
Content Specifications for the Registered Radiologist Assistant Examination



Content Specifications Effective with the Fall 2005 Examination

The American Registry of Radiologic Technologists (ARRT) administers the national certifying examination for Registered Radiologist Assistants (R.R.A.s). To establish certification requirements for this area of advanced practice, the ARRT sponsored a practice analysis project. That study was completed in 2004 under the direction of the R.R.A. Advisory Committee, which consisted of representatives from the American College of Radiologists (ACR) and the American Society of Radiologic Technologists (ASRT). Participants in the study included national samples of radiologists and radiology practitioner assistants. The project culminated in the R.R.A. Role Delineation which identifies activities and clinical procedures performed by R.R.A.s, as well as the level of supervision required.

The R.R.A. Role Delineation serves as the basis for the content specifications presented on the following pages. The content specifications identifies the knowledge and cognitive skills required to effectively perform the activities and clinical procedures included in the Role Delineation.

The table below presents the six major content categories, along with the number of questions appearing in each category. The examination consists primarily of multiple-choice test questions. In addition, case studies will be presented that require a short essay response to several questions. Some questions may require that you select multiple responses from a list of choices. Candidates are allowed 3½ hours to complete the multiple-choice section, and 2 hours to complete the case study section.

The pages that follow provide a detailed listing of topics within each major content category. Although this document covers many of the same topics included in curricula guides and related documentation, it is not intended to serve as a guide for educational programs. Educational programs are likely to be broader in scope.

Content Categories	Multiple Choice Questions	Case Study Questions¹
A. Patient Communication, Assessment, and Management	55	
B. Drugs and Contrast Materials	35	
C. Anatomy, Physiology, and Pathophysiology ²	60	
D. Radiologic Procedures ²	25	17 – 25
E. Radiation Safety, Radiation Biology, and Fluoroscopic Operation	15	
F. Medical-Legal, Professional, and Governmental Standards	<u>10</u>	<u>3 – 5</u>
Total Number of Questions ³	200	20 – 30
Testing Time Allowed	3.5 hours	2 hours

* Notes: (1) The case studies used on the examination will be representative of the nine mandatory procedures that comprise the clinical portfolio requirements. Case studies may consist of multiple questions; the range presented in the table refers to the number of test questions, not the number of case studies. (2) Test content in sections C or D may refer to images produced by fluoroscopy, radiography, CT, or MRI. (3) The exam also consists of an additional 20 unscored pilot questions.

A. PATIENT COMMUNICATION, ASSESSMENT, AND MANAGEMENT (55)

I. PATIENT COMMUNICATION (4)

- A. Patient Education
 - 1. explanation of procedure
 - 2. alternatives to current procedure
 - 3. risk versus benefit
- B. Psychosocial Support
 - 1. communication skills and issues
 - 2. cultural awareness
 - 3. social support structures
- C. Post-Procedure Care Instructions

II. PATIENT ASSESSMENT (30): Includes adaptations for pediatric, geriatric, and special needs populations

- A. Medical Data Review
 - 1. indications for procedure (ACR appropriateness guide)
 - 2. contraindications for procedure
 - 3. laboratory values
 - 4. prior diagnostic studies
 - 5. current medications
 - 6. previous history (e.g., vital signs, nurses/physicians notes)
 - 7. assessment of vital signs, height, and weight
- B. Patient Interview
 - 1. verification
 - a. patient identification and correct procedure
 - b. patient preparation
 - c. pregnancy status
 - 2. medical history
 - a. chief complaint
 - b. present illness
 - c. past history
 - d. family history
 - e. personal and social history
 - f. review of systems
 - 3. risk factors
 - a. medications
 - b. allergy history
 - c. medical or psychological indicators
 - d. alternative medicines

