# Practice Standards for the Medical Dosimetrist

Approved June 14, 2013

## PREAMBLE

This Scope of Practice is designed to assist the Qualified Medical Dosimetrist in defining his / her roles in the technical services that he/she provides in radiation oncology [1]. This document stresses that it is essential that the Qualified Medical Dosimetrist be an active participant in the collaborative team approach to patient care and that effective communication with the radiation oncology team is essential for providing quality patient care.

The Qualified Medical Dosimetrist (QMD) is an individual who has the knowledge and skills to practice under the supervision of a Licensed Practitioner (Radiation Oncologist) and a Qualified Medical Physicist. This individual may practice independently and uses critical thinking and problem solving skills while exercising discretion and judgment in the performance of medical dosimetry procedures [2].

It is expected that an individual will hold him/herself qualified to practice in medical dosimetry only when the knowledge and skills to perform dosimetric tasks has been established. An individual shall be considered eligible to practice independently if he/she is certified by the Medical Dosimetry Certification Board (MDCB).

The AAMD recommends all personnel practicing in Medical Dosimetry attain certification provided by the MDCB. Accordingly, the CMD (Certified Medical Dosimetrist) is recognized as the appropriate credential for the Medical Dosimetrist [2].

In addition, the Scope of Practice is designed to educate professionals in the fields of health care, education, other communities of interest and the general public regarding the qualifications and abilities of the Qualified Medical Dosimetrist [1]. This document can be used by individual facilities to develop job descriptions and practice responsibilities.

## I. INTRODUCTION

The complex nature of the cancer disease process involves multiple treatment modalities with surgery, medical oncology and radiation oncology among the most common. Depending on the location, pathology and stage of disease, these methods may be used individually, concurrently or sequentially. Radiation Oncology employs ionizing radiation to not only destroy cancerous tumors while sparing surrounding tissue, but is also utilized to treat specific benign conditions. An interdisciplinary team of radiation oncologists, radiation oncology medical physicists, medical dosimetrists, radiation therapists, nurses, and support staff plan and deliver the course of treatment. While each team member plays a critical role in the delivery of health services, it is the medical dosimetrist who performs, assists, or directs the dosimetric treatment planning process as designated by the radiation oncologist or the qualified medical physicist [1].

The Statement on the Scope and Standards of Medical Dosimetry Practice was approved in 2001 [1]. Since that date the field of Radiation Oncology has witnessed tremendous advances in the process of patient treatment. Technology has driven the majority of advances that have been seen in imaging, dosimetric treatment planning, treatment delivery and the recording of patient treatment. In recent years concerns for patient safety and quality assurance have been in the headlines, and the many disciplines within the radiation oncology community have worked together to address these concerns and establish guidelines for promoting a culture of safety in the field of radiation oncology [2].

In the Fall of 2011 the American Association of Medical Dosimetrists Board of Directors requested that the Scope of Practice of the Medical Dosimetrist and Practice Standards for Medical Dosimetrists be reviewed and revised to reflect the advances in the field of radiation oncology and the changing role of the medical dosimetrist. The Scope of Practice of the Medical Dosimetrist was revised, reviewed by members of ASTRO and AAPM, and approved by the AAMD board of directors in October 2012. The Practice Standards of the Medical Dosimetrist have been developed with members of ASTRO, AAPM and SROA actively involved in both the creative and review processes. These Practice Standards were approved by the AAMD board of directors on June 14, 2013 and forwarded to the MDCB.

Practice Standards are guidelines used to determine what a medical dosimetrist should or should not do. Practice Standards may be defined as a “benchmark of achievement which is based on a desired level of excellence”. A “Standard” as it relates to professionals is a guide to established practices that are considered sufficient and acceptable. Standards of practice provide a guide to the knowledge, skills, judgment and attitudes that are needed to practice safely [3].

These Practice Standards for Medical Dosimetrists shall be considered the baseline for quality medical dosimetry practice. As a “Living” document, it will be modified with the laws governing medical dosimetry practice. (Currently there are no laws governing medical dosimetry.) The goal was to make these standards applicable to the medical dosimetrist in any setting. Ultimately, this will govern the practice of the medical dosimetrist at all levels of practice [4].

Professionals who employ this document must be cognizant of state and federal laws affecting their practice as well as institutional policies and guidelines. The intent is not to supersede these laws or affect the interpretation or implementation of such laws. It may serve, however, as a model for the development or modification of licensure laws [1, 5].

