



Radiation Therapy

The purpose of continuing qualifications requirements (CQR) is to assist registered 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 purpose of the CQR SSA is to assist registered technologists identify gaps in the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required for practice within the disciplines of certification and registration held and help direct their professional development efforts.

The *Structured Self Assessment Content Specifications for Radiation Therapy* is provided to assist radiation therapists during their CQR compliance period. Its purpose is to prepare radiation therapists for the SSA and to help education providers develop coursework for the radiation therapists 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 80 minutes to complete the SSA for Radiation Therapy. Please allow an additional eight minutes for the tutorial, two minutes for the non-disclosure agreement (NDA), and 10 minutes for a follow-up survey.

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 Questions	Potential CE Credits
Patient Care	20	
<i>Patient Interactions and Management (10)</i>		5
<i>Patient and Medical Record Management (10)</i>		3
Safety	20	
<i>Radiation Physics and Radiobiology (10)</i>		4
<i>Radiation Protection, Equipment Operation, and Quality Assurance¹ (10)</i>		5
Procedures	40	
<i>Treatment Sites and Tumors (10)</i>		5
<i>Treatment Volume Localization (10)</i>		4
<i>Prescription and Dose Calculation (10)</i>		4
<i>Treatments (10)</i>		6
	Total 80	Maximum CE 36

¹ SI units are the primary (principle) units of radiation measurement used on the radiation therapy SSA.



Patient Care

1. Patient Interactions and Management

A. Ethical and Legal Aspects

1. patients' rights
 - a. consent
(*e.g., informed, oral, implied)
 - b. confidentiality (HIPAA)
 - c. American Hospital Association (AHA) Patient Care Partnership (Patients' Bill of Rights)
 1. privacy
 2. extent of care (e.g., DNR)
 3. access to information
 4. living will, health care proxy, advanced directives
 5. research participation
 6. goal of care (e.g., definitive, palliative)
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 (e.g., positioning aids used to prevent motion)
3. ARRT Standards of Ethics

B. Interpersonal Communication

1. modes of communication
 - a. verbal/written
 - b. nonverbal (e.g., eye contact, touching)
2. challenges in communication
 - a. interactions with others
 1. language barriers
 2. cultural and social factors
 3. physical, sensory, or cognitive impairments
 4. age
 5. emotional status, acceptance of condition (e.g., stage of grief)
 - b. explanation of medical terms
 - c. strategies to improve understanding
3. patient education
 - a. explanation of treatment or procedure (e.g., purpose, length of time, radiation dose)

- b. pre- and post-treatment or procedure instructions (e.g., preparation, diet, and medications)
 - c. respond to inquiries about other imaging modalities (e.g., dose differences, types of radiation, patient preparation)
 - d. treatment compliance (e.g., positioning, skin marks)
4. support services
 - a. hospice
 - b. other professionals (e.g., dietitian, clergy, social services)

C. Ergonomics and Monitoring

1. body mechanics (e.g., balance, alignment, movement)
 - a. patient transfer techniques
 - b. ergonomic devices (e.g., transfer board, Hoyer lift, gait belt)
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)
3. patient monitoring and documentation
 - a. vital signs
 - b. signs and symptoms (e.g., motor control, cognitive changes)
 - c. fall prevention
 - d. weight

D. Medical Emergencies

1. non-contrast allergic reactions (e.g., latex)
2. cardiac/respiratory arrest (e.g., CPR, AED)
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. chain of infection (cycle of infection)
 - a. pathogen
 - b. reservoir
 - c. portal of exit
 - d. mode of transmission
 1. direct
 - a. droplet
 - b. direct contact
 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 handling of contaminated equipment/surfaces
 - d. disposal of contaminated materials
 1. linens
 2. needles
 3. patient supplies
 4. blood and body fluids
 - e. safe needle practices
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. chemicals
 - b. chemotherapy
 - c. metals (e.g., block alloy)
2. safety data sheet (e.g., material safety data sheet)

G. Pharmacology

1. contrast media types and properties (e.g., iodinated, water soluble, barium, ionic versus non-ionic)
2. appropriateness of contrast media to procedure
 - a. patient condition
 - b. patient age and weight
 - c. laboratory values (e.g., BUN, creatinine, eGFR)
3. complications/reactions
 - a. local effects (e.g., extravasation/infiltration, phlebitis)
 - b. systemic effects
 1. mild
 2. moderate
 3. severe
 - c. emergency medications
 - d. radiation therapist's response and documentation

(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, PSA)
 - b. factors affecting blood values
3. dietary counseling
 - a. common problems
 - b. causes
 - c. dietary management

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
 - l. imaging orders
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. basic charge capture terminology¹
 - a. professional and technical components
 - b. general principles and purpose (e.g., billable services, procedures, and devices)

¹ Specific CPT® codes are not covered.



