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The American College of Radiology will periodically define new practice guidelines and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice guidelines and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice guideline and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice guideline and technical standard by those entities not providing these services is not authorized.

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## ACR PRACTICE GUIDELINE FOR RADIATION ONCOLOGY

### PREAMBLE

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to these guidelines will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action

based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

### I. INTRODUCTION

Radiation oncology, together with surgical and medical oncology, is one of the 3 primary disciplines involved in cancer treatment. Radiation therapy with either curative or palliative intent is used to treat up to 60% of all cancer patients [1]. Radiation therapy uses ionizing radiation, delivered with either external beam therapy or radioisotopes, to destroy or inhibit the reproductive ability of neoplastic cells or to cause programmed cell self-destruction (apoptosis). It is also occasionally used to inhibit the growth of non-neoplastic tissues in certain benign diseases.

Separate guidelines and standards define the appropriate use of external beam therapy, brachytherapy, and therapies using radioisotopes, sealed isotopes, and unsealed isotopes.. This guideline addresses the overall role of the radiation oncologist, medical physicist, and other specialized personnel involved in the delivery of radiation therapy.

The use of radiation therapy requires detailed attention to personnel, equipment, patient and personnel safety, and continuing staff education. Because the practice of radiation oncology occurs in a variety of clinical environments, the judgment of a qualified radiation oncologist should be used to apply these guidelines to individual practices.

A literature search was performed and reviewed to identify published articles regarding guidelines and

standards in radiation oncology. Selected articles are found in the suggested reading section.

## II. PROCESS OF RADIATION THERAPY

The clinical use of ionizing radiation is a complex process involving trained personnel who carry out a variety of interrelated activities.

### A. Clinical Evaluation

The initial evaluation of the patient includes obtaining a history, performing a physical examination, reviewing pertinent diagnostic studies and reports, and communicating with the referring physician and other appropriate physicians involved in the patient's care. The extent of the tumor must be determined and recorded for staging; this will facilitate treatment decisions, determine prognosis, and allow a comparison of treatment results. Consideration should be given to performing pain assessment when clinically appropriate.

### B. Establishing Treatment Goals

The goal of treatment (curative, palliative, adjuvant, or to establish local tumor control) should be defined as clearly as possible. Treatment options with their relative merits and risks should be discussed with the patient. If the treatment plan requires combining radiation therapy with surgery, chemotherapy, or other systemic therapies, the anticipated interactions between the modalities should be discussed with the patient. A summary of the consultation should be communicated to the referring physician and to other physicians involved in the care of the patient [2].

### C. Informed Consent

Prior to simulation and treatment, informed consent must be obtained and documented. The anticipated side effects and potential complications, the availability of alternative treatment options, and the risks and benefits of forgoing treatment, should be discussed with the patient. The radiation oncologist should ensure that language and cultural barriers do not prevent the patient from gaining the understanding of his/her disease and treatment plan necessary to provide informed consent [3].

### D. Patient Education

To help patients retain the information that the radiation oncologist imparts to them at the time of the consultation visit, additional reinforcement of patient education may be considered. Techniques may include subsequent visits between the patient and the radiation oncologist or nurse, and/or the use of printed materials or electronic presentations.

### E. Simulation of Treatment

Simulation is the process of establishing and documenting the appropriate volume to be treated and identifying the normal structures within or adjacent to this volume. During simulation, optimal patient positioning is determined. Treatment positioning devices are used or fabricated as needed to aid in optimal positioning and reproducibility. Patient anatomic data are acquired, often with computed tomography (CT) imaging (treatment-planning CT scan) or other modalities (i.e., magnetic resonance imaging (MRI), positron emission tomography (PET), ultrasound). For some situations, simpler 2-dimensional simulation techniques may be appropriate. Beam entry sites and other points helpful in patient positioning and field localization are identified on the patient. All field setups should be documented by properly labeled photographs and/or diagrams and, when appropriate, by standard radiographs or digitally reconstructed radiographs (DRRs).

After treatment planning has been completed, a simulation-per-plan procedure may be appropriate. This procedure involves duplicating the intended treatment setup either on a conventional simulator or on the treatment unit itself. Images of each intended treatment portal and of associated treatment parameters are obtained and are compared to planning images generated from the treatment planning system to confirm accuracy and reproducibility of treatment setup and delivery.

