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THE SOLO PRACTICE OF MEDICAL PHYSICS IN RADIATION ONCOLOGY

Report of the AAPM Professional Information & Clinical Relations Committee Task Group #11

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PREFACE

A significant portion of radiation oncology in the United States is practiced in moderately sized clinics with a single individual responsible for the institution's medical physics activities. Medical physicists in “solo practice” face challenges and conditions very different from those faced by physicists working in larger groups. The solo practice medical physicist is likely to be responsible for a broad range of duties, and for both implementing and overseeing a system of quality control and audits to ensure patient safety. Additionally, effective peer review is difficult and expensive to implement in the solo practice environment.

This report summarizes the recommendations of the Professional Information & Clinical Relations Committee’s Task Group on The Solo Practice of Medical Physics in Radiation Oncology. The charge of this Task Group was to propose standards and recommendations for the solo practice of radiation oncology physics.

Introduction

"The Role of a Physicist in Radiation Oncology," an AAPM report, describes the role of medical physicists in radiation oncology [(1)]. Guidelines for the performance of some aspects of radiation oncology physics have been published by the AAPM[(2–4)], the American College of Medical Physics (ACMP)[(5,6)] and the American College of Radiology (ACR)[(7–12)]. The AAPM has defined a "qualified medical physicist" as "an individual who is competent to practice independently in one or more of the sub-fields of medical physics." Further, "The AAPM regards board certification in the appropriate medical sub-field and continuing education as the appropriate qualifications for the designation of Qualified Medical Physicist." *Throughout this report, "physicist" specifically refers to a Qualified Medical Physicist in the medical sub-field of radiation oncology*.

Certification does not, however, preclude the occurrence of mistakes and recently (2000) the International Atomic Energy Agency (IAEA) published an analysis of accidental exposures in radiotherapy[(13)], suggesting measures for the prevention of such incidents. The Quality of Health Care in America Project, initiated by the Institute of Medicine (IOM) and supported by the National Research Council, recently submitted its first report on errors in medicine[(14)], with recommendations for reducing the rate of errors. Recommendation 7.2 of this report states, in part, that "Professional societies should make a visible commitment to patient safety by establishing a permanent committee dedicated to safety improvement. This committee should…(3) Recognize patient safety considerations in practice guidelines and in standards related to the introduction and diffusion of new technologies, therapies, and drugs…".

This AAPM Task Group report "Solo Practice of Medical Physics in Radiation Oncology" is a direct response to the above recommendation, as the practice of the medical physicist in radiation oncology includes unique responsibilities for the safety of the patients under treatment. These responsibilities include the calibration of the radiation beams and sources and development and management of the system of dosimetry as it is applied to individual patients, ensuring that the oncologist's prescription is delivered in a safe and accurate manner.

The solo practice physicist faces a considerable challenge: to provide up-to-date, high-quality physics services in a small- to medium-sized institution whose resources are often limited, and in some cases, to cover multiple sites. In addition to these challenges, the solo practice physicist is often expected to perform multiple "non-traditional" duties, such as supporting computer systems and networks, establishing and verifying interfaces with multiple imaging systems, overseeing institutionwide radiation safety programs, and assuming various managerial responsibilities.

This document presents guidelines for the solo practice physicist to aid in providing a consistently high level of quality in the medical physics services offered.

Established Practice Patterns

Certain practice patterns in radiation oncology medical physics have been established and accepted. For instance, the calibration of dose from clinical megavoltage photon and electron beams was standardized in 1983 according to the AAPM Task Group 21 protocol(15). In 1999 the standard was updated to the protocol established by AAPM Task Group 51(16). Calibration of the institution's reference dosimetry instruments is performed every 2 years at an Accredited Dosimetry Calibration Laboratory, ensuring consistency in the absolute calibration of dose from teletherapy treatment units.

In addition to calibration protocols, reports of AAPM Radiation Therapy Committee's Task Groups 45 and 56 established a code of practice for the physics of medical electron accelerators and brachytherapy(3,4), and Task Group 40 established an overall set of guidelines for quality assurance in a radiation oncology department(2). Numerous other AAPM Task Group reports address specific technologies and clinical procedures. These established practice patterns have been endorsed by the ACR(7–12). This report assumes that the aforementioned practice patterns are met, and is strictly concerned with additional measures to ensure quality standards for the solo practice physicist.

