



Radiation Therapy

The purpose of continuing qualifications requirements (CQR) is to assist technologists in documenting their continued qualifications in the disciplines of certification and registration held. To accomplish this purpose the continuing qualifications requirements are presented in three parts: the professional profile, the structured self assessment (SSA) and continuing education (CE).

The *Structured Self Assessment Content Specifications for Radiation Therapy* is provided to assist technologists during their CQR compliance period. Its purpose is to prepare technologists for the SSA and to help education providers develop coursework for the technologists who need to address specified areas with targeted continuing education. Targeted CE is assigned only if a standard is not met in a category on the SSA.

The SSA is composed of sets of questions that are designed to evaluate an individual's knowledge in topics related to current practice. Participants are allowed a maximum of two hours and 30 minutes to complete the SSA for Radiation Therapy.

The table below presents the major categories and subcategories covered on the SSA. The number of questions in each category are listed in bold and number of questions in each subcategory in parentheses. The potential number of targeted CE credits that would be prescribed if the standard is not met, are across from each subcategory, with the maximum amount listed at the bottom. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	Number of Questions¹	Potential CE Credits
Patient Care	20	
<i>Patient Interactions (10)</i>		5
<i>Patient and Medical Record Management (10)</i>		4
Safety	20	
<i>Radiation Physics, Equipment, and Quality Assurance (10)</i>		4
<i>Radiation Protection² (10)</i>		5
Procedures	40	
<i>Treatment Sites and Tumors (10)</i>		5
<i>Treatment Volume Localization (10)</i>		3
<i>Prescription and Dose Calculation (10)</i>		4
<i>Treatments (10)</i>		6
	Total 80	Maximum CE 36

¹ The SSA includes an additional 40 unscored (pilot) questions.

² SI units are the primary (principal) units of radiation measurement used on the radiation therapy SSA.



Patient Care

1. Patient Interactions

A. Ethical and Legal Aspects

1. patient's rights
 - a. informed consent
(*e.g., written, oral, implied)
 - b. confidentiality (HIPAA)
 - c. American Hospital Association (AHA) Patient Care Partnership (Patient's Bill of Rights)
 1. privacy
 2. goal of care
(e.g., definitive, palliative)
 3. access to information
 4. living will, advanced directive
(e.g., DNR), health care proxy
 5. research participation
2. legal issues
 - a. verification (e.g., patient identification, treatment site, prescription)
 - b. common terminology (e.g., battery, negligence, malpractice, beneficence)
 - c. legal doctrines (e.g., respondeat superior, res ipsa loquitur)
 - d. restraints versus immobilization
3. ARRT Standards of Ethics

B. Interpersonal Communications

1. modes of professional communication
 - a. verbal/written
 - b. nonverbal (e.g., eye contact, touching)
2. challenges in communication
 - a. interaction with others
 1. language barriers
 2. cultural and social factors
 3. physical or sensory impairments
 4. age
 5. emotional status, acceptance of condition (e.g., stage of grief)
 - b. explanation of medical terms
3. patient education
 - a. explanation of treatment
 - b. strategies to improve understanding
 - c. treatment compliance
(e.g., positioning, skin marks)
4. support services
 - a. hospice
 - b. other professionals
(e.g., dietitian, clergy, social services)

C. Physical Assistance

1. patient transfer and movement
 - a. body mechanics (e.g., balance, alignment, movement)
 - b. patient transfer techniques
 - c. fall prevention
2. assisting patients with medical equipment
 - a. infusion catheters and pumps
 - b. oxygen delivery systems
 - c. other (e.g., nasogastric tubes, urinary catheters, tracheostomy tubes)

D. Medical Emergencies

1. allergic reactions
 - a. contrast media
 1. contraindications
 2. adverse reactions
 - b. other (e.g., latex)
2. cardiac or respiratory arrest
(e.g., CPR)
3. physical injury or trauma
4. other medical disorders
(e.g., seizures, diabetic reactions)

* The abbreviation "e.g.," is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

(Patient Care continues on the following page.)



