcome.
2. Takes action based on patient and procedural variances.
3. Measures and evaluates the results of the revised action plan.
4. Notifies appropriate health provider when immediate clinical response is necessary based on procedural findings and patient condition.

Specific Criteria
None added.

Standard Seven – Outcome Measurement
The practitioner reviews and evaluates the outcome of the procedure.

Rationale
To evaluate the quality of care, the practitioner compares the actual outcome with the intended outcome.

General Criteria
The practitioner:

1. Reviews all diagnostic/therapeutic data for completeness and accuracy.
2. Determines whether the actual outcome is within the established criteria.
3. Evaluates the process and recognizes opportunities for future changes.
4. Assesses the patient's physical and mental status prior to discharge from the practitioner's care.

Specific Criteria
None added

Standard Eight – Documentation
The practitioner documents information about patient care, the procedure and the final outcome.

Rationale
Clear and precise documentation is essential for continuity of care, accuracy of care and quality assurance.

General Criteria
The practitioner:
Documents diagnostic, treatment and patient data in the appropriate record. Documentation must be timely, accurate, concise and complete.
Documents any exceptions from the established criteria or procedures.
Records diagnostic or treatment data.

Specific Criteria
None added.

Quality Performance Standards

Standard One - Assessment
The practitioner collects pertinent information regarding equipment, the procedures and the work environment.

Rationale
The planning and provision of safe and effective medical services relies on the collection of pertinent information about equipment, procedures and the work environment.

General Criteria
The practitioner:

1. Ensures that services are performed in a safe environment in accordance with established guidelines.
2. Ensures that equipment maintenance and operation comply with established guidelines.
3. Assesses equipment to determine acceptable performance based on established guidelines.
4. Ensures that protocol and procedure manuals include recommended criteria and are reviewed and revised on a regular basis.

Specific Criteria
The practitioner:

1. Maintains controlled access to restricted area during radiation exposure to ensure safety of patients, visitors and hospital personnel.

Standard Two - Analysis/Determination
The practitioner analyzes information collected during the assessment phase and determines whether changes need to be made to equipment, procedures or the work environment.

Rationale
Determination of acceptable performance is necessary for the provision of safe and effective services.

General Criteria
The practitioner:

1. Assesses whether services, procedures and the work environment meet or exceed established guidelines. If not, the practitioner develops an action plan.
2. Evaluates equipment to determine if it meets or exceeds established standards. If not, the practitioner develops an action plan.
3. Analyzes information collected during the assessment phase to determine whether optimal services are being provided. If not, the practitioner develops an action plan.

Specific Criteria
None added.

Standard Three - Education
The practitioner informs patients, the public and other health care providers about procedures, equipment and facilities.

Rationale
Open communication promotes safe practices.

General Criteria
The practitioner:

1. Elicits confidence and cooperation from the patient, the public and health care providers by providing timely communication and effective instruction.
2. Presents explanations and instructions at the learner's level of understanding and learning style.

Specific Criteria
The practitioner:

1. Instructs health care providers and students regarding radiographic procedures and radiation safety.
2. Educates the public about radiographic procedures and radiation safety.

Standard Four - Performance
The practitioner performs quality assurance activities or acquires information on equipment and materials.

Rationale
Quality assurance activities provide valid and reliable information regarding the performance of materials and equipment.

General Criteria

1. The practitioner:
2. performs quality assurance activities based on established quality standards.

Specific Criteria
The practitioner:

1. Monitors image production to determine variance from established quality standards.

Standard Five - Evaluation
The practitioner evaluates quality assurance results and establishes an appropriate action plan.

Rationale
Materials, equipment and procedure safety depend on ongoing quality assurance activities that evaluate performance based on established guidelines.

General Criteria
The practitioner:

1. Compares quality assurance results to established acceptable values.

2. Verifies quality assurance testing conditions and results.
3. Formulates an action plan following verification of testing.

Specific Criteria
None added.

Standard Six - Implementation
The practitioner implements the quality assurance action plan.

Rationale
Implementation of a quality assurance action plan is imperative for quality diagnostic and therapeutic procedures and patient care.

General Criteria
The practitioner:
1. Obtains assistance from appropriate personnel to implement the quality assurance action plan.
2. Implements the quality assurance action plan.