### F. Treatment Planning

The cognitive process of treatment planning requires the radiation oncologist to have knowledge of the natural history of the tumor to be treated and to determine the tumor site, its extent, and its relationship with adjacent normal tissues. This process is based on consideration of the history, physical examination, endoscopy, diagnostic imaging, findings at surgery, pathological findings, and response to previous therapies.

When ionizing radiation is to be used, the radiation oncologist must select beam characteristics and/or radionuclide sources, method of delivery, doses, and coordination with other treatments. Multimodality treatments should be coordinated in collaboration with medical and surgical oncologists and other specialists. The radiation oncologist determines the dose to be delivered to the tumor, limiting doses to critical structures, and the fractionation desired. Using these parameters, the radiation oncologist directs the medical physicist and dosimetrist in the design of potential treatment programs or develops them personally. This process uses the patient data obtained during the initial simulation procedure. Beam-specific physical data are used with source data and other physical characteristics measured by the physicist to calculate the dose to a

specific point within the patient or to calculate the dose distribution within a region of interest.

The radiation oncologist, in consultation with the medical physicist and dosimetrist, selects the treatment plan. The radiation oncologist prescribes the radiation treatment course. The prescription should include: volume (site) to be treated, description of portals (anteroposterior [AP], posteroanterior [PA], lateral, etc.), radiation modality, energy, dose per fraction, number of fractions per day, number of fractions per week, total number of fractions, total tumor dose, and prescription point or isodose volume. The prescription shall be signed by the radiation oncologist prior to the initiation of radiation therapy or approved electronically. The graphical isodose plan, when warranted, should be signed within 1 week of initiation of treatment.

Daily treatments are carried out by the radiation therapist following the prescription and treatment plan of the radiation oncologist. It is essential that all treatment parameters be described in detail and orders be signed by the responsible radiation oncologist. Likewise, any changes in the planned treatment by the radiation oncologist requiring adjustment in immobilization, new calculations, or even a new treatment plan must be documented on the record and signed or initialed by the radiation oncologist.

#### G. Fabrication of Treatment Aids

Devices to aid in positioning and immobilizing the patient, normal tissue shielding, compensating filters, etc. are designed to improve treatment accuracy and reduce treatment toxicity. They should be used where clinically appropriate.

#### H. Physics

The medical physicist, dosimetrist, and radiation oncologist perform the calculations necessary to determine the appropriate dose to be delivered by the treatment equipment. This requires knowledge of the physical properties of the treatment units, whether external beam or radioactive implants. These calculations must be checked by an independent person or method before the first treatment if the total number of fractions is 5 or fewer, or otherwise before the third fraction.

#### I. External Beam Treatment

External beam radiation therapy is usually delivered in single daily doses for several weeks or in multiple increments daily over the same period (hyperfractionation) or over shorter times (accelerated fractionation). Fractionation schemes in which the intended dose is delivered over a shorter time period than

used in standard fractionation using larger-than-usual fraction sizes (hypofractionation) may be appropriate in some clinical situations.

Intensity modulated radiation therapy (IMRT) may be used as a form of external beam RT in some cases. If so, consideration should be given to the [Practice Guideline for Intensity-Modulated Radiation Therapy \(IMRT\)](#) [4]. In some cases, image-guided radiation therapy (IGRT) may also be clinically indicated, and centers that use it should refer to the [Practice Guideline for Image-Guided Radiation Therapy \(IGRT\)](#) [5].

To permit proper delivery of therapy, portal or isocenter verification images produced by each treatment beam unit with the patient in the treatment position are compared with the treatment planning images to verify that the treatment beams and fields planned at simulation are well matched. A set of initial portal or isocenter verification images should be obtained. A set of patient positioning or target localization images should be taken at least every 5 to 10 treatments and for any new fields. Dosimeters may be used in vivo to measure and record actual doses at specific anatomic sites.

#### J. Patient Evaluation During Treatment

The radiation oncologist monitors the patient's progress, checks entries in the treatment chart, and discusses the plan of therapy and any changes with appropriate team members. Re-evaluation examinations of the patient should be performed at least weekly, or more often when warranted. Pertinent laboratory and imaging studies are periodically ordered and reviewed. The patient and/or referring physician should be informed of the progress of treatment whenever deemed appropriate. At completion of irradiation, the radiation oncologist should assess the tumor response and acute side effects.

