

Chapter 16

Radiation Oncology Medical Physics Resources for Working, Teaching, and Learning

Jacob Van Dyk

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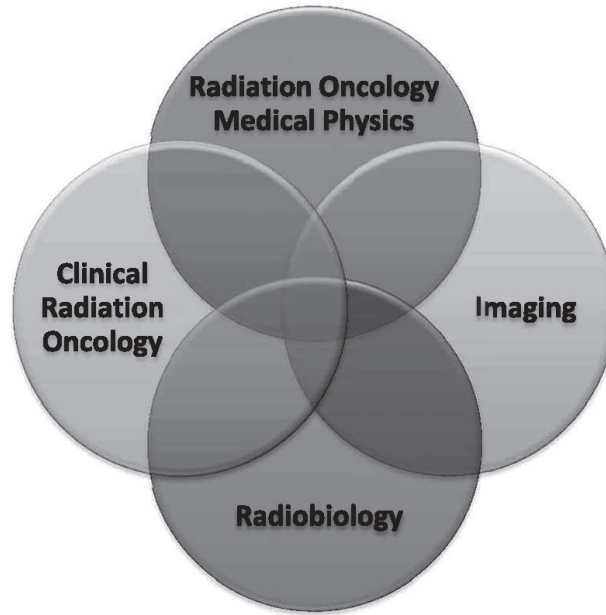
16.1 Introduction

Medical physics is the application of physics to medicine. Radiation oncology medical physics is a sub-discipline within medical physics that has a special application of medical physics in the context of radiation oncology. However, there are three other major sub-disciplines associated with radiation oncology medical physics as shown in the figure below. To practice their professional discipline, radiation oncology medical physicists need to have a clear understanding of relevant medical physics, in addition to components of clinical radiation oncology, radiobiology, and imaging. Furthermore, the other associated professionals—i.e., radiation oncologists, radiation therapists, and dosimetrists—need to have an appropriate knowledge of radiation oncology medical physics. While the Venn diagram below demonstrates overlapping sub-topics, the magnitude of these sub-topics is not to scale and, moreover, these are dynamic with time.

Twenty years ago, imaging was only a small component of a radiation oncology medical physicist's needed knowledge base, but there has been a tremendous growth in the use of computerized tomography (CT) both for treatment planning and image guidance, in addition to the more recent applications of imaging modalities such as magnetic resonance imaging (MRI), positron emission tomography (PET), single photon emission tomography (SPECT), and ultrasound (US). Additionally, with a greater use of dose-volume constraints for treatment planning, combined with the possibility of optimizing individual treatment plans based on radiobiological endpoints, a much greater knowledge of radiobiology is also required.

In terms of the working environment, the radiation oncology medical physicist is involved in all the technical and physics aspects associated with radiation treatment:

1. Physicists participate in the general design of radiation therapy facilities.
2. Physicists are major partners in the purchase and acquisition of radiation treatment and related equipment.
3. Physicists have a major responsibility for the accuracy and quality of the computerized treatment planning process.
4. Physicists develop and execute the quality assurance program, including the quality control of individual technologies associated with radiation treatment, as well as patient-specific treatment and dose verification.



Schematic Venn diagram demonstrating the multidisciplinary nature of radiation oncology medical physics.

5. Physicists are involved in all aspects of radiation safety, including the design of treatment and imaging rooms, licensing applications for nuclear regulatory agencies, staff monitoring of radiation exposures to personnel, development of an incident (error) reporting system, and addressing any radiation-related concerns for patients, the hospital staff, students, and the general public.
6. Physicists keep abreast of the developments in new technologies which are evolving at an enormously rapid rate and provide a leadership role in the implementation of new techniques and technologies as they become available to the clinic.
7. Physicists provide in-service education sessions for staff on topics related to treatment techniques, quality assurance programs, and radiation safety procedures.
8. For institutions having academic responsibilities associated with nearby universities, medical physicists may be involved in teaching radiation oncology medical residents, radiation therapists, medical physics residents, or medical physics students at the undergraduate and graduate levels. Furthermore, all medical physicists are involved in some sort of teaching, whether this be formal course lectures to students, in-service education, introductions to new techniques and technologies, or the necessary annual radiation safety lectures to professional staff.
9. Furthermore, academically oriented medical physicists may have significant research responsibilities.

The education and training required for radiation oncology medical physicists and the career structure of radiation oncology medical physicists in Canada has been described in detail by Van Dyk and Battista [2].