- C. Examination Techniques (i.e., inspection, palpation, percussion, auscultation)
- D. Common Laboratory Tests Analysis and Response
 - 1. complete blood count, red blood cells (RBC), white blood cells (WBC), hematocrit
 - 2. electrolytes (sodium, potassium, bicarbonate, chloride)
 - 3. enzymes (amylase, lipase)
 - 4. pancreatic enzymes
 - 5. calcium
 - 6. albumin and total protein
 - 7. coagulation factors (e.g., prothrombin time (PT), partial thromboplastin time (PTT), International Normalized Ratio (INR), platelets)
 - 8. liver function (e.g., total bilirubin)
 - 9. renal function (e.g., blood urea nitrogen (BUN), creatinine)
 - 10. glucose
 - 11. culture and sensitivity of fluids (microbiology)
 - 12. cytology (cell count) and histopathology (tissue diagnosis)
- E. Psychological Responsiveness (Status)
 - 1. cognitive abilities
 - 2. emotional stability
 - 3. speech and language skills
 - 4. disorders that affect communication
 - a. dementia
 - b. mental retardation
 - c. drug and/or alcohol impairment
- F. Abdomen Assessment
 - 1. landmarks for examination
 - 2. assessment procedures
 - a. bowel sounds
 - b. percussion of spleen
 - c. liver palpation
 - d. visual inspection and palpation (e.g., surgical intervention, significant mass)

(Section A continues on the following page)

3. signs and symptoms
 - a. tenderness on palpation
 - b. diarrhea
 - c. flatulence
 - d. dysuria
 - e. pain
 - f. constipation
 - g. reflux
- G. Thorax and Lung Assessment
 1. landmarks for examination
 2. assessment procedures
 - a. breath sounds
 - b. pulmonary function measurement
 - c. oxygen saturation
 - d. visual inspection and palpation (e.g., surgical intervention)
 3. signs and symptoms
 - a. cough
 - b. pain
 - c. breathing pattern
- H. Cardiovascular Function
 1. assessment procedures
 - a. electrocardiogram (ECG)
 - b. vital signs
 - c. visual inspection and palpation (e.g., surgical intervention, abnormal color)
 - d. perfusion status (e.g., pulses)
 2. signs and symptoms
 - a. distended veins
 - b. heart rate and rhythm
 - c. peripheral pulse
- I. Musculoskeletal Assessment
 1. assessment procedures
 - a. body structure and habitus
 - b. range of motion
 - c. mobility
 - d. strength
 - e. visual inspection and palpation (e.g., significant mass, structures and contours)
 2. signs and symptoms
 - a. redness
 - b. swelling
 - c. crepitus
 - d. pain
 - e. temperature
 - f. loss of function
- J. Peripheral Vascular System
 1. landmarks (vascular anatomy)
 2. assessment procedures (e.g., ABI- Ankle Brachial Index)
 3. signs and symptoms of arterial occlusion and insufficiency
 - a. pain
 - b. pallor
 - c. weak pulse
 - d. venous hum
 - e. carotid artery bruits
 4. signs and symptoms of venous obstruction and insufficiency
 - a. color change
 - b. swelling
 - c. generalized edema
 - d. localized swelling
 - e. varicose veins
- K. Nervous System
 1. assessment procedures
 - a. pupil size and symmetry
 - b. superficial and deep tendon reflex examination
 - c. sensory evaluation
 - d. motor evaluation
 2. signs and symptoms
 - a. pain
 - b. weakness
 - c. sensory changes
 - d. motor changes
- L. Breast and Axillae
 1. landmarks
 2. assessment procedures
 - a. clinical breast examination (CBE)
 - b. visual inspection and palpation (e.g., mass, surgical intervention)
 3. signs and symptoms
 - a. mass
 - b. discharge
 - c. depression
 - d. discoloration
 - e. dermatologic changes
 - f. asymmetry
 - g. pain/tenderness

(Section A continues on the following page)