## II. FORMAT

The 2001 Standards of Medical Dosimetry Practice were divided into three sections: clinical performance, quality performance and professional performance [1]. For the revised Standards of Practice, the task group reviewed practice standards and practice guidelines from several professions that comprise the radiation oncology team. To best reflect the growing role of the medical dosimetrist, a format was selected that defines practice standards by specific aspects of radiation oncology and treatment techniques similar in design of the American College of Radiology Practice Guideline for Radiation Oncology Res. 8-2009 [2]. This format should allow for revision as the profession continues to evolve. In addition a brief description to each section is provided so that individuals not familiar with terminology and techniques would have a reasonable understanding of each section.

## III. 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. The following information is specifically related to the Qualified Medical Dosimetrist [1].

## A. Clinical Evaluation [1]

The Radiation Oncologist has the ultimate responsibility to perform a complete and thorough initial evaluation of each patient. Beyond that, however, the QMD has an obligation to communicate to the Radiation Oncologist any further information found during the process of assessing and designing a dosimetric treatment plan. The QMD 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 QMD's course of action should be in accordance with department/ institution policies and procedures.

The QMD should have access to the patients' clinical evaluation information and be familiar with basic patient anatomy as demonstrated by computed tomography and other modalities used in dosimetric treatment planning (i.e., magnetic resonance imaging (MRI), positron emission tomography (PET), ultrasound). The QMD should be cognizant of any patient limitations that may impact dosimetric treatment planning.

A clinical assessment by a QMD includes an evaluation of patient setup and position, prior irradiation, and patient condition (such as weight gain or loss). Any limitations discovered during the planning process are also a part of the Clinical Assessment: (e.g. patient physically unable to maintain treatment position, inadequate pre-simulation patient, claustrophobic patient, uncooperative patient, etc.).

After the dosimetric treatment planning process is complete, the QMD shall ensure that all dosimetric treatment parameters are clearly documented and orders are approved by the responsible radiation oncologist prior to the initiation of radiation therapy. For a patient undergoing external beam radiation, the QMD should periodically monitor treatment sites, and changes in the treatment area that may affect depth or volume of calculation should be evaluated to determine the necessity of an adjustment in the original dosimetric treatment plan. Any changes in the planned treatment prescribed by the radiation oncologist, such as adjustment in mobilization, new calculations, or design of a new dosimetric treatment plan must be documented on the record and approved by the radiation oncologist.

## B. Establishing Treatment Goals [1, 2]

The QMD must clearly know the physician-directed treatment goals for the cancer patient. He/she evaluates the patient in order to provide knowledge and guidance for the following:

- Delineation of prior irradiated areas.
- Dose tolerances of normal tissues and critical structures.
- Application of the therapeutic modalities to achieve treatment goals.
- Delineation of critical structure volumes.
- Reproducible positioning, immobilization and verification of patient positioning.

## C. Informed Consent [1, 2]

Informed consent provides important documentation of the complex process of the physician's discussion with the patient, and by his/her signature or signature of a legal guardian, a patient indicates that he/she understands and consents to the treatments and procedures that will be performed. Informed consent with appropriate documentation must follow institutional policies and procedures and comply with applicable state and federal law. Physician informed consent for radiation oncology procedures must be obtained by or under the supervision of a licensed physician qualified to perform the procedure.

The QMD may be called upon to provide information and standardized information materials. As a member of the treatment team, he/she may also serve as a witness to the informed consent to verify that the patient understands the procedure.

**D. Patient Education**

Effective patient education is vital throughout the patient's treatment process. Accurate and easily communicable educational information in the clinic helps to ensure the desired treatment outcome [1]. Educational opportunities may include but are not limited to the initial consultation with the radiation oncologist, subsequent visits between the patient and the radiation oncologist, nurse, medical resident, nurse practitioner, and physician assistant, and the use of printed materials or electronic presentations, and explanations and instructions regarding the entire treatment process [2].

The responsibility to educate the patient and the family may be shared by many members of the radiation oncology team. The QMD should be prepared to provide accurate and appropriate patient education in accordance with departmental/institutional policies. This communication should facilitate the establishment of a positive relationship with the patient, family members, and health care providers while preserving all measures of patient confidentiality [3].

Accurate and appropriate patient education by the QMD includes, but is not limited to:

- Assess the patient's need for information.
- Provide reassurance and privacy.
- Address patient questions and concerns regarding the procedure.
- Refer questions about diagnosis, treatment, or prognosis to the patient's physician.
- Accurate explanation and instruction at a level that the patient can comprehend and retain.

  Specific information may include delivery of radiation, instructions for the daily maintenance of treatment field markings, and instruction on self-care procedures [3].

**E. Simulation of Treatment**

Simulation can be broadly defined as the process of establishing the volume to be treated and the normal structures adjacent to or within this volume. This includes the determination of optimal simulation techniques, patient positioning, and positioning aids and immobilization devices [1, 2].