Basic Resources for the Solo Practice of Radiation Oncology Medical Physics

As is evident from the following guidelines, ensuring high standards of safety and quality in radiotherapy physics requires a significant commitment both by the physicist *and* by the clinic's administration. The physicist's ability to meet such standards of safety and quality is directly affected by the administration's investment in the necessary infrastructure. The following components are crucial to ensuring that a solo physicist has the necessary resources:

A. Adequate staffing level of physicist coverage.

B. Adequate staffing levels of dosimetrist(s) and support personnel.

C. Appropriate authority delegation such that all staff providing physics- or dosimetry-related services within the clinic report directly to the medical physicist, who in turn reports to the medical director.

D. Equipment for dosimetry, treatment planning, and radiation safety surveys to meet the physicist's stated needs.

E. Service support agreements for linear accelerators, simulators, treatment verification systems, treatment planning systems, and computer networks.

F. Regular, timely upgrades of computer technology.

G. When implementing a new technology or service, inclusion of staff training in the project's budget, and allowing sufficient time for the physicist to complete testing and validation prior to commencing clincal use.

H. Adequate funding for continuing professional development and training programs.

Guidelines for the Solo Practice Physicist

The following guidelines are presented:

1. Adequate amount of physicist time on-site

Many solo practice physicists provide services to multiple clinics, and are therefore present part-time at any one clinic. The IOM report(14) identified time pressure and interruptions as frequent causes of human error. While each clinic has different needs and will therefore require different physics services, the physicist and clinic administration must ensure that the physicist will have adequate time on-site during normal working hours to observe treatments, be available for staff consultation, perform thorough work, and provide thoughtful data analysis.

The staffing question is a challenging issue beyond the scope of this report. The Abt "Study of Medical Physicist Work Values for Radiation Oncology Services"(18) assessed the medical physicist work within the United States radiation oncology community by evaluating the physicist work associated with the 77300 CPT series procedures. A revised Abt report will be completed in 2003. The AAPM TG-45 report specifically recommends a minimum staffing level of one full-time physicist for a facility with one dual-energy accelerator[3]. A joint European task group [European Society for Therapeutic Radiology and Oncology (ESTRO)/European Federation of Organisations for Medical Physics (EFOMP)][19] stressed the increasing importance of medical physics staffing levels for quality assurance and patient safety. The British Institute of Physics & Engineering in Medicine (IPEM) recently issued "Guidelines for the Provision of a Physics Service to Radiotherapy"[20], quantifying minimum physics staffing levels, and the European Federation of Organisations for Medical Physics (EFOMP) issued a Policy Statement[21] quantifying minimum physics staffing levels.

2. Annual review by a qualified medical physicist

A formal agreement with an outside, qualified medical physicist should include a minimum of one full-day visit per year, with a written report to the solo physicist summarizing the findings of the review and providing suggestions for further enhancement of the physics program. At a minimum, the annual peer review should include the components outlined below. The qualified physicist performing the peer review shall personally verify these items **and report on each item in writing**. *The written report should be addressed to the solo practice physicist*, and should also address components A through G in the previous section entitled "Basic resources for the solo practice of radiation oncology medical physics". An executive summary of this report should be provided to the administrator responsible for Radiation Oncology and to the medical director.

Note: *The format of the agreement with an outside physicist should be established in consultation with the solo physicist and the administrator responsible for radiation oncology*. Some possible scenarios include: A contractual agreement with an individual, qualified physicist; a mutual written agreement whereby the two physicists provide annual reviews of each other's program; a contractual agreement with a larger institution whereby the larger institution provides a qualified physicist annually for a review.

The following components will be part of this review:

- Independent check of treatment machines' output calibrations (including source strength verification for high-dose rate (HDR) units). For the linear accelerators, the reviewer may alternately verify that independent thermoluminescent dosimeter (TLD) output verifications have been performed during the past year, and that the results are within acceptable tolerances.

- Chart audit of a *minimum* of five randomly selected, recently completed treatment charts for patients treated during the review period. The charts should be representative of the most common disease types treated in the clinic. The chart audit should include:
    - Verifying that the dosimetry calculations were checked by a second person or second method, before the lesser of three fractions or 20% of the total dose was delivered;
    - Verifying that the chart was reviewed by the physics staff on a weekly basis;
    - Verifying that the physicist reviewed the chart at the completion of treatment; and
    - Assessing whether the treatment plan is technically and physically reasonable, and well documented. (Evaluate, at a minimum: proper localization of target and relevant normal organs, beam geometry, use of beam modifiers, beam margins around target, choice of treatment modality and energy, choice of dose reference point and normalization.)
- Review of the quality control and quality assurance program, using AAPM's TG-40 "Comprehensive QA for Radiation Oncology" as a guideline (as well as other Task Group reports as appropriate for specialty procedures).
- Assessment of whether the clinical physics program is adequately documented in such a way that another physicist could readily continue the clinic's physics services in the event of an unplanned extended absence. At a minimum, clear documentation should exist for: clinical dose calculations, treatment machine calibrations and routine quality control, dosimetry equipment quality control, and clinical physics quality assurance.
- Verification that the clinical physics program is in compliance with applicable radiation safety regulations (e.g., accelerator license, Radiation Safety officer (RSO) designation, occupational dose limits, and review of radiation surveys for any new treatment room construction).
- Review of the physicist's continuing professional development records, using the ACR Standard for Continuing Medical Education[17] as a reference.