Specific Criteria
None added.

Standard Seven - Outcome Measurement
The practitioner assesses the outcome of the quality assurance action plan in accordance with established guidelines.

Rationale
Outcome assessment is an integral part of the ongoing quality assurance plan to enhance diagnostic and therapeutic services.

General Criteria
The practitioner:
1. Reviews the implementation process for accuracy and validity.
2. Determines whether the performance level of equipment and materials is safe for practice based on outcome assessment.
3. Develops and implements a modified action plan when testing results are not in compliance with guidelines.

Specific Criteria
None added.

Standard Eight – Documentation
The practitioner documents quality assurance activities and results.

Rationale

Documentation provides evidence of quality assurance activities designed to enhance the safety of patients, the public and health care providers during diagnostic and therapeutic services.

General Criteria
The practitioner:
Maintains documentation of quality assurance activities, procedures and results in accordance with established guidelines.
Provides timely, concise, accurate and complete documentation.
Provides documentation that adheres to current protocol, policy and procedures.

Specific Criteria
None added.

Professional Performance Standards

Standard One – Quality
The practitioner strives to provide optimal care to all patients.

Rationale
All patients expect and deserve optimal care during diagnosis and treatment.

General Criteria
The practitioner:

1. Works with others to elevate the quality of care.
2. Participates in quality assurance programs.
3. Adheres to the accepted standards, policies and procedures adopted by the profession and regulated by law.
4. Provides the best possible diagnostic study or therapeutic treatment for each patient by applying professional judgment and discretion.
5. Anticipates and responds to the needs of the patient.

Specific Criteria
None added.

Standard Two – Self-assessment
The practitioner evaluates personal performance, knowledge and skills.

Rationale
Self-assessment is an important tool in professional growth and development.

General Criteria
The practitioner:

1. Monitors personal work ethics, behaviors and attitudes.
2. Evaluates performance and recognizes opportunities for improvement.
3. Recognizes his or her strengths and uses them to benefit patients, coworkers and the profession.
4. Performs procedures only after receiving appropriate education and training.
5. Recognizes and takes advantage of opportunities for educational growth and improvement is technical and problem-solving skills.
6. Actively participates in professional societies and organizations.

Specific Criteria
None added.

Standard Three – Education
The practitioner acquires and maintains current knowledge in clinical practice.

Rationale

Advancements in medical science require enhancement of knowledge and skills through education.

General Criteria
The practitioner:

1. Demonstrates completion of the appropriate education related to clinical practice.
2. Maintains appropriate credentials and certification related to clinical practice.
3. Participates in educational activities to enhance knowledge, skills and performance.
4. Shares knowledge and expertise with others.

Specific Criteria
None added.

Standard Four – Collaboration and Collegiality
The practitioner promotes a positive, collaborative practice atmosphere with other members of the health care team.

Rationale
To provide quality patient care, all members of the health care team must communicate effectively and work together efficiently.

General Criteria
The practitioner:
Shares knowledge and expertise with colleagues, peers, students and all members of the health care team.
Develops collaborative partnerships with other health care providers in the interest of diagnostic and therapeutic quality and cost effectiveness.

Specific Criteria
None added.

Standard Five – Ethics
The practitioner adheres to the profession's accepted Code of Ethics.

Rationale
All decisions and actions made on behalf of the patient must be based on a sound ethical foundation.

General Criteria
The practitioner:

1. Provides health care services with respect for the patient's dignity and needs.
2. Acts as a patient advocate to support patients' rights.
3. Takes responsibility for professional decisions.
4. Delivers patient care and service without bias based on personal attributes, nature of the disease, sex, race, creed, religion or socioeconomic status.
5. Respects the patient's right to privacy and confidentiality.

6. Adheres to the established practice standards of the profession.

Specific Criteria
None added.

Standard Six – Exploration and Investigation
The practitioner participates in activities that lead to the acquisition, dissemination and advancement of the professional knowledge base.

Rationale
Scholarly activities such as research, scientific investigation, presentation and publication advance the profession and thereby improve the quality and efficiency of patient services.