The QMD, in accordance with departmental/institutional policy, should participate in the development of optimal treatment strategies using critical thinking skills and technical knowledge during the simulation process that results in attainable radiation therapy plans.

This participation may include, but is not limited to the following [2, 3]:

- Acquisition of patient data via computer generated data sets from medical imaging devices such as CT, PET, MR, etc.
- Acquisition of patient data via manual methods such as physical measurements and wire contour.
- Input into the use or necessity of ancillary treatment devices and patient immobilization techniques.
- Any additional patient positioning techniques needs for simulation.

**F. Fabrication of Treatment Aids**

Devices to aid in positioning and immobilizing the patient, normal tissue shielding, compensating filters, bolus, etc. are designed to improve treatment accuracy and reduce treatment toxicity. They should be carefully designed and used where clinically appropriate [1].

The QMD should be involved in the consultation, development and fabrication of treatment aids and devices [2]. The Qualified Medical Dosimetrist works under the direction of the Qualified Medical Physicist and the Radiation Oncologist to design and fabricate optimal treatment aids as necessary.

**G. Physics**

Calculations are performed to determine the appropriate dose to be delivered by the treatment equipment. Calculations are performed for all external beam treatments and brachytherapy treatments [1].

The QMD uses knowledge of the physical properties of the treatment units, both external beam and radioactive implants, to perform dose calculations, both manual and computer generated, for treatment delivery [1, 2]. These calculations may include, but are not limited to beam modifying devices, irregular fields, gaps for adjacent fields, and off-axis calculations for external beam treatment units. Calculations for brachytherapy require the QMD to use his/ or her knowledge of radioactive isotopes, radioactive decay, source construction, and optimal geometry of source placement [2].
The QMD may perform these calculations independently and may provide assistance with calculations to the Qualified Medical Physicist [2].

**H. Patient Evaluation during Treatment**

Throughout the entire course of treatment, each patient should be continuously monitored for any unwanted effects, reactions, and therapeutic responses as directed by the Radiation Oncologist or Qualified Medical Physicist [1]. The Radiation Oncologist should be informed of the patient's progress any time it is determined to be appropriate.

The QMD may be involved in the monitoring of the patients in accordance with institutional/departmental policy. Patient monitoring and evaluation may include the following [2, 3]:

- Periodic review of the patient treatment record.
- Patient weight gain / loss.
- Anatomic changes.

**I. External Beam Treatment** [1-7]

External beam treatment includes, but is not limited to, the following: 2D/3D treatment, Intensity Modulated Radiation Therapy, Image Guided Radiation Therapy, Stereotactic Radiosurgery, Stereotactic Body Radiosurgery, Total Body Irradiation, and any other source of external radiation treatment. External beam treatment also includes, but is not limited to, the use of individualized immobilization devices, skin bolusing, methods, computer-generated radiographic image reconstruction, and sophisticated breath control techniques and motion detection.

For the QMD, participation includes, but is not limited to, the following activities, which are performed under the supervision of Qualified Medical Physicists and Radiation Oncologists and in accordance to each institution's policies:

- Consultation during simulation.
- Design of treatment modifying devices, including bolus.
- Dosimetric treatment planning.
- Associated calculations.
- Appropriate documentation.
- Quality assurance.

**J.Dosimetric Treatment Planning**

**1. 2D Planning**

2D dosimetric treatment planning refers to a traditional technique of planning from a two dimensional single plane radiographic image or a single external patient contour that is most often acquired using lead wire or plaster strips in conjunction with physical measurements. The contour must contain the central ray location, point of calculation and one collimator axis of a beam that is coplanar with the contour plane [1]. Two examples of a single plane image include radiographs taken during simulation using a conventional simulator, and a single axial CT slice from a CT exam [1, 2].

Multiple radiographs can allow for organs at risk to be identified, i.e. spinal cord, lungs, heart, kidneys, bladder, and rectum [2].

For the QMD, participation includes, but is not limited to, the following activities, which are performed under the supervision of Qualified Medical Physicists and Radiation Oncologists and in accordance to each institution's policies [3]:

- Acquisition of patient data from manual contour and physical measurements.
- Incorporation of patient contours and physical measurements while applying principles and concepts of radiation physics and treatment machine properties in order to develop an optimal dosimetric treatment plan based upon the Radiation Oncologists written directive.
- Understand and perform calculations pertaining to bean modifying devices, irregular fields, gaps for adjacent fields and off-axis calculations.
- Evaluation of information generated from the radiation treatment plan to measure its appropriateness and efficacy.
- Accurate transferal of treatment parameters into the patient treatment record.
- Available for assistance with the patient set-up and treatment execution.