Patient Care (continued)

E. Infection Control

1. cycle of infection
 - a. pathogen
 - b. reservoir
 - c. portal of exit
 - d. mode of transmission
 1. direct
 - a. direct contact
 - b. droplet
 2. indirect
 - a. airborne
 - b. vehicle-borne – fomite
 - c. vector-borne – mechanical or biological
 - e. portal of entry
 - f. susceptible host
2. asepsis
 - a. equipment disinfection
 - b. equipment sterilization
 - c. medical aseptic technique
 - d. sterile technique
3. CDC Standard Precautions
 - a. hand hygiene
 - b. use of personal protective equipment (e.g., gloves, gowns, masks)
 - c. safe needle practices
 - d. safe handling of contaminated materials
 - e. disposal of contaminated materials
 1. linens
 2. needles
 3. patient supplies
 4. blood and body fluids
4. transmission-based precautions
 - a. contact
 - b. droplet
 - c. airborne
5. additional precautions
 - a. neutropenic precautions (reverse isolation)
 - b. healthcare associated (nosocomial) infections

F. Handling and Disposal of Toxic or Hazardous Material

1. types of materials
 - a. metals (e.g., block alloy)
 - b. chemicals
 - c. chemotherapy
2. material safety data sheet (MSDS)

(Patient Care continues on the following page.)



Patient Care (continued)

2. Patient and Medical Record Management

A. Evaluation

1. epidemiology and etiology
 - a. cancer risk factors
 - b. prevalence and incidence
2. cancer screening
3. signs and symptoms
4. history and physical examination
5. imaging studies (e.g., CT, MRI, PET/CT)
6. other diagnostic studies
 - a. lab results
 - b. surgical reports
 - c. pathology reports

B. Assessment

1. treatment side effects
 - a. signs and symptoms
 - b. causes
 - c. management
2. blood studies
 - a. types of studies
(e.g., CBC, BUN, creatinine)
 - b. factors affecting blood values
3. dietary counseling
 - a. common problems
 - b. causes
 - c. dietary management
4. routine monitoring
 - a. weight
 - b. vital signs
 - c. signs and symptoms
 - d. documentation

C. Documentation

1. information included in treatment record
 - a. prescription
 - b. monitor units
 - c. target dose (daily and accumulated)
 - d. energy and type of radiation
 - e. date
 - f. time of day for b.i.d. treatment
 - g. fraction
 - h. elapsed days
 - i. field number and description
 - j. doses to other regions of interest
 - k. set-up instructions
2. elements of record keeping
 - a. patient identification
 - b. accountability (e.g., signatures)
 - c. accuracy and legibility
 - d. variance from prescription (errors, prescription changes)
 - e. medical events (definition and required documentation)
3. charge capture terminology
 - a. professional and technical components
 - b. CPT® principles



Safety

1. Radiation Physics, Equipment, and Quality Assurance

- A. Sources of Radiation
 - 1. radioactive material
 - 2. machine-produced radiation
- B. Basic Properties of Radiation
 - 1. wave characteristics
 - 2. attenuation
 - 3. inverse-square law
 - 4. x-ray beam quality
- C. Interactions with Matter
 - 1. photon interactions (e.g., Compton, photoelectric effect)
 - 2. electron interactions
 - 3. particle interactions (e.g., proton, neutron)
- D. Components and Operation
 - 1. linear accelerator
 - 2. CT simulator
- E. Quality Control Procedures
 - 1. warm-up and inspection of linear accelerators and CT simulators
 - a. interlock systems
 - b. safety lights
 - c. emergency switches
 - d. critical machine parameters (e.g., pressure, temperature)
 - e. electrical and mechanical hazards
 - f. imaging systems
 - 2. radiation output verification
 - a. methods
 - b. frequency
 - c. effect of environment (e.g., humidity) on measurements
 - 3. light and treatment field checks
 - a. light and radiation field agreement
 - b. collimator indicator agreement
 - c. multileaf collimator performance
 - d. sidelight/laser accuracy check (isocenter)
 - 4. rotation check
 - a. safety procedures
 - b. operation of gantry/console
 - 5. evaluation of quality assurance results
 - a. interpretation
 - b. course of action
 - c. documentation