- Review of the arrangements in place for physicist coverage of extended absences by the solo physicist for vacations, illness, and continuing professional development.
- Assessment of whether the existing provisions for on-site physicist coverage are adequate for the scope of clinical services provided at the facility.
- Review of service agreements in place for major equipment (including, but not limited to, accelerators, simulators, treatment planning computers, and patient management computer systems), and assessment of additional equipment needs consistent with the scope of clinical services being provided and/or in the process of implementation.

3. Physicist coverage during absences

A formal arrangement should provide for medical physics coverage during planned absences. This arrangement should provide for a level of on-site physics services that is appropriate for the institution's clinical program, to be provided by a qualified medical physicist.

4. Standardization and documentation

The IAEA and IOM reports[13,14] both conclude that standardization of routine procedures, coupled with clear and complete documentation of these procedures, can significantly reduce the potential for error. Though a solo practice physicist may feel that such an approach is less important in the solo practice environment, the potential for error would clearly be magnified at times of physicist absence or succession without these safeguards. Patient safety should be of prime concern, and standardization of procedures, with clear documentation, is equally important in the solo practice environment and is therefore recommended.

5. Continuing professional development and maintenance of competency

The solo practice physicist must remain well informed of developments in the fields of radiation oncology, imaging, and radiation protection, and be able to advise the institution on future technology investments. This will ensure that the physicist is included in preparations for new imaging and radiotherapy services. Participation in national meetings (annual professional society meetings and conferences) is an effective way for the physicist to maintain up-to-date knowledge.

Active use of the AAPM's Remotely Directed Continuing Education (RDCE) program is recommended. The practicing physicist should obtain 100 Medical Physics Continuing Education Credits every 3 years. The physicist should also ensure that the dosimetry staff participates in adequate relevant continuing education in keeping with standards established by the American Association of Medical Dosimetrists (AAMD). Finally, the physicist should work with the clinic staff to present periodic in-service training sessions on topics relevant to the clinic's services. These should provide the staff with current information on new technology or new services, and thereby reduce the risk of human error.

6. Practice accreditation or comprehensive review

Independent on-site radiation oncology practice accreditation, such as that offered by the ACR and other organizations, is invaluable in assuring that all aspects of the entire radiation oncology program are in keeping with current national standards. The accreditation process provides objective peer review of many aspects of the practice (not simply the physics program), and helps demonstrate the physicist's adherence to national standards. While such accreditation is voluntary in most states and can require significant expenditure, accreditation is particularly valuable for the solo practice physicist and may provide an independent perspective on how the physics program synergizes with the overall clinical program. *Alternatively*, a comprehensive review may be performed and documented by an external auditor at an interval not to exceed 5 years, covering topics similar to the practice accreditation programs.

7. Periodic assessment of resource needs

Many new services, if implemented clinically, require significant personnel and appropriate physics instrumentation. An annual review of the institution's current and planned clinical physics services would be prudent. Significant new clinical services, such as three-dimensional (3-D) conformal therapy, intensity-modulated therapy, or HDR brachytherapy, may significantly increase the physicist's workload. This is particularly important for the solo practice physicist who may not have as much flexibility in absorbing increased workloads as a group of several physicists. Such reviews should be conducted jointly with the radiation oncologist and the administration, and should separately assess manpower and physics instrumentation needs.

8. Introduction of new procedures

Every clinic, regardless of size, should have a structured approach to the introduction of new services and procedures, including critical assessment of the quality and effectiveness of the new procedure(7,14). For the solo practice physicist, this process is perhaps more important than in larger centers, due to the lack of on-site colleagues to provide critique and advice. Any significant new technology or treatment method should be reviewed by a second qualified medical physicist prior to clinical implementation; the total project budget should include this review (either consultant fees for an on-site review, or travel expenses for the solo practice physicist to visit other institutions with experience in the new service).