**2. 3D Conformal Dosimetric Treatment Planning**

Three dimensional or 3D conformal radiation dosimetric treatment planning (3D-CRT) is a type of external beam dosimetric planning that utilizes image based studies to acquire a 3D visualization of the treatment site and surrounding area. When used in conjunction with treatment planning evaluation tools, an optimal treatment field arrangement of tailored radiation treatment fields are utilized to deliver conformal doses of radiation to the tumor and affected area while reducing dose to nearby healthy tissue [1, 2].

For the QMD, participation includes, but is not limited to, the following activities, which are performed under the supervision of Qualified Medical Physicists and Radiation Oncologists and in accordance to each institution's policies [3 – 11]:

- Contour clearly discernible critical normal structures.
- Ensure proper orientation of volumetric patient imaging data on the 3D RTP system.
- Design and generate the 3D dosimetric treatment plan in consultation with the Radiation Oncologist and Qualified Medical Physicist as required.
- Generate all technical documentation required to implement the 3D dosimetric treatment plan.
- Transfer 3D plan parameters (including beam monitor units) and planning images to the treatment delivery unit.
- Participate in peer review of contours, prescription, 3D dosimetric treatment plans, and verification images in conjunction with other members of the team.
- Is available to assist the Radiation Therapist with the implementation of the dosimetric treatment plan.
- Participates in QA under the supervision of the Qualified Medical Physicist.

### 3. Intensity Modulated Radiotherapy (IMRT) Dosimetric Treatment Planning

Intensity Modulated Radiotherapy (IMRT) to include Volumetric Modulated Arc Therapy (VMAT) is an inverse dosimetric planning technique in which the dose across the treatment site is modulated resulting in sharp dose gradients between target and non-target areas in a conformal manner while delivering minimal dose to critical structures and surrounding normal tissue. This is accomplished by the use of multiple beam projections and beams containing multiple segments to modify the beam intensity across the field. The QMD specifies desired dose constraints for the target(s), adjacent structures, critical structures, beam energy, and beam orientation. The treatment planning system will optimize a plan and create intensity fluences for each beam based on data input and prioritization of structures in order to deliver a dose distribution to meet planning objectives [1, 2]. IMRT requires sophisticated treatment planning systems and specialized training for all personnel involved.

For the QMD, participation includes, but is not limited to, the following activities, which are performed under the supervision of Qualified Medical Physicists and Radiation Oncologists and in accordance to each institution's policies [3 – 9]:

- Contouring of clearly discernible critical normal structures.
- Ensuring proper orientation of volumetric patient image data on the IMRT RTP system (from CT and other fused image data sets).
- Design and generate the IMRT dosimetric treatment plan under the direction of the Radiation Oncologist and the Qualified Medical Physicist as required.
- Generate all technical documentation required to implement the IMRT dosimetric treatment plan.
- Be available for the first treatment and assist with verification for subsequent treatments as necessary.

### 4. 4D Dosimetric Treatment Planning

4D dosimetric treatment planning adds the dimension of motion to the treatment planning image. It involves respiratory correlated CT (4D-CT) imaging and image guided tracking of tumor motion. 4D dosimetric treatment planning should be employed when respiratory motion is a concern, particularly in the thoracic and abdominal regions [1]. There are several techniques for 4D dosimetric treatment planning such as gating and non-gating approaches [2, 3]. It may be used in IMRT and Stereotactic Body Radiotherapy/Stereotactic Ablative Radiotherapy (SBRT/SABR) dosimetric treatment planning with the aim of maximizing tumor dose by tracking and compensating for target motion during radiation treatment delivery while minimizing normal tissue dose to surrounding structures [4]. 4D planning and 4D CT data acquisition requires sophisticated helical multi-slice CT scanners, treatment planning systems, and specialized training for all personnel involved.

For the QMD, participation includes, but is not limited to the following activities, which are performed under the supervision of a Qualified Medical Physicist and Radiation Oncologist, in accordance to each department/ institution's policies and procedures [5 – 14]:

- Assist in the planning and implementation of patient positioning and immobilization devices as needed.
- Participation in image acquisition according to department policies.
- Participation in the analysis of organ motion and delineation.
- Contouring clearly discernible critical normal structures.
- Ensuring the proper orientation of volumetric patient imaging data on the 3D RTP system.
- The design and generation of the 4D dosimetric treatment plan in consultation with the Radiation Oncologist and Qualified Medical Physicist as required.
- Generate all technical documentation required to implement the 4D dosimetric treatment plan.
- Transfer all 4D dosimetric plan parameters (including beam monitor units) and planning images to the treatment delivery unit.
- Participation in peer review of contours, prescription, 4D dosimetric treatment plans, and verification images in conjunction with other members of the team.
- Is available to assist the Radiation Therapist with the implementation of the dosimetric treatment plan.
- Participation in QA under the supervision of the Qualified Medical Physicist.