III. PATIENT MANAGEMENT (21)

- A. Standard Precautions (mechanism of disease transmission)
- B. Sterile Technique
- C. Patients with Disabilities
- D. Patient Monitoring and Assessment (pre, during, and post-procedure)
 - 1. physical status
 - 2. emotional status
- E. Cardiac Monitoring
 - 1. lead application
 - 2. life threatening rhythm recognition
- F. Intravenous (IV) Therapy
 - 1. venipuncture
 - 2. flow rate monitoring
 - 3. complications
- G. Oxygen Therapy
 - 1. level (flow rate)
 - 2. indications and contraindications
- H. Urinary Catheterization
 - 1. technique
 - 2. complications
 - 3. contraindications
- I. Medical Emergencies
 - 1. adverse reactions
 - 2. cardiac arrest
 - 3. hypoglycemia
 - 4. seizure
 - 5. respiratory arrest
 - 6. shock
- J. Radiological Procedure Complications
 - 1. infection
 - 2. bleeding
 - 3. pneumothorax
 - 4. perforation (gastrointestinal (GI) and genitourinary (GU))
 - 5. respiratory distress
 - 6. aspiration
 - 7. vasovagal reaction
 - 8. pulmonary edema or congestive heart failure (CHF)
 - 9. embolus
 - 10. complications of catheterization (e.g., hematoma, pseudo aneurysms)
 - 11. pain
 - 12. stroke
 - 13. radiation injury
 - 14. death
- K. Tubes and Lines
 - 1. identification
 - 2. indications
 - 3. contraindications
 - 4. radiographic appearance
 - 5. appropriate location
 - 6. complications

B. DRUGS AND CONTRAST MATERIAL (35)

I. TERMINOLOGY (10)

- A. Regulations
 - 1. Federal Drug Administration (FDA)
 - 2. Drug Enforcement Agency (DEA)
 - 3. controlled substances
- B. Identifying Names
 - 1. generic
 - 2. trade
 - 3. United States Pharmacopoeia (USP)
- C. Drug Characteristics
 - 1. actions
 - 2. synergisms
 - 3. indications
 - 4. contraindications
 - 5. side effects
 - 6. adverse actions
- D. Dosage
 - 1. loading
 - 2. maintenance
 - 3. therapeutic dose
 - 4. lethal dose
- E. Safe Dosage Calculation
 - 1. ratio
 - 2. proportion
 - 3. pediatric
 - 4. geriatric
- F. Administration
 - 1. oral
 - 2. rectal
 - 3. sublingual
 - 4. parenteral
 - 5. intravenous
 - 6. intramuscular
 - 7. intrathecal
 - 8. cutaneous
 - 9. nasal

II. ANESTHETICS (6)

- A. Local Anesthetics
 - 1. short acting
 - 2. long acting
 - 3. injectables
 - 4. cutaneous
- B. Moderate Sedation
 - 1. definitions (American Society of Anesthesiologists)
 - 2. guidelines
 - a. pre-procedure
 - b. intra-procedure
 - c. post-procedure
 - d. dismissal
 - 3. equipment
 - a. oxygen
 - b. pulse oximetry
 - c. suction
 - d. blood pressure
 - e. basic airway management
 - 4. discharge scoring system
 - a. motor activity
 - b. respirations
 - c. standing blood pressure
 - d. consciousness
 - e. oxygen saturation
 - 5. types of drugs (indications, contraindications, dosing guidelines)
 - a. fentanyl
 - b. morphine
 - c. meperidine
 - d. diazepam
 - e. midazolam
 - f. lorazepam
 - g. pentobarbital
 - h. chloral hydrate
 - i. naloxone
 - j. flumazenil
 - k. epinephrine
 - l. atropine
- C. General Anesthesia (indications, contraindications)

(Section B continues on the following page)

**III. GENERAL MEDICATIONS (9):
classifications, indications,
contraindications**

- A. Anti-Infective Drugs
 - 1. antibiotics
 - 2. antivirals
 - 3. antifungals
- B. Cardiac Drugs
 - 1. antihypertensive
 - 2. beta-blockers
 - 3. vasoconstrictors
 - 4. vasodilators
- C. Gastrointestinal Drugs
 - 1. anti-reflux agents
 - 2. glucagon
 - 3. cholecystokinin
- D. Vascular Drugs
 - 1. platelet inhibitors
 - 2. tissue plasminogen activator (TPA)
- E. Anti-Inflammatory Drugs
 - 1. aspirin
 - 2. Non Steroidal Anti-Inflammatory Drugs (NSAIDs)
 - 3. corticosteroids
- F. Endocrine Drugs
 - 1. insulin
 - 2. glucagon
 - 3. levothyroxine thyroid hormone replacement