#### K. Follow-Up Evaluation

After treatment periodic assessments by the radiation oncologist of tumor response and sequelae of treatment are recommended as clinically indicated. They should be communicated to appropriate other physicians. Early detection of post-treatment tumor progression may permit additional, potentially beneficial treatment. Early detection and treatment of radiation-induced sequelae may avoid serious problems later.

#### L. Brachytherapy

Brachytherapy may be used for many sites and may be delivered with either low-dose-rate or high-dose rate techniques. The ACR has practice guidelines relating to low-dose-rate brachytherapy, low-dose-rate brachy-

therapy for prostate cancer, and high-dose-rate brachytherapy [6-8].

#### M. Stereotactic Radiosurgery

Stereotactic radiosurgery may be used for some intracranial lesions and lesions elsewhere in the body. ACR has guidelines relating to stereotactic radiosurgery and stereotactic body radiation therapy [9,10].

#### N. Other Treatment Modalities

Other treatment modalities are sometimes combined with external photon beams or brachytherapy to enhance the antitumor effects and decrease the effects on surrounding normal tissues. Examples include hyperthermia, photodynamic therapy, and the use of unsealed-source radioisotopes [11].

#### O. External Beam Sources

The radiation oncologist may have at his/her disposal external beam treatment equipment that provides beams other than conventional photon and electron beams (e.g., proton beams). The general principles discussed above apply to the use of unconventional beam sources, but special expertise on the part of the radiation oncologist as well as the physics and therapy staff will be required for safe use of this treatment equipment.

### III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

#### A. Qualifications and Certification

1. The medical director of the radiation oncology center or service should be a radiation oncologist who is credentialed as indicated below.
2. Radiation oncologists (staff)
  - a. Certification in Radiology by the American Board of Radiology (ABR) of a physician who confines his/her professional practice to radiation oncology or certification in Radiation Oncology or Therapeutic Radiology by the ABR, the American Osteopathic Board of Radiology, the Royal College of Physicians and Surgeons of Canada, or Le College des Medecins du Quebec may be considered proof of adequate physician qualifications.  
or
  - b. Satisfactory completion of an American Council of Graduate Medicine Education (ACGME) approved residency program or an American Osteopathic Association

(AOA) approved residency program in radiation oncology.

The continuing education of a radiation oncologist should be in accordance with the [ACR Practice Guideline for Continuing Medical Education \(CME\)](#).

#### 3. Qualified Medical Physicist

A Qualified Medical Physicist is an individual who is competent to practice independently one or more of the subfields in medical physics. The American College of Radiology (ACR) considers certification and continuing education and experience in the appropriate subfield(s) to demonstrate that an individual is competent to practice one or more of the subfields in medical physics and to be a Qualified Medical Physicist. The ACR recommends that the individual be certified in the appropriate subfield(s) by the American Board of Radiology (ABR), the Canadian College of Physics in Medicine, or for MRI, by the American Board of Medical Physics (ABMP) in magnetic resonance imaging physics.

The appropriate subfields of medical physics for this guideline are Therapeutic Radiological Physics and Radiological Physics.

A Qualified Medical Physicist should meet the [ACR Practice Guideline for Continuing Medical Education \(CME\)](#). (ACR Resolution 16g, adopted in 2006 – Revised 2008, Resolution 7)

#### 4. Radiation therapists and simulation staff

Radiation therapists and simulation staff should fulfill state licensing requirements, and treating radiation therapists should have American Registry of Radiologic Technologists (ARRT) certification in radiation therapy. Simulation staff should have ARRT certification in either radiation therapy or diagnostic imaging.

#### 5. Dosimetrist

Certification by the Medical Dosimetrist Certification Board is recommended.

#### 6. Patient support staff

Individuals involved in the nursing care of patients should have appropriate nursing credentials and appropriate experience in the care of radiation therapy patients.

## B. Availability

1. A radiation oncologist should be available for direct care and quality review on a daily basis. The radiation oncologist, facility, and support staff should be available to initiate urgent treatment within a medically appropriate response time on a 24-hour basis or refer to a facility that is available to treat on a 24-hour basis. When unavailable, the radiation oncologist is responsible for arranging appropriate coverage. A radiation oncologist's availability should be consistent with state and federal requirements.
2. The medical physicist must be available when necessary for consultation with the radiation oncologist and to provide advice or direction to technical staff when a patient's treatments are being planned or patients are being treated. The center should have written policies specifying any special procedures (e.g., high-dose-rate brachytherapy [6] or stereotactic radiosurgery [9]) that require the presence of the medical physicist. When a physicist is not immediately available on site during routine patient treatment, clinical needs should be met by using documented procedures. Authority to perform specific clinical physics duties shall be established by the medical physicist for each member of the physics staff in accordance with his or her competence. The radiation oncologist should be informed of the clinical activities authorized for each member. Refer to the [ACR Technical Standard for the Performance of Radiation Oncology Physics for External Beam Therapy](#) for minimal requirements for physics support.