## K. Stereotactic Radiotherapy (SRT) / Stereotactic Radiosurgery (SRS)/ Stereotactic Body Radiotherapy (SBRT) / Stereotactic Body Radiosurgery (SBRS) [1 – 3]

Stereotactic Radiation Therapy (SRT) and Stereotactic Radiosurgery (SRS) are external beam radiation treatment techniques designed specifically to deliver very high doses of radiation for cranial lesions in either a single fraction (SRS) or in multiple fractions (SRT). Additionally, Stereotactic Body Radiation Therapy (SBRT) and Stereotactic Body Radiosurgery (SBRS) are similar but designed for extra cranial lesions also in either a single fraction (SBRS) or multiple fractions (SBRT). The term Stereotactic Ablative Radiotherapy (SABR) is also used to describe these techniques. Specialized dosimetric planning techniques, or even specific treatment planning systems are utilized to design a dosimetric treatment plan that will not only have high target doses, but steep dose fall off gradients outside of the Radiation Oncologist determined target volume.

A high level of coordinated efforts on the part of the Simulation Radiation Therapists, Radiation Oncologist, Qualified Medical Dosimetrist, Qualified Medical Physicist, and treating Radiation Therapists must be practiced in order to assure high quality, timely, accurate treatment delivery. In addition, strict quality assurance measures, as well as machine tolerance parameters must be utilized for SRT and/or SRS procedures. Additionally, if medical dosimetry training did not include SRS/ SRT/ SBRT/ SABR training and direct clinical experience, then specific training and mentoring in these procedures should be obtained prior to performing any radiosurgical procedure. In addition there may be vendor specific delivery systems that require additional training.

For the QMD, participation includes, but is not limited to the following activities, which may be performed under the supervision of a Qualified Medical Physicist and Radiation Oncologist, in accordance to each department/ institution's policies and procedures:

- Contour clearly discernible critical normal structures.
- Ensure proper orientation of volumetric patient imaging data and the radiation therapy treatment planning (RTP) system (from computed tomography and other fused image data sets).
- Design and generate the dosimetric treatment plan under the direction of the Radiation Oncologist and the Qualified Medical Physicist as required.
- Generate all technical documentation required to implement the dosimetric treatment plan.
- Be available for the first treatment and assist with verification for subsequent treatments as necessary.

**L. Craniospinal Irradiation (CSI) [1, 2]**

Craniospinal Irradiation (CSI) is a highly specialized technique utilized in the treatment management of central nervous system malignancies such as medulloblastoma, neuroectodermal tumors, ependymomas, gliomas and some leukemias. CSI is particularly demanding technically due to the potential gaps, overlaps or unacceptable dosimetry isodose distributions that may be encountered. Multimodality imaging is typically used for better target delineation. Immobilization devices are generally non-invasive and are chosen to significantly reduce patient movement, prevent target misalignment, and to improve the accuracy of treatment delivery.

A high level of coordinated efforts on the part of the Simulation Radiation Therapists, Radiation Oncologist, Medical Dosimetrist, Medical Physicist, and Treating Radiation Therapists must be practiced in order to assure high quality, timely, accurate treatment delivery. In addition, strict quality assurance measures, as well as machine tolerance parameters must be utilized for Craniospinal Irradiation procedures.

- For the QMD, the following duties may be performed, under the supervision of a Qualified Medical Physicist and Radiation Oncologist in accordance to each department/institution's policies and procedures:Participation in radiation treatment simulation during creation of immobilization devices and obtaining of treatment planning images.
- Ensuring proper orientation of volumetric patient image data into treatment planning system (from CT and other fused data sets).Contouring of clearly discernible normal structures.
- Participation with the Radiation Oncologist and the Qualified Medical Physicist regarding treatment set up decisions (allowable couch angles, treatment machine choice, etc.) as needed or requested.
- Design and generate the dosimetric treatment plan in consultation with the Radiation Oncologist and the Qualified Medical Physicist as required.
- Generation of dose calculations for treatment.
- Generation of all technical documentation required for the implementation of the CSI dosimetric treatment plan.
- Transfer the CSI plan parameters (including bean monitor units) to the treatment delivery unit.
- Participation in dose measurements under the direction of the Qualified Medical Physicist.
- Participate in QA under the supervision of the Qualified Medical Physicist.
- Be available for the first treatment and assist with verification for subsequent treatments as necessary.