IV. CONTRAST MEDIA (10)

- A. Agents (e.g., indications, contraindications, adverse reactions, dosage, routes of administration, excretion process)
 - 1. barium sulfate
 - 2. iodinated contrast media
 - a. osmolality (high versus low)
 - b. molecular structure
 - c. advantages
 - 3. MR agents
 - 4. negative contrast agents
 - 5. special considerations
 - a. hydration status
 - b. renal status
 - c. diseases of concern (e.g., multiple myeloma, diabetes)
 - d. incompatible medications
 - (1) metformin (Glucophage)
 - (2) acetylcysteine (Mucomyst)
- B. Allergies
 - 1. types of reactions (mild to severe)
 - 2. premedications
 - a. diphenhydramine
 - b. corticosteroids
- C. Resuscitation
 - 1. life support
 - a. basic life support (BLS)
 - b. advanced cardiac life support (ACLS)
 - 2. basic drugs
 - a. epinephrine
 - b. atropine
 - c. bronchodilator
 - d. nitroglycerine
 - e. lidocaine
 - f. intravenous fluid

C. ANATOMY, PHYSIOLOGY, AND PATHOPHYSIOLOGY (60)

I. ANATOMY (20): Includes gross and sectional anatomy, age-related changes, common surgical changes, congenital and developmental abnormalities/anomalies

- A. Abdominal Section
- B. Thoracic Section
- C. Musculoskeletal Section
- D. Neurological and Endocrine Section
- E. Vascular and Lymphatic Section

II. PHYSIOLOGY (16): Includes age-related and surgery-related physiologic changes

- A. Abdominal Section
 - 1. gastrointestinal
 - 2. hepatobiliary
 - 3. urinary
 - 4. reproductive
- B. Thoracic Section
 - 1. cardiovascular
 - 2. pulmonary
- C. Musculoskeletal Section
 - 1. muscular
 - 2. skeletal
- D. Neurological and Endocrine Section
 - 1. neurological
 - 2. endocrine
- E. Vascular and Lymphatic Section
 - 1. vascular
 - 2. lymphatic

III. PATHOPHYSIOLOGY (24)

- A. Abdominal Section
 - 1. alteration in function related to disease/injury
 - 2. compensation mechanisms
 - 3. diseases/disorders/injuries (e.g., etiology, manifestations, physical examination, diagnostic studies, history and physical findings/clinical data)
 - a. general abdomen
 - i. abdominal calcifications
 - ii. abdominal aortic aneurysm
 - iii. normal and abnormal gas patterns – (e.g. ileus, obstruction, volvulus)
 - iv. pneumatosis intestinalis
 - v. portal venous gas
 - vi. peritonitis
 - vii. pneumoperitoneum
 - viii. abscess
 - ix. free fluid
 - b. gastrointestinal
 - i. esophagus
 - a) dysphagia
 - b) achalasia
 - c) scleroderma
 - d) fistulae
 - e) esophagitis
 - f) varices
 - g) Crohn's disease
 - h) presbyesophagus
 - i) webs
 - j) diverticuli
 - k) primary muscular and neural disorders
 - l) malignant and benign masses

(Section C continues on the following page)

- ii. stomach
 - a) hiatal hernias
 - b) gastric outlet obstruction
 - c) malignant and benign masses
 - d) gastroparesis
 - e) volvulus
 - f) pyloric stenosis
 - g) bezoar
 - h) ulcers
 - i) gastritis
- iii. small intestine
 - a) diverticuli
 - b) non and malrotated bowel
 - c) duodenitis
 - d) Crohn's disease
 - e) peptic ulcer disease
 - f) malignant and benign tumors
 - g) ischemia
 - h) adhesions
 - i) malabsorption
 - j) hernias
 - k) infections
 - l) fistulae
 - m) superior mesenteric artery (SMA) syndrome
 - n) intussusception
 - o) necrotizing enterocolitis
- iv. large intestine
 - a) intussusception
 - b) Crohn's disease
 - c) polyps
 - d) malignant and benign masses
 - e) Hirschsprung's disease
 - f) fistulae
 - g) inflammatory diseases
 - h) adhesions
 - i) appendicitis
 - j) non-rotation and malrotation
 - k) colitis
 - l) diverticulosis/diverticulitis
 - m) volvulus
 - n) constipation
 - o) toxic megacolon
- v. hepatobiliary, pancreas, and spleen
 - a) hepatitis
 - b) cirrhosis
 - c) pancreatitis
 - d) cholecystitis
 - e) biliary calculi
 - f) liver failure
 - g) portal hypertension
 - h) malignant and benign masses
 - i) inflammatory processes
 - j) biliary dyskinesia
 - k) fatty liver
 - l) Gaucher's disease
 - m) splenomegaly
 - n) pancreatic insufficiency
- vi. renal
 - a) malignant and benign masses
 - b) calculi
 - c) inflammatory processes and abscesses
 - d) acute and chronic renal failure
 - e) glomerulonephritis and nephrotic syndrome
 - f) infarcts/ischemia/thrombosis
 - g) nephrocalcinosis
 - h) renal papillary necrosis
- vii. reproductive
 - a) female
 1. endometriosis
 2. malignant and benign masses
 3. pelvic inflammatory disease
 4. polycystic ovary disease
 5. pregnancy
 - b) male
 1. benign prostatic hypertrophy
 2. malignant and benign masses
 3. inflammatory processes