The combination of the multidisciplinary nature of medical physics and the rapid evolution of technology results in a dynamic, lifelong, learning environment for medical physicists and the other associated professionals, e.g., medical physics assistants/associates/technologists, radiation oncologists, dosimetrists, and radiation therapists.

There is a plethora of professional and educational resources available for all the professionals involved in radiation oncology. However, these resources are not always known to medical physics practitioners, especially those who are in the learning or early phases of their careers. This chapter provides a summary of resources that can be used by radiation oncology medical physicists for working, teaching, and learning. The intent is to provide an overview of the available resources. The level of importance of each cited resource will depend on the needs and the local circumstances; hence, there is no prioritization of the resources listed in this chapter. The use of references in peer-reviewed journals has been minimized since the reference list would become extremely long. In some cases, as with staffing considerations, a few on-line peer-reviewed articles are referenced.

The chapter is broadly divided into a series of subsections to provide some guidance to the uninitiated in the field. However, it is clear that there is significant overlap between the categorizations in many instances. For example, references within “Basic Radiation Therapy Physics” may also appear in “Clinically Applied Radiation Oncology Physics.” The concept and format of this chapter was influenced by the Resource Letters published by the American Journal of Physics, especially the most recent one that was done on medical physics in radiation therapy [1].

16.2 General Textbook References

The following references are categorized by the sub-title of the section and then listed in reverse chronological order, i.e., the most recent being first.

16.2.1 Basic radiation therapy physics

Proton Beam Therapy by Harald Paganetti, IOP Publishing, Bristol, UK 2017 (Physics World eBook series). <http://iopscience.iop.org/book/978-0-7503-1370-4>.

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Applied Physics for Radiation Oncology, Revised edition. R. Stanton and D. Stinson. Madison, WI: Medical Physics Publishing, 2009.

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Radiation Oncology Physics: A Handbook for Teachers and Students. E. B. Podgorsak, editor. Vienna, Austria: International Atomic Energy Agency (IAEA), 2005. Available on-line at http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1196_web.pdf.

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The Basic Physics of Radiation Therapy. J. Selman. Springfield, IL: Charles C. Thomas, 1990.

Introduction to Radiological Physics and Radiation Dosimetry. F. H. Attix. Weinheim, Germany: Wiley-VCH, 1986.

Absorption of Ionizing Radiation. D. W. Anderson. Baltimore, MD: U. Park Press, 1984.

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Radiation Dosimetry, Volume 1, Fundamentals, 2nd edition. F. H. Attix and W. C. Roesch, editors. New York: Academic, 1968.

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Radiation Dosimetry, Volume 3, Sources, Fields, Measurements, and Applications, 2nd edition. F. H. Attix and Eugene Tochilin, editors. New York: Academic, 1969.

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Emerging Technologies in Brachytherapy. W. Y. Song, K. Tanderup, and B. Pieters. Boca Raton, FL: CRC Press, Taylor and Francis, 2017.

Tutorials in Radiotherapy Physics: Advanced Topics with Problems and Solutions. P. N. McDermott. Boca Raton, FL: CRC Press, Taylor and Francis, 2016.

Khan's Treatment Planning in Radiation Oncology. F. M. Khan, Ph.D (Author), J. P. Gibbons (Editor), P. W. Sperduto (Editor). Lippincott Williams & Wilkins, 2016.

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Machine Learning in Radiation Oncology: Theory and Applications. I. El Naqa, R. Li, M. J. Murphy, editors. Switzerland: Springer, 2015.

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Sample on-line Chapter 6, "Treatment Planning Considerations Using IMRT" at:
<http://www.medicalphysics.org/documents/LingCh6.pdf>.

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http://www.medicalphysics.org/documents/Ch_10_Ling.pdf.

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- ALERT–Adverse Late Effects of Cancer Treatment. Volume 2. Normal Tissue Specific Sites and Systems. P. Rubin, L. S. Constine, and L..B. Marks, editors. New York: Springer, 2014.
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16.3 Resources from National and International Organizations

16.3.1 American Association of Physicists in Medicine (AAPM) task group reports

The AAPM's task group reports can be found at <http://www.aapm.org/pubs/reports/>. The individual reports, primarily related to radiation oncology medical physics, are listed below by descending report number, which is largely reverse chronological order from most recent to earliest. Some reports may require AAPM membership for direct access.

Report No. 158. AAPM TG 158: Measurement and calculation of doses outside the treated volume from external-beam radiation therapy. Med. Phys. 44: e391-e429, 2017. <http://www.aapm.org/pubs/reports/detail.asp?docid=165>.