**M. Image Guided Radiotherapy (IGRT)**

Image guided radiation therapy (IGRT) is fraction-by-fraction imaging and guidance within the treatment room [1]. IGRT is used to localize the target and normal structures at the time of treatment to ensure accurate treatment while minimizing the volume of normal tissue exposed [2].

For the QMD, the following duties may be performed, under the supervision of a Qualified Medical Physicist and Radiation Oncologist in accordance to each department/institution's policies and procedures [2]:

- Consult with, and communicate the treatment plan to, the multi-professional radiation treatment team.
- Contours of critical normal structures, with extreme accuracy.
- Ensure proper orientation of volumetric patient image data.
- Design and generate the dosimetric treatment plan under the direction of the radiation oncologist and medical physicist.
- Generate all technical documentation required for accurate implementation of the IGRT dosimetric treatment plan.
- Devise and transfer well-defined digitally reconstructed radiographs (DRRs).
- Be available for the initial treatment verification, first treatment, and subsequent treatments as necessary.

**N. Total Body Irradiation (TBI)**

Total Body Irradiation (TBI) is a large field radiotherapy technique that has played an important role in hematopoietic stem cell transplant (HSCT). TBI has primarily three objectives: immunosuppression to avoid rejection of donor transplant; eradication of malignant cells such as in the case of leukemia, lymphoma and some solid tumors; and eradication of cell populations with genetic disorders [1].

For the QMD, the following duties may be performed, under the supervision of a Qualified Medical Physicist and Radiation Oncologist in accordance to each department/institution's policies and procedures [2 – 7]:

- Generation of the dose calculations for treatment.
- Accumulation of accurate dosimetry measurements.
- Assistance with patient setup and immobilization.
- Assistance with measurements with phantom prior to patient setup for dose verification.
- Assist with "in vivo" dosimetry measurements.
- Participation in QA under the supervision of the Qualified Medical Physicist.
- Availability for assistance of the Therapists as the patient set-up and treatment is executed.

**O. Total Skin Electron Irradiation (TSEI)**

Low energy electrons have been found useful for treating superficial lesions covering large areas of the body, such as mycosis fungoides and other cutaneous lymphomas. At these energies, electron beams are characterized by a rapid falloff in dose beyond a shallow depth and a minimal x-ray background. Thus, superficial skin lesions extending to about 1 cm depth can be effectively treated without exceeding bone marrow tolerance [1]. This therapy is also identified in the literature by combinations of words in part abstracted from total skin electron therapy together with additions such as: whole body or whole skin, superficial irradiation, or electron beam [2].

The majority of TSEI procedures are time-consuming to carry out because of the multiple field and patient – position requirements [2].

TSEI procedures require that a rigorous quality assurance program be established. The QMD may be called upon to assist the Qualified Medical Physicist with the various types of dosimetric measurements that are performed prior to initiating TSEI procedures [1, 2].

For the QMD, the following duties may be performed, under the supervision of a Qualified Medical Physicist and Radiation Oncologist in accordance to each department/institution's policies and procedures [2, 3]:

- Patient positioning.
- Providing auxiliary patient support devices.
- Shielding of specific anatomic sites or organs.
- Maintenance of shielding between treatments.
- In vivo dosimetry that is necessary to assess the uniformity of dose and confirm monitor calibration.

**P. Proton Therapy [1, 2]**

Proton beam radiotherapy is used to treat most of the tumors that are traditionally treated with x-rays and electrons. The most commonly used applications are the treatment of tumors in close vicinity of critical normal structures. Protons inherently have less entrance and exit dose, therefore the integral dose is significantly less than photons. Therefore, protons are a preferred modality in the treatment of pediatric tumors where there is always a concern for a possible development of secondary malignancies during the lifetime of the patient.

The QMD should be eligible to participate in all aspects of proton beam therapy. To be effective the QMD should possess:

- A working knowledge of the interactions of protons with matter.
- The radiobiology of charged particles.
- How protons are generated and delivered.
- The dosimetry of proton beams.
- Dosimetric treatment planning with proton beams.
- Understand the uncertainties related to proton therapy.
- The quality assurance program at their institution.

The QMD should then be eligible to participate in the development of optimal treatment strategies, in accordance with the written directive, that result in attainable proton therapy plans that include:

- Image import and registration.
- Localization of tumor volumes.
- Localization of critical structures.
- Generation of isodose distributions.
- Evaluation of information obtained from dosimetric treatment plans, such as isodose distributions, dose volume histograms (DVH's), and other data.
- Performance of dose calculations.
- Accurate transfer and documentation of treatment parameters.