(Section C continues on the following page)

B. Thoracic Section

1. alteration in function related to disease/injury
2. compensation mechanisms
3. diseases/disorders/injuries (e.g., etiology, manifestations, physical examination, diagnostic studies, history and physical findings/ clinical data)
 - a. inflammatory and infectious diseases
 - b. malignant and benign masses
 - c. adult respiratory distress syndrome (ARDS)
 - d. infant respiratory distress syndrome (IRDS)
 - e. hyaline membrane disease (HMD)
 - f. bronchopulmonary dysplasia (BPD)
 - g. chronic obstructive pulmonary disease (COPD)
 - h. pleural effusions
 - i. asthma
 - j. diaphragmatic paresis
 - k. pulmonary edema
 - l. pulmonary fibrosis
 - m. pulmonary emboli
 - n. atelectasis
 - o. pulmonary venous and arterial hypertension
 - p. calcification
 - q. pneumothorax
 - r. pneumomediastinum
 - s. congestive heart failure (CHF)
 - t. coronary artery disease
 - u. valvular heart disease
 - v. pericardial disease
 - w. cardiac dysrhythmias
 - x. pleural diseases

C. Musculoskeletal Section

1. alteration in function related to disease/injury
2. compensation mechanisms
3. diseases/disorders/injuries (e.g., etiology, manifestations, physical examination, diagnostic studies, history and physical findings/ clinical data)
 - a. arthritis
 - i. gout
 - ii. osteoarthritis
 - iii. rheumatoid arthritis
 - iv. ankylosing spondylitis
 - v. psoriatic arthritis
 - b. trauma (fractures, dislocations, and associated soft tissue injuries)
 - c. tumors
 - i. osteochondroma
 - ii. Ewing's sarcoma
 - iii. osteosarcoma
 - iv. enchondroma
 - v. chondrosarcoma
 - vi. osteoid osteoma
 - vii. metastatic disease
 - d. infection
 - e. acute and chronic osteomyelitis
 - f. soft tissue infection
 - g. diseases
 - i. osteomalacia
 - ii. osteoporosis
 - iii. Paget's disease
 - iv. fibrous dysplasia
 - v. osteogenesis imperfecta
 - vi. renal osteodystrophy

(Section C continues on the following page)

D. Neurological and Endocrine Section

1. alteration in function related to disease/injury
2. compensation mechanisms
3. diseases/disorders/injuries (e.g., etiology, manifestations, physical examination, diagnostic studies, history and physical findings/ clinical data)
 - a. neurological
 - i. cerebrovascular accident (CVA)
 - ii. malignant and benign masses
 - iii. Parkinson's disease
 - iv. amyotrophic lateral sclerosis (ALS)
 - v. multiple sclerosis (MS)
 - vi. hydrocephalus
 - vii. increased cranial pressure
 - viii. infection/inflammation
 - ix. open and closed head injuries
 - x. spinal cord injury
 - xi. seizures
 - xii. myasthenia gravis
 - xiii. Alzheimer's disease
 - xiv. dementia
 - xv. herniated disc
 - b. endocrine
 - i. osteoporosis
 - ii. hyperparathyroidism
 - iii. diabetes
 - iv. pituitary disorder
 - v. hypo and hyperthyroidism
 - vi. Cushing's syndrome