## IV. EQUIPMENT SPECIFICATIONS

High-energy photon and electron beams, a computer-based treatment-planning system, simulation, dosimetry with direct participation of the medical physicist, brachytherapy, stereotactic radiosurgery, radioisotope therapy, and the ability to fabricate treatment aids must be available to patients in all facilities, either on site or through arrangements with another center.

A. Radiation oncology equipment, either on site or available through arrangements with another center, should include:

1. Megavoltage radiation therapy equipment for external beam therapy.
2. Electron beam or X-ray equipment for treating skin lesions or superficial lesions.
3. Simulator capable of duplicating the setups of any megavoltage unit and producing either standard radiographs or digitally reconstructed radiographs (DRRs) of the fields to be treated. A dedicated CT simulator may be substituted for a conventional simulator.
4. Appropriate brachytherapy equipment for intracavitary and interstitial treatment (or arrangements for referral to appropriate facilities).
5. Appropriate equipment for stereotactic radiosurgery procedures (or arrangements for referral to appropriate facilities).
6. Computerized dosimetry equipment capable of providing external beam isodose curves as well as brachytherapy isodose curves and 3-dimensional (3D) radiation treatment planning.
7. Physics calibration devices for all equipment.
8. Beam-shaping devices.
9. Immobilization devices.

## B. Maintenance and Repair

Regular maintenance and repair of equipment are mandatory. The medical physicist is responsible for documenting maintenance and repair. It is recommended that the medical physicist maintain up-to-date statistics regarding treatment unit uptime.

The center should have procedures in place to provide treatment for patients in case of extended treatment interruption due to equipment repair, maintenance, or replacement.

## V. PATIENT AND PERSONNEL SAFETY

A. Patient protection measures should include:

1. Charting systems for prescription, definition, and delivery of treatment parameters, and daily dose recording and summation, including appropriate forms for brachytherapy and radiosurgery procedures, as needed.
2. A physics program for calibrating equipment that ensures accurate dose delivery to the patient, including external beam therapy, brachytherapy, and radiosurgery (see [ACR Technical Standard for the Performance of Radiation Oncology Physics for External Beam Therapy](#) [12]).
3. A system for independent checking by another person or method before the first treatment if the total number of fractions is 5 or fewer, or otherwise before the third fraction.
4. A system for independent checking of initial dose for single or 2-fraction treatments (intraoperative, stereotactic, hemibody, etc.) before any treatment is given.

5. A system for the radiation oncologist and medical physicist to check independently all brachytherapy parameters to be used in each procedure (source, isotope and activity, dose rate, source position, total dose prescribed and time, etc.).
6. A program to prevent mechanical injury by the machine or accessory equipment.
7. Visual and audio contact with the patient while under treatment.

**B. Personnel safety measures should include:**

1. A radiation exposure-monitoring program, as required by the Nuclear Regulatory Commission or appropriate state agencies.
2. Systematic inspection of interlock systems.
3. Appropriate room shielding.
4. Routine leak testing of all sealed sources, as required by regulatory agencies.
5. Appropriate safety equipment for use of sealed sources.

**VI. EDUCATIONAL PROGRAM**

Continuing medical education programs should include the radiation oncologists and the physics, dosimetry, nursing, and radiation therapy staffs. The programs must cover the safe operation of facility equipment as appropriate to the individual's responsibility, and the treatment techniques and new developments in radiation oncology. In addition, each licensed staff member will undertake and document continuing professional education as required by his/her licensing authority.

**VII. QUALITY IMPROVEMENT**

The medical director of radiation oncology is responsible for instituting and supervising the continuing quality improvement (CQI) program. It will be the responsibility of the director to identify problems, see that actions are taken, and evaluate the effectiveness of the actions.

The director will select appropriate personnel to constitute a CQI Committee, which will meet on a regular basis. The review will be documented as the committee's minutes. Problems recognized will be addressed, and any special studies or further in-depth analysis required will be outlined and undertaken. CQI records should be maintained in a manner that will, to the extent permitted by state and federal law, protect the confidentiality and undiscoverability of these records.