Summary

To ensure safe and accurate delivery of radiation therapy in clinics staffed by a single medical physicist, the eight aforementioned components must be addressed. This requires a qualified medical physicist who remains up-to-date on developments in radiation oncology physics, a strong commitment by the clinic's administration and radiation oncologist(s) to the aforementioned components, and a positive collaboration between these professionals focused on the goal of safe, high-quality delivery of radiation therapy.

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References

1. AAPM (1993). "The Role of a Physicist in Radiation Oncology." AAPM Report No. 38 (American Institute of Physics, New York).

2. AAPM (1994). "Comprehensive QA for Radiation Oncology." Task Group 40 of the Radiation Therapy Committee. *Med. Phys*. 21:581–618. Also published as AAPM Report No. 46 (American Institute of Physics, New York).

3. AAPM (1994). "AAPM Code of Practice for Radiotherapy Accelerators." Task Group 45 of the Radiation Therapy Committee. *Med. Phys*. 21:1093–1121. Also published as AAPM Report No. 47 (American Institute of Physics, New York).

4. AAPM (1997). "AAPM Code of Practice for Brachytherapy Physics." Task Group 56 of the Radiation Therapy Committee. *Med. Phys*. 24:1557–1596. Also published as AAPM Report No. 59 (American Institute of Physics, New York).

5. ACMP (2000). "ACMP Draft Standard for External Beam Radiation Oncology Physics (Draft)." (American College of Medical Physics, Reston, VA).

6. ACMP (2000). "ACMP Draft Standard for Telemedicine as it Pertains to the Practice of Medical Physics in Radiation Oncology (Draft)." (American College of Medical Physics, Reston, VA).

7. ACR (1999). "ACR Standard for Radiation Oncology." (American College of Radiology, Reston, VA).

8. ACR (1998). "ACR Standard for Radiation Oncology Physics for External Beam Therapy." (American College of Radiology, Reston, VA).

9. ACR (1998). "ACR Standard for Quality Assurance of Radiation Oncology Dose-Distribution Calculation and Implementation." (American College of Radiology, Reston, VA).

10. ACR (2000). "ACR Standard for the Performance of Brachytherapy Physics: Remotely Loaded HDR Sources." (American College of Radiology, Reston, VA).

11. ACR (2000). "ACR Standard for the Performance of Brachytherapy Physics: Manually-Loaded Temporary Implants." (American College of Radiology, Reston, VA).

12. ACR (2001). "ACR Standard for 3-D External Beam Radiation Planning and Conformal Therapy." (American College of Radiology, Reston, VA).

13. IAEA (2000). "Lessons Learned from Accidental Exposures in Radiotherapy." Safety Reports Series No. 17. (International Atomic Energy Agency, Vienna, Austria).

14. IOM (2000). "To Err is Human: Building a Safer Health System." Quality of Health Care in America project. (Institute of Medicine, Washington, DC).

15. AAPM (1983). "A protocol for the determination of absorbed dose from high-energy photon and electron beams." Task Group 21 of the Radiation Therapy Committee. Med. Phys. 10:1–31.

16. AAPM (1999). "AAPM's TG-51 Protocol for Clinical Reference Dosimetry of High-Energy Photon and Electron Beams." Task Group 51 of the Radiation Therapy Committee. *Med. Phys*. 26:1847–1870. Also published as AAPM Report No. 67 (Medical Physics Publishing, Madison, WI).

17. ACR (2000). "ACR Standard for Continuing Medical Education (CME)." (American College of Radiology, Reston, VA).

18. AAPM (1993). "Study of Medical Physicist Work Values for Radiation Oncology Services." Abt Associates report to AAPM. (American Institute of Physics, New York).

19. S. Belletti, A. Dutreix, G. Garavaglia, H. Gfirtner, J. Haywood, K. A. Jessen, I. L. Lamm, B. Mijnheer, A. Noel, F. Nüsslin, U. Rosenow, P. Schneider, W. Seelentag, S. Sheriff, H. Svensson, and D. Thwaites. (1996). "Quality assurance in radiotherapy: The importance of medical physics staffing levels. Recommendations from an ESTRO/EFOMP joint task group." *Radiother. Oncol*. 41:89–94.

20. IPEM (2002). "Guidelines for the provision of a physics service to radiotherapy." Policy Statement of the Institute of Physics & Engineering in Medicine. (IPEM, York, UK.)

21. EFOMP (1997). "Criteria for the staffing levels in a medical physics department." Policy Statement Number 7. (European Federation of Organisations for Medical Physics, Nancy, France.)

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