E. Vascular and Lymphatic Section

1. alteration in function related to disease/injury
2. compensation mechanisms
3. diseases/disorders/injuries (e.g., etiology, manifestations, physical examination, diagnostic studies, history and physical findings/ clinical data)
 - a. blood clotting disorders
 - b. anemias
 - c. leukemias
 - d. lymphomas
 - e. multiple myeloma/plasma cell
 - f. shock
 - g. hypertension
 - h. arterio and atherosclerosis
 - i. aneurysm
 - j. varicosities
 - k. arterial venous malformations (AVM)
 - l. lymphedema

D. RADIOLOGIC PROCEDURES (25)

This section addresses radiographic procedures for the categories that follow (I-IV). Questions will cover the following topics:

- Anatomy & Pathophysiology
 - Indications for Procedure
 - Contraindications for Procedure
 - Patient Assessment and Preparation for the Procedure
 - Alternative and/or Complementary Procedures
 - Access Methods and Closure Devices
 - Patient Management During Procedure
 - Operation of Diagnostic Equipment to Reduce Patient Exposure
 - Contrast and Drug Administration
 - Image Enhancement and Post-Processing
 - Evaluation of Images for Diagnostic Utility
 - Complications and Response to Emergencies
 - Post-Procedure Patient Care
 - Outcomes Measurement
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I. FLUOROSCOPIC STUDIES (10)

- A. Upper GI
- B. Esophagus
- C. Small Bowel Studies
- D. Barium Enema
- E. Cystogram
- F. T-Tube Cholangiogram
- G. Hysterosalpingogram
- H. Retrograde Urethrogram
- I. Nasoenteric and Oroenteric Feeding Tube Placement
- J. Port Injection
- K. Fistulogram/Sinogram
- L. Loopogram
- M. Swallowing Study

II. CONTRAST MEDIA – NEEDLE – CATHETER PLACEMENT PROCEDURES (10)

- A. Lumbar Puncture under Fluoroscopic Guidance
- B. Myelogram (Lumbar, Thoracic, Cervical)
- C. Joint Injection and Joint Aspiration
- D. Arthrogram (Conventional, CT and MR)
- E. Peripherally Inserted Central Catheter (PICC) Line Placement
- F. Non Tunneled Venous Central Line Placement
- G. Paracentesis with Appropriate Image Guidance
- H. Thoracentesis with Appropriate Image Guidance

- I. Venous Catheter Placement for Dialysis
- J. Lower Extremity Venography
- K. Breast Needle Localization
- L. Ductogram (Galactogram)

III. IMAGE POST-PROCESSING (3)

- A. Routine CT
 - 1. 3D reconstruction
 - 2. modifications to field of view (FOV)
 - 3. slice spacing
 - 4. algorithm
 - 5. maximum intensity projection (MIP)
 - 6. multiplanar reconstruction
 - 7. quantitative measurements (volume, distance, diameter)
- B. Specialized CT
 - 1. cardiac scoring
 - 2. shunt graft measurements
- C. Routine MR
 - 1. 3D reconstructions
 - 2. maximum intensity projection (MIP)
 - 3. 3D surface rendering
 - 4. volume rendering
 - 5. multiplanar reconstruction
 - 6. quantitative measurements (volume, distance, diameter)

IV. QUALITY IMPROVEMENT PROCEDURES (2)

- A. Patient Centered, Outcomes Based, Quality Improvement Procedures
 - 1. quality of care
 - 2. patient flow
 - 3. patient satisfaction