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Report No. 258: Monitor unit calculations for external photon and electron beams: Report of the AAPM Therapy Physics Committee Task Group No. 71. Medical Physics 41:3. http://aapm.org/pubs/reports/RPT_258.pdf.

Report No. 255: An introduction to molecular imaging in radiation oncology: A report by the AAPM Working Group on Molecular Imaging in Radiation Oncology (WGMIR) Medical Physics 40:10. http://aapm.org/pubs/reports/RPT_255.pdf.

Report No. 249: Essentials and Guidelines for Clinical Medical Physics Residency Training Programs. http://aapm.org/pubs/reports/RPT_249.pdf.

Report No. 229: Dose Calculation for Photon-Emitting Brachytherapy Sources with Average Energy Higher than 50 keV: Full Report of the AAPM and ESTRO. http://www.aapm.org/pubs/reports/RPT_229.pdf.

Report No. 229 (short report): Dose calculation for photon-emitting brachytherapy sources with average energy higher than 50 keV: Report of the AAPM and ESTRO—Short Report published in Medical Physics, Vol. 39, Issue 5. http://www.aapm.org/pubs/reports/RPT_229ShortReport.pdf.

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- Report No. 201: Information technology resource management in radiation oncology. http://www.aapm.org/pubs/reports/RPT_201Preliminary.pdf.
- Report No. 197: Academic Program Recommendations for Graduate Degrees in Medical Physics. (This is a revision of Reports #44 and #79.) http://www.aapm.org/pubs/reports/RPT_197.pdf.
- Report No. 197S: The Essential Medical Physics Didactic Elements for Physicists Entering the Profession through an Alternative Pathway: A Recommendation from the AAPM Working Group on the Revision of Reports 44 & 79. http://www.aapm.org/pubs/reports/RPT_197S.pdf.
- Report No. 192: AAPM and GEC-ESTRO Guidelines for Image-guided Robotic Brachytherapy. Report of Task Group 192. Medical Physics, Volume 41, Issue 10. http://www.aapm.org/pubs/reports/RPT_192.pdf.
- Report No. 186: Report of the Task Group 186 on model-based dose calculation methods in brachytherapy beyond the TG-43 formalism: Current status and recommendations for clinical implementation. Medical Physics, Vol. 39, Issue 10. http://www.aapm.org/pubs/reports/RPT_186.pdf.
- Report No. 179: Quality assurance for image-guided radiation therapy utilizing CT-based technologies: A report of the AAPM TG-179. Medical Physics, Vol. 39, Issue 4. http://www.aapm.org/pubs/reports/RPT_179.pdf.
- Report No. 176: Dosimetric effects caused by couch tops and immobilization devices: Report of AAPM Task Group 176. Medical Physics, Vol 41, Issue 6, 2014. http://aapm.org/pubs/reports/RPT_176.pdf.
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- Report No. 159: Recommended ethics curriculum for Medical Physics graduate and residency programs: Report of Task Group 159. http://www.aapm.org/pubs/reports/RPT_159.pdf.
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- Report No. 152: The 2007 AAPM response to the CRCPD request for recommendations for the CRCPD's model regulations for electronic brachytherapy. http://www.aapm.org/pubs/reports/RPT_152.pdf.
- Report No. 149: Dose calculation formalisms and consensus dosimetry parameters for intravascular brachytherapy dosimetry: Recommendations of the AAPM Therapy Physics Committee Task Group No. 149. http://www.aapm.org/pubs/reports/RPT_149.pdf.
- Report No. 148. QA for helical tomotherapy: Report of the AAPM Task Group 148. Medical Physics, Vol. 39, Issue 4. http://www.aapm.org/pubs/reports/RPT_148.pdf.
- Report No. 142: Task Group 142 report: Quality assurance of medical accelerators. Medical Physics, Vol. 36, Issue 9. http://www.aapm.org/pubs/reports/RPT_142.pdf.
- Report No. 128: Quality assurance tests for prostate brachytherapy ultrasound systems: Report of Task Group 128. Medical Physics, Vol. 35, Issue 12. http://www.aapm.org/pubs/reports/RPT_128.pdf.

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Report No. 101. Stereotactic body radiation therapy: The report of AAPM Task Group 101. Med. Phys. 37: 4078-4101, 2010. <http://onlinelibrary.wiley.com/doi/10.1118/1.3438081/epdf>.

Report No. 99: Recommendations for clinical electron beam dosimetry: Supplement to the recommendations of Task Group 25. Medical Physics, Vol. 36, Issue 7. http://www.aapm.org/pubs/reports/RPT_99.pdf.