2. Radiation Protection

- A. Biological Effects of Radiation
 - 1. radiosensitivity
 - 2. dose-response relationships
 - 3. somatic effects
 - a. cellular
 - b. tissue (e.g., hemopoietic, skin, reproductive organs)
 - c. embryonic and fetal risks
 - d. carcinogenesis
 - e. early versus late effects
 - f. acute versus chronic effects
- B. Radiation Tissue Tolerance
 - 1. tolerance levels (TD_{5/5})
 - 2. adverse effects
 - 3. dose to critical structures
 - 4. radiobiological factors (e.g., dose, fractionation, volume)
 - 5. biological factors (e.g., age, anatomic variation, medical conditions)
 - 6. medical factors (e.g., prior surgery, pacemakers)
 - 7. other factors (e.g., radiosensitizers, radioprotectors)
 - 8. contribution from other sources
 - a. chemotherapy
 - b. brachytherapy¹
 - c. other fields (e.g., prior or abutting)
 - d. radiation effect modifiers

¹ Only basic concepts related to common uses of brachytherapy are covered, including dose to surrounding tissue and radiation protection issues. Specific procedures and isotope characteristics are not covered.

(Safety continues on the following page.)



Safety (continued)

- C. Measurement of Radiation
 - 1. units of measurement
 - a. absorbed dose
 - b. dose equivalent
 - c. exposure
 - 2. instrumentation
 - a. ionization chamber
 - b. Geiger-Müller detector
 - c. TLD/OSL (optically stimulated luminescence)
 - d. diodes
 - e. neutron detectors
- D. Fundamental Principles
 - 1. ALARA
 - 2. basic methods of protection (time, distance, shielding)
- E. Personnel Monitoring
 - 1. NCRP recommendations for personnel monitoring (report #116)
 - a. occupational exposure
 - b. public exposure
 - c. embryo/fetus exposure
 - 2. maintenance and evaluation of personnel dosimetry records
- F. Facilities and Area Monitoring
 - 1. NRC regulations (10 CFR, parts 20 and 35)
 - a. classification of areas (restricted, controlled, unrestricted)
 - b. required postings (signs)
 - c. area monitoring devices
 - 2. barrier requirements
 - a. primary
 - b. secondary
- G. Handling and Disposal of Radioactive Materials



Procedures

1. Treatment Sites and Tumors

- A. Anatomy, Pathophysiology, Lymphatic Drainage, and Metastatic Patterns
 1. brain and spinal cord
 2. head and neck (includes thyroid and salivary glands)
 3. breast
 4. lung
 5. abdomen, pelvis, GI, and GU
 - a. esophagus, stomach, small bowel, large bowel, rectum, and anus
 - b. pancreas, adrenals, liver, and gallbladder
 - c. ureters, kidneys, bladder, and urethra
 6. reproductive
 - a. prostate, testes
 - b. endometrium, cervix, ovaries, uterus, vagina, and vulva
 7. skeletal
 8. miscellaneous
 - a. lymphoma (Hodgkin and non-Hodgkin)
 - b. sarcomas (bone and soft tissue)
 - c. multiple myeloma
 - d. skin
 - e. leukemia
 - f. mycosis fungoides
 - g. bone marrow transplant
 - h. benign (e.g., heterotopic bone, keloid, AVM)
 - i. oncologic emergencies (e.g., whole brain, SVC, cord compression)
- B. Tumor Classification
 1. histopathologic types (e.g., benign, sarcomas, carcinomas)
 2. histopathologic grade
 - a. purpose (differentiation and growth rate)
 - b. grading system (e.g., GX, G1-G4)
 3. staging (basic concepts; not specific sites)
 - a. purpose
 - b. components (e.g., TNM, I-IV)

2. Treatment Volume Localization

- A. Treatment Techniques and Anatomic Relationships
 1. radiation therapy techniques
 2. sectional and topographic anatomy
 3. critical organs
 4. patient positioning and immobilization
 5. types and uses of contrast media
- B. CT Simulation
 1. CT image acquisition (e.g., mA, slice thickness, and spacing)
 2. CT image processing and display (e.g., reconstruction, window level, field of view, CT number)
 3. contour volume and isocenter determination
 4. image transmission, storage, and retrieval
 5. programmable lasers
- C. Documentation of Simulation Procedure
 1. anatomic position
 2. equipment orientation
 3. accessory equipment
 4. field parameters
 5. set-up diagrams or photographs
 6. temporary and/or permanent reference marks

(Procedures continues on the following page.)