E. RADIATION SAFETY, RADIATION BIOLOGY, AND FLUOROSCOPIC OPERATION (15)

I. RADIATION SAFETY (5)

- A. Exposure and Dose
 - 1. exposure
 - 2. absorbed dose, equivalent dose, effective dose
 - 3. measurement and calculation of quantities
- B. Radiation Safety Standards
 - 1. organizations and their roles
 - a. National Council on Radiation Protection and Protection (NCRP)
 - b. Nuclear Regulatory Commission (NRC)
 - c. Occupational Safety and Health Administration (OSHA)
 - d. Environmental Protection Agency (EPA)
 - e. Food and Drug Administration (FDA)
 - f. state health departments
 - 2. principles of dose limitation (time, distance, shielding, ALARA)
 - 3. monitoring and measuring devices
 - 4. effective dose limits
- C. Methods to Reduce Patient Exposure
 - 1. intermittent fluoroscopy
 - 2. limitation of field size
 - 3. technique factors
 - 4. filtration of the x-ray beam
 - 5. protective shielding
 - 6. immobilization
- D. High Dose Exams
- E. Methods to Reduce Occupational Exposure
 - 1. variation of exposure from scatter at different locations
 - 2. shielding devices in x-ray rooms
 - 3. personal shielding devices

II. RADIATION BIOLOGY (5)

- A. Cell Growth and Division
- B. Radiosensitivity of Cells
 - 1. direct and indirect effects
 - 2. linear energy transfer (LET)
 - 3. relative biological effectiveness (RBE)
 - 4. oxygen enhancement ratio (OER)
 - 5. dose rate, fractionation, and protraction

C. Radiation Effects

- 1. deterministic effects versus stochastic effects
- 2. background radiation
- 3. dose-response relationships
- 4. skin effects
- 5. acute radiation syndromes
- 6. local tissue damage
- 7. hematological effects
- 8. carcinogenesis
- 9. fetal effects
- 10. genetic effects

III. FLUOROSCOPIC OPERATION (5)

- A. Fluoroscopy
 - 1. components
 - a. x-ray tube
 - b. image intensifier
 - c. collimators
 - d. recording devices
 - i. digital cameras
 - ii. cine
 - iii. spot films
 - iv. photo spot
 - e. generator
 - f. controls (e.g., control panel, foot switches)
 - g. display
 - h. recording
 - 2. static image storage
 - 3. dynamic image storage
 - 4. pulsed fluoroscopy
 - 5. high-level or boost mode
 - 6. technical factors
 - 7. cumulative timer
- B. Equipment Malfunctions
 - 1. collimation
 - 2. exposure limitation
 - 3. dose monitoring
 - 4. interlocks
- C. Dose Monitoring Equipment (e.g., dose area product meters)

F. MEDICAL-LEGAL, PROFESSIONAL, AND GOVERNMENTAL STANDARDS (10)

I. MEDICAL RECORDS (3)

- A. Components of Documentation
 - 1. types of documentation for patient chart
 - 2. electronic and paper records
 - 3. fluoroscopic and image documentation
- B. Techniques and Procedures for Documentation
- C. Document Development and Administration
 - 1. examination findings
 - 2. exceptions from established protocol or procedure
 - 3. patient's questions and concerns
 - 4. information regarding patient care, the procedure and final outcome
 - 5. diagnostic/therapeutic procedure and patient data
 - 6. radiologists report to referring physician
 - 7. direct communication with referring physician
 - 8. discharge summary for radiologists' patient
- D. Informed Consent
 - 1. patient's competence
 - a. mental impairment
 - i. competence-assessment
 - ii. mental status
 - iii. medication
 - b. surrogate consent
 - i. power of attorney
 - ii. family
 - c. patient education
 - i. explain procedure
 - ii. risk versus benefit
 - iii. alternatives and options
 - iv. refusal of procedure and implications

II. REGULATORY REQUIREMENTS (2)

- A. Quality Assurance Management
 - 1. facility rules
 - 2. Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requirements
- B. Credentialing
 - 1. local or hospital requirements
 - 2. state licensing/registration regulations
 - 3. continuing education requirements
 - 4. supervisory notification
 - 5. professional standards
- C. Government regulations
 - 1. Medical Practice Act – supervisory requirements
 - 2. Health Insurance Portability and Accountability Act (HIPAA)
 - 3. public health considerations

III. MALPRACTICE CONSIDERATIONS (3)

- A. Definitions
 - 1. negligence
 - 2. standard of care
 - 3. assault and battery
- B. Legal Doctrines
 - 1. respondeat superior
 - 2. res ipsa loquitur
 - 3. foreseeability
 - 4. personal liability

IV. ETHICS (2)

- A. Patient Rights
- B. Advocacy for Patients
- C. Professional Standards
- D. Medical Values
- E. ARRT Standards of Ethics