Safety

1. Radiation Physics and Radiobiology

- A. Sources of Radiation
 - 1. radioactive material
 - 2. machine-produced radiation
 - a. target interactions (i.e., bremsstrahlung, characteristic)
 - b. particles (e.g., protons)
- B. Principles of Radiation Physics
 - 1. wave characteristics
 - 2. attenuation
 - 3. inverse-square law
 - 4. x-ray beam quality
 - 5. interactions with matter
 - a. photon interactions (e.g., Compton, photoelectric effect, pair production)
 - b. electron interactions
 - c. particle interactions (e.g., proton, neutron)
 - d. attenuation by various tissues
- C. Biological Effects of Radiation
 - 1. Units of measurement (NCRP #160)
 - a. absorbed dose (Gy)
 - b. dose equivalent (Sv, rem)
 - c. exposure (C/kg)
 - d. effective dose (Sv, rem)
 - e. air kerma (Gy)
 - 2. radiosensitivity
 - a. dose-response relationships
 - b. relative tissue radiosensitivities (e.g., LET, RBE)
 - c. oxygen effect
 - 3. somatic effects
 - a. cells
 - b. tissue (e.g., hemopoietic, skin, reproductive organs)
 - c. embryo and fetus
 - d. carcinogenesis

- e. early versus late or acute versus chronic
 - f. deterministic versus stochastic
 - g. short-term versus long-term exposure
 - h. acute radiation syndromes
 - 1. hemopoietic
 - 2. gastrointestinal (GI)
 - 3. central nervous system (CNS)
 - 4. genetic effects (e.g., genetically significant dose)
- D. Radiation Tissue Tolerance
- 1. tolerance levels (i.e., whole organ TD_{5/5})
 - 2. adverse effects
 - 3. dose to critical structures
 - 4. radiobiological factors (e.g., dose, fractionation schemes, 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. brachytherapy ²
 - c. other fields (e.g., prior or abutting)
 - d. radiation effect modifiers
 - e. daily imaging
 - f. CT simulation

² 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)

2. Radiation Protection, Equipment Operation, and Quality Assurance

- A. Minimizing Patient Exposure
 - 1. exposure factors
 - a. kVp
 - b. mAs
 - 2. shielding
 - a. rationale for use
 - b. types
 - c. placement
 - 3. collimation/beam width
 - 4. patient considerations
 - a. positioning
 - b. communication
 - c. pediatric
 - d. morbid obesity
- B. Personnel Protection (ALARA)
 - 1. sources of radiation exposure
 - 2. basic methods of protection (i.e., time, distance, shielding)
 - 3. personnel monitoring (NCRP recommendations for personnel monitoring, Report #116)
 - a. occupational exposure
 - b. public exposure
 - c. embryo/fetus exposure
 - d. dose equivalent limits
 - e. evaluation and maintenance of personnel dosimetry records
- C. 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

- D. MRI Magnetic Field Screening
 - 1. biomedical implants
 - 2. ferrous foreign bodies
 - 3. medical conditions (e.g., pregnancy)
 - 4. prior diagnostic or surgical procedures
 - 5. topical or externally applied items (e.g., tattoos, medication patches, body piercing jewelry, monitoring devices, clothing)
 - 6. ancillary equipment (e.g., oxygen tank, IV pole)
- E. Handling and Disposal of Radioactive Materials
- F. Components and Operation
 - 1. linear accelerator
 - 2. CT simulator
- G. Instrumentation
 - 1. ionization chamber
 - 2. Geiger-Müller detector
 - 3. TLD/OSL (optically stimulated luminescence)
 - 4. diodes
 - 5. neutron detectors

(Safety continues on the following page.)



Safety (continued)

H. Quality Control Procedures

1. warm-up and inspection of linear accelerators
 - a. interlock systems
 - b. safety lights
 - c. emergency switches
 - d. laser alignment
 - e. critical machine parameters (e.g., pressure, temperature)
 - f. electrical and mechanical hazards
 - g. imaging systems
 - h. audio/visual systems
2. warm-up and inspection of CT simulators
 - a. safety lights
 - b. emergency switches
 - c. laser alignment
 - d. QC water phantom (e.g., CT number, noise)
 - e. tube warm-up
3. radiation output verification
 - a. methods
 - b. frequency
 - c. effect of environment (e.g., humidity) on measurements
4. 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)
5. rotation check
 - a. safety procedures
 - b. operation of gantry/console
6. evaluation of quality assurance results
 - a. interpretation
 - b. course of action
 - c. documentation



Procedures

1. Treatment Sites and Tumors

- A. Anatomy, Pathophysiology, Lymphatic Drainage, and Metastatic Patterns
 1. brain and spinal cord
 2. head and neck (including 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, penis
 - 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, meningioma)
 - 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. systems (e.g., TNM, Ann Arbor)

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)
 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 and Verification of Simulation Procedure
 1. implement according to physician order
 2. anatomic position
 3. equipment orientation
 4. accessory equipment
 5. field parameters
 6. set-up instructions
 7. set-up photographs
 8. 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 (TSD) and SAD (TAD)
 - 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. depth of maximum equilibrium (d_{max})
 - 5. percentage depth dose
 - 6. TAR, TMR
 - 7. SSD (TSD), SAD (TAD)
 - 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. machine output data
 - 16. verification and documentation

4. Treatments

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

² 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.

(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
 - d. motion management
 1. surface guided radiation therapy (SGRT)
 2. gating systems
 3. abdominal compression
2. machine operations
 - a. collimator or cone settings
 - b. optical or mechanical distance indicator
 - c. gantry angle
 - d. collimator angle
 - e. field light
 - f. treatment couch
 - g. six degrees of freedom couch
 - h. console controls
 - i. pendant controls
3. parameters
 - a. SSD (TSD), SAD (TAD), depth
 - b. gantry, collimator, and field size settings
 - c. beam energy and type

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

E. Treatment Administration

1. patient monitoring
 - a. visual
 - b. audio
 - 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)
6. equipment malfunctions
 - a. types (e.g., radiation, electrical, mechanical, software)
 - b. troubleshooting and correction
 - c. documentation and reporting