The following items should be included:

**A. Chart Review**

A designated chart reviewer will audit an appropriate number of charts opened each month after an adequate time has passed to allow completion and closure of these charts. A chart screen must be performed and may include:

1. Diagnosis.
2. Stage of disease.
3. Pertinent histopathologic report.
4. Pertinent history and physical findings of disease.
5. Signed and dated graphical treatment plan (if done) and prescription at beginning of treatment and any prescription changes.
6. Planned total dose, numbers of fractions, dose/fraction, and fractions/day.
7. Method of delivery.
8. Treatment site or treatment volume, with diagrams and/or photographs of fields.
9. Fields documented by port films or electronic portal images.
10. Dosimetry calculations.
11. Summary or a completion-of-therapy note.
12. Follow-up plan.
13. Documentation that the treatment record was checked weekly during treatment.
14. Documented periodic examination of the patient by the radiation oncologist, including patient progress and tolerance.
15. Documented informed consent.

Charts failing to pass any one of the indicators chosen for review will be documented and the report referred to the CQI Committee staff for review and corrective action, as warranted.

**B. Review of regular physics quality improvement program report.**

**C. Review of all cases in which there is a variation from the prescription of greater than 10% of the intended total dose. This review includes any chart in which mathematical corrections of 10% or more are made on the second check of dose calculations.**

**D. If a new treatment modality or technique is started in a facility (e.g., high-dose-rate brachytherapy, stereotactic radiosurgery), the procedures, results, problems, complications, etc. should be reviewed by the CQI Committee in a timely fashion consistent with patient safety.**

E. Review of any chart in which an incident report is filed or in which there is a report of an accident or injury to a patient.

F. Review of unplanned interruptions during treatment; unusual or severe, early or late complications of treatment; and unexpected deaths.

G. Review of outcome studies from the cancer committee, tumor registry, or any other section, department, or committee of an associated hospital that includes radiation oncology patients.

#### H. Individual Physician Peer Review

If there is a hospital-wide or similar broad-ranging peer-review program that includes evaluation of appropriateness of actions by radiation oncologists, this evaluation should be reviewed by the CQI Committee and may be used as its physician peer review. If no such higher-level program exists, or if a separate intradepartmental review is desired, a facility physician peer-review program will be put in place.

It is recognized that the peer-review process for the radiation oncologist in solo practice presents a unique and difficult situation; however, the practitioner should institute a documented peer-review mechanism for reviewing the appropriateness of given treatment.

#### I. Patient Outcome

Radiation oncologists should attempt to follow up, at appropriate intervals, all patients treated with curative intent and document the outcome of therapy, including results of treatment (tumor control, survival) and significant sequelae. Patients who are treated with palliative intent may also require close follow-up. For patients who are not followed by the radiation oncologist, the name of the physician who will be responsible for the patient's ongoing care should be documented.

J. Appropriate patient radiation records should be kept in the radiation oncology department or facility, consistent with state and local requirements.

#### K. Patient-Related Outcome Data

Facilities should collect data for an annual summary, including:

1. Number of new patients.
2. Number of consultations.
3. Number of patients treated.
4. Treatment intent: curative, palliative, and local control.

5. Number of simulations, external treatments, and/or brachytherapy procedures performed.

Facilities should also strive to collect data on:

1. Anatomic site and stage (American Joint Committee on Cancer [AJC], International Federation of Gynecology and Obstetrics [FIGO], etc.) of tumors treated.
2. Stage-related survival and local control.
3. Complications and complication rate.

These functions can be accomplished by maintaining a tumor registry.

#### L. Patient Satisfaction and Quality-of-Life Audits

Throughout the year the facility may endeavor to perform audits of patient attitudes, observations, and recommendations.

#### M. Other General Information That Helps to Assure Quality

The following items are recommended; however, constraints of the practice setting are recognized.

1. New patient review conferences: documented review of plans of management for new patients by attending staff to the greatest degree possible.
2. Portal verification review: documented and dated review of appropriate initial and periodic (at least every 5 to 10 treatments) portal films or electronic portal images by the radiation oncologist.
3. Chart review: documented initial and periodic review of all records of patients under treatment to assess completeness and to monitor patient progress.

### VIII. DOCUMENTATION

Documentation should be in accordance with the [ACR Practice Guideline for Communication: Radiation Oncology](#) [2].

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