**Q. Brachytherapy**

Brachytherapy is a method of treatment in which sealed radioactive sources are used to deliver radiation at a short distance by interstitial, intracavitary, or surface application. With brachytherapy a high radiation dose can be delivered locally to the tumor with rapid falloff in the surrounding normal tissue [1].

For the QMD, the following duties may be performed, under the supervision of a Qualified Medical Physicist and Radiation Oncologist in accordance to each department/institution's policies and procedures [2 - 5]:

- Implant localization.
- Dosimetric treatment planning.
- Associated calculations.
- Source assay.
- Source inventory.
- Source preparation.
- Source transportation.
- Consultation during applicator placement and loading.
- Quality assurance.
- Loading and/ or removal of radioisotopes.
- Participation in low dose rate (LDR), pulsed dose rate (PDR), and high dose rate (HDR) procedures.

It is imperative that the QMD be appropriately trained in emergency procedures and follows the principles of ALARA to minimize exposure to patients, staff and others [3].

The QMD is considered eligible to do all of the above listed tasks, unless specifically prohibited by state statue or rule; NRC regulations allow other individuals to administer ionizing radiation to patients provided it is under the personal supervision of an authorized user [2].

## IV. QUALIFICATIONS AND RESPONSIBILITIES

### A. Qualifications and Certification [1, 2]

Qualified Medical Dosimetrist

A Qualified Medical Dosimetrist (QMD) is an individual who has the knowledge and skills to practice under the supervision of a Radiation Oncologist and a Qualified Medical Physicist. This individual uses critical thinking and problem solving skills as well as exercises discretion and judgment in the performance of medical dosimetry procedures.

As a member of the radiation oncology team, the Qualified Medical Dosimetrist has knowledge of the overall characteristics and clinical relevance of radiation oncology in the management of cancer or other disease process, with special expertise in radiation therapy treatment planning.

It is expected that an individual will hold him/herself qualified to practice in medical dosimetry only when the knowledge and skills to perform dosimetric tasks has been established. An individual shall be considered eligible to practice independently if he/she is certified by the Medical Dosimetry Certification Board.

The American Association of Medical Dosimetrists (AAMD) recommends all personnel practicing in Medical Dosimetry attain, at a minimum, certification provided by the Medical Dosimetry Certification Board (MDCB). Accordingly, the CMD (Certified Medical Dosimetrist) is recognized as the appropriate credential for the Medical Dosimetrist.

**B. Responsibilities**

The essential responsibility of the Qualified Medical Dosimetrist (QMD) is to demonstrate an understanding of topics including, but not limited to cancer, radiation biology, radiation therapy techniques, radiation oncology physics, equipment technology, radiation safety and protection, anatomy, physiology, and mathematics to generate dosimetric treatment plans. Once the dosimetric treatment plan has been generated the QMD is responsible for communicating the plan to the Licensed Practitioner, and then to the Radiation Therapist for implementation. The QMD must maintain a commitment to a high degree of accuracy, attention to detail, and safety. The QMD uses critical thinking skills when performing dosimetric treatment planning, plan evaluation, recognizing and resolving equipment problems and treatment discrepancies [1, 2].

**The Qualified Medical Dosimetrist should always be aware of limitations of his/her skills, knowledge, credentials, and experience and will only undertake tasks that he/she is qualified to perform. It is expected that an individual will hold him/herself qualified to perform tasks only when the knowledge and skills to perform those tasks has been established [1]. Certification, alone, does not qualify a QMD to perform all procedures in the Scope of Practice/ Practice Standards. Additional training, education, and experience should be acquired when appropriate [3]. The Qualified Medical Dosimetrist will follow all federal and state regulations regarding licensing, certification, and registration and know when to disclose known limitations when relevant [1].**

**C. Education [1 - 3]**

The AAMD recommends that Qualified Medical Dosimetrists entering the field be prepared for this profession by earning the minimum of a Baccalaureate degree, completing a Medical Dosimetry educational program accredited by the Joint Review Committee on Education in Radiologic Technology (JRCERT) and obtaining certification by the Medical Dosimetry Certification Board (MDCB).

Beginning in 2017, minimum requirements for MDCB eligibility include a Baccalaureate degree and graduation from a JRCET accredited Medical Dosimetry educational program. The AAMD fully supports the 2017 initiative.

**V. PATIENT AND PERSONNEL SAFETY**

Each facility should have in place policies and procedures to provide for the safety of patients and personnel. These should include attention to the physical environment; the proper use, storage, and disposal of medications and hazardous materials and their attendant equipment; and methods for addressing medical and other emergencies [1].