Procedures (continued)

3. Prescription and Dose Calculation

- A. Treatment Prescription
 - 1. total target dose
 - 2. fractionation schedules
 - 3. beam energy
 - 4. types of radiation
 - 5. treatment volume (e.g., GTV, CTV, PTV)
 - 6. number of fields
 - 7. fixed/rotational fields
 - 8. field weighting
 - 9. field orientation
 - 10. treatment unit capabilities and limitations
 - 11. plan modifications
 - 12. beam modifiers
- B. Geometric Parameters and Patient Measurements
 - 1. field size and shape
 - 2. target depth
 - 3. patient thickness
 - 4. SSD, SAD
 - 5. collimator setting
 - 6. abutting fields (e.g., gap calculations)
 - 7. fusion with outside diagnostic studies
- C. Dose Calculation and Verification
 - 1. selection of energy
 - 2. equivalent square (open and blocked field)
 - 3. scatter factors (e.g., collimator, phantom)
 - 4. D_{max}
 - 5. percentage depth dose
 - 6. TAR, TMR
 - 7. SSD, SAD
 - 8. inverse square
 - 9. extended distance factors
 - 10. wedges (e.g., wedge angle or factor)
 - 11. off-axis calculation
 - 12. isodose curve characteristics (e.g., penumbra, DVH)
 - 13. factors for beam modifiers (e.g., tray factor, bolus, compensator)
 - 14. inhomogeneity correction factors
 - 15. rotational factors
 - 16. machine output data
 - 17. verification and documentation

4. Treatments

- A. Treatment Options (indications, benefits, risks)
 - 1. chemotherapy
 - 2. surgery
 - 3. radiation therapy
 - a. external beam
 - b. brachytherapy²
 - 4. multimodality treatment
- B. Verification and Application of the Treatment Plan
 - 1. patient position
 - 2. isocenter
 - 3. treatment parameters (e.g., beam orientation, energy)
 - 4. prescription
 - 5. modality
 - a. 2D
 - b. 3D
 - c. 4D (e.g., respiratory gating)
 - d. IMRT
 - e. arc therapy
 - f. stereotactic
 - 6. imaging procedures
 - a. kV imaging
 - b. cone beam CT (CBCT)
 - c. MV imaging

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(Procedures continues on the following page.)



Procedures (continued)

C. Treatment Machine Set-Up

1. auxiliary set-up devices
 - a. couch indexing
 - b. positioning aids
 - c. alignment lasers
2. machine operations
 - a. SSD, SAD
 - b. collimator or cone settings
 - c. optical or mechanical distance indicator
 - d. gantry angle
 - e. collimator angle
 - f. field light
 - g. treatment couch
 - h. console controls
 - i. pendant controls

D. Treatment Accessories

1. beam modifiers
 - a. compensating filters
 - b. shielding
 - c. blocks (e.g., thickness, half value layer (HVL), half-value thickness (HVT))
 - d. multileaf collimation
 - e. bolus
 - f. wedges (enhanced dynamic wedge, physical wedge)
2. immobilization devices
 - a. custom
 - b. standard
3. parameters
 - a. SSD, SAD, depth
 - b. gantry, collimator, and field size settings
 - c. beam energy and type

E. Treatment Administration

1. patient monitoring
 - a. visual (mirror, TV monitor)
 - b. two-way voice communication system
 - c. back-up systems
 - d. monitoring regulations
 - e. emergency situations
2. record and verify systems
3. image acquisition and registration
4. site verification
5. dose verification (e.g., diodes, film)
6. equipment malfunctions
 - a. types (e.g., radiation, electrical, mechanical, software)
 - b. troubleshooting and correction
 - c. documentation and reporting