General Criteria
The practitioner:
1. Reads and critically evaluates research in diagnostic and therapeutic services.
2. Investigates new, innovative methods and applies them in practice.
3. Shares information with colleagues through publication, presentation and collaboration.
4. Pursues lifelong learning.
5. Participates in data collection.

Specific Criteria
None added.

Radiography Glossary

Artifact - False features in the image produced by patient instability or equipment deficiencies.

Assess - To determine the significance, importance or value.

Clinical - Pertaining to or found on actual observation and treatment of patients.

Competency - having the ability to perform a task.

Contrast media - Substance administered to subject being imaged to alter selectively the image intensity of a particular anatomical or functional region.

Contraindicate - To make the indicated or expected treatment or drug inadvisable.

Disease - A disorder or abnormal condition having a characteristic train of symptoms that may affect the whole body or any of its parts. Its etiology, pathology and prognosis may be known or unknown.

Ethical - Conforming to the standards of conduct of a given profession or group.

Interpret - To understand and explain an image to provide a diagnostic report.

Interventional procedures - Percutaneous catheterization for diagnostic and therapeutic purposes.

Quality assurance - A comprehensive set of policies and procedures designed to optimize the performance of personnel and equipment.

Radiation protection - Procedures followed to prevent inappropriate or accidental irradiation of patient, public and health care professionals.

Radiography - An image produced on a sensitized film by x-rays.

Venipuncture - The puncture of a vein.

Glossary

Artifacts – False features in the image produced by patient instability or equipment deficiencies.

Competent – Trained, well-qualified; meeting requirements of mammography.

Compression – To uniformly reduce the thickness of the breast using rigid, plastic device so that the breast is more readily and uniformly penetrated by the x-ray beam.

Densitometer – An instrument that measures the degree of blackening or optical density of the film.

Dose measurements – The measure of the amount of energy deposited in tissue due to x-ray exposure.

Entrance exposure – That amount of radiation at the skin of the breast, quantitated by measuring the amount of ionization in air caused by the radiation.

Estrogen replacement therapy – A regular program of estrogen to replace the natural estrogen that wanes at menopause.

Exposure factor – Technical factors in the design of the mammography machine that affect production of the mammographic image. The goal is to produce consistent, high-contrast diagnostic images.

FDA inspector – A person certified by the U.S. Food and Drug Administration to inspect assigned mammography facilities to assure that the mammography services provided to the community are safe and effective.

Federal Register – United States document containing requirements for mammography facilities, accrediting bodies, quality standards and certification requirements.

Focal spot size – A test performed to evaluate the focal spot performance on the mammographic machine by measuring the focal spot dimensions.

Half-value layer – The thickness of a specified substance which, when introduced into the path of a given beam of radiation, reduces the exposure rate by one-half. HVL is a measure of beam quality and usually is specified by millimeters of aluminum for diagnostic units. The higher the HVL, the more penetrating the x-ray beam.

Image receptor – The screen-film combination is the standard image receptor used in mammography.

kVp accuracy and reproducibility – Test used to ensure that the indicated peak x-ray beam energy is accurate and reproducible so that consistent x-ray output and contrast are maintained.

Low-dose mammography – The recording of breast tissue on a radiographic image with the least amount of radiation possible for the purpose of detecting any abnormalities.

Medical physicist – A trained specialist who conducts a number of mammography-related tests, at least annually, intended to assess the continuing performance of mammography equipment.

Phantom – A test object that simulates the average composition of various structures within the breast.

Positioning – The art and skill of the mammographer to adequately demonstrate the entire breast in at least two differing projections, known as the craniocaudal and mediolateral projections.

Processor – An automated device that transports film at a constant speed by a system of rollers through development fixing, washing and drying cycles.

Projection – Demonstration of breast tissue from a specific angle depending on what area of the breast needs to be seen.

Radiation therapy – A series of high-dose radiation treatments applied to a specific area of the body to destroy malignant cells.

Radiopaque marker – A permanent identification label to indicate right or left laterality and projection. This marker is placed on the top of the cassette holder near the axillary portion of the breast.

"Repeat analysis" test – A system for determining the causes of repeat radiographs.

Sensitometer – A device used to reproducibly expose film to a number of known different levels of light.

Technique – Technical factors in the design of the mammography machine that affect production of the mammographic image. The goal is to produce consistent, high-contrast diagnostic images.

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