The Qualified Medical Dosimetrist may be involved in activities designed to enhance the safety of patients as well as the public and health care providers during diagnostic and therapeutic services [2]. The QMD role in safety and quality in cancer care delivery includes but is not limited to:

- Participation in pretreatment team discussion to anticipate dosimetric challenges with a patient's treatment. This might include results from research and analysis of the patient's previous radiation treatment history.
  In consultation with team members, the responsibilities of the dosimetrist may include, but are not limited to, participation in decisions/recommendations for appropriate patient positioning, positioning aids, immobilization for simulation and treatment and other strategies to curb potential dosimetric and safety challenges.
- Communicate thorough information about treatment strategy to the radiation oncology team members to assure safety and accuracy.

- Participation in chart rounds.
- Participation in safety rounds within radiation oncology. Participation in safety rounds to discuss near misses or unsafe conditions causing potential or real harm to patients or employees is critical in facilitating a culture of safety [3].
- Adhereance to radiation oncology and institutional safety guidelines and standards at all times.
- Practice ALARA. As defined in Title 10, Section 20.1003, of the Code of Federal Regulations (10 CFR 20.1003), ALARA is an acronym for "as low as (is) reasonably achievable," which means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical, consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- Practice a culture of safety within the department and organization.
- Actively participates on an error reporting and analysis committee, when present.
- Practice the successful application of quality assurance as applicable.
- Develop collaborative partnerships with other healthcare providers in the interest of safety.
- Reviews safety issues related to data transfer, equipment and materials performance, under established guidelines of a Qualified Medical Physicist.
- The Qualified Medical Dosimetrist is trained in emergency plans outlined by their institution in order to ensure patient safety at all times and recognizes a patient emergency and activates established emergency procedures [2].

## VI. EDUCATIONAL PROGRAMS

The Qualified Medical Dosimetrist should continually strive to improve their knowledge and skill sets related to the medical dosimetry profession [1]. The field of radiation oncology is a continuously growing and rapidly evolving field. Participation in appropriate continuing medical dosimetry education activities and sharing knowledge and skills with colleagues is essential [2]. Each licensed, credentialed, and /or certified staff member will undertake and document continuing professional education as required by the appropriate licensing authority [3].

## VII. QUALITY IMPROVEMENT [1]

A Quality Improvement Program is recommended for every Radiation Oncology Facility. A Quality Improvement Program's goal includes, but is not limited to, the following: identify problems, create action plans, verify action plan was taken, and evaluate the effectiveness of the action plan.

The Qualified Medial Dosimetrist should participate in the departmental QI program per departmental policies.

## VIII. DOCUMENTATION AND COMMUNICATION

Radiation oncology incorporates the science and technology of complex, integrated radiation treatment delivery and the art of managing individual patients [1].
It is essential that both documentation and communication be timely, accurate, and precise to provide each patient with optimal care [1, 2].

The Qualified Medical Dosimetrist's participation in both documentation and communication is essential to the process of patient data acquisition, dosimetric treatment planning, treatment evaluation, accurate treatment delivery, and quality management for radiation oncology patients [3].

The Qualified Medical Dosimetrist is able to clearly and accurately communicate with the Radiation Oncologist and the Qualified Medical Physicist during the treatment planning process [3].

The Qualified Medical Dosimetrist is able to accurately transfer and document the treatment parameters either manually or electronically, according to department policies, and then clearly communicates the treatment plan to the Radiation Therapists [3].

The Qualified Medical Dosimetrist may be involved in the performance and documentation of daily and weekly checks on calculations, treatment delivery, and treatment charting, depending upon departmental policies. He/ or she also participates in documentation as related to fiscal practices, such as billing, in accordance with institutional policies [3].

The Qualified Medical Dosimetrist is expected to participate in the documentation of dosimetry/ departmental procedures, and to openly and effectively communicate with all members of the radiation oncology team.

As is becoming increasing understood, maintaining a safety culture in the healthcare environment is critical to patient safety [4]. Therefore, the Qualified Medical Dosimetrist should understand the ways in which they can contribute to safety culture. The QMD should foster a sense of teamwork both within teams and across teams. He/she should pay particular attention to communication around handoffs and transitions. The QMD should engage in honest reporting about any adverse events. They should display commitment to organizational learning. The QMD should adopt a non-punitive response to error, free from shaming or judgment. He/she should also be vocal about any practices which might negatively impact a patient.

**Practice Standards for the Medical Dosimetrist**
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**Practice Standards for the Medical Dosimetrist**
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