Report No. 98: Report of the AAPM Low Energy Brachytherapy Source Calibration Working Group: Third-party brachytherapy source calibrations and physicist responsibilities. Medical Physics, Vol. 35, Issue 9. http://www.aapm.org/pubs/reports/RPT_98.pdf.

Report No. 95: The management of imaging dose during image-guided radiotherapy: Report of the AAPM Task Group 75. Medical Physics, Vol. 34, Issue 10. http://www.aapm.org/pubs/reports/RPT_95.pdf.

Report No. 92: Intraoperative radiation therapy using mobile electron linear accelerators. http://www.aapm.org/pubs/reports/RPT_92.pdf.

Report No. 91: The Management of Respiratory Motion in Radiation Oncology. http://www.aapm.org/pubs/reports/RPT_91.pdf.

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Report No. 87: Diode in Vivo Dosimetry for Patients Receiving External Beam Radiation Therapy. http://www.aapm.org/pubs/reports/RPT_87.pdf.

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Report No. 85: Tissue Inhomogeneity Corrections for Megavoltage Photon Beams. http://www.aapm.org/pubs/reports/RPT_85.pdf.

Report No. 84: A Revised AAPM Protocol for Brachytherapy Dose Calculations. (Update of AAPM TG 43; Report No. 51.) Medical Physics, Vol. 31, Issue 3. http://www.aapm.org/pubs/reports/RPT_84.pdf.

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Report No. 83: Quality Assurance for Computed-Tomography Simulators and the Computed-Tomography- Simulation Process. http://www.aapm.org/pubs/reports/RPT_83.pdf.

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- Report No. 75: Clinical Use of Electronic Portal Imaging. http://www.aapm.org/pubs/reports/RPT_75.pdf.
- Report No. 72: Basic Applications of Multileaf Collimators. http://www.aapm.org/pubs/reports/RPT_72.pdf.
- Report No. 71: A Primer for Radioimmunotherapy and Radionuclide Therapy. http://www.aapm.org/pubs/reports/RPT_71.pdf.
- Report No. 69: Recommendations of the AAPM on 103Pd Interstitial Source Calibration and Dosimetry: Implications for Dose Specification and Prescription. http://www.aapm.org/pubs/reports/RPT_69.pdf.
- Report No. 68: Permanent Prostate Seed Implant Brachytherapy. Medical Physics, Vol. 26, Issue 10. http://www.aapm.org/pubs/reports/RPT_68.pdf.
- Report No. 67: AAPM's TG51 Protocol for Clinical Reference Dosimetry of High-Energy Photon and Electron Beams. Medical Physics, Vol. 26, Issue 9. http://www.aapm.org/pubs/reports/RPT_67.pdf.
- Addendum to the AAPM's TG-51 protocol for clinical reference dosimetry of high-energy photon beams. http://www.aapm.org/pubs/reports/RPT_67_Addendum.pdf.
- Report No. 66: Intravascular Brachytherapy Physics. Medical Physics, Vol. 26, Issue 2. http://www.aapm.org/pubs/reports/RPT_66.pdf.
- Report No. 65: Ultrasound Task Group No. 1. Real-time B-mode ultrasound quality control test procedures: a Report of AAPM Ultrasound Task Group No. 1. Medical Physics 25:1385–1406 (1998). http://www.aapm.org/pubs/reports/RPT_65.pdf.
- Report No. 64: A Guide to the Teaching of Clinical Radiological Physics to Residents in Diagnostic and Therapeutic Radiology. http://www.aapm.org/pubs/reports/64/RPT_64.pdf.
- Report No. 63: Radiochromic Film Dosimetry. Medical Physics, Vol. 25, Issue 11. http://www.aapm.org/pubs/reports/RPT_63.pdf.
- Report No. 62: Quality Assurance for Clinical Radiotherapy Treatment Planning. Medical Physics, Vol. 25, Issue 10. http://www.aapm.org/pubs/reports/RPT_62.pdf.
- Report No. 61: High Dose-Rate Brachytherapy Treatment Delivery. Medical Physics, Vol. 25, Issue 4. http://www.aapm.org/pubs/reports/RPT_61.pdf.
- Report No. 59: Code of Practice for Brachytherapy Physics. Medical Physics, Vol. 24, Issue 10. http://www.aapm.org/pubs/reports/RPT_59.pdf.
- Report No. 56: Medical Accelerator Safety Considerations. Medical Physics, Vol. 20, Issue 4. http://www.aapm.org/pubs/reports/RPT_56.pdf.
- Report No. 55: Radiation Treatment Planning Dosimetry Verification. http://www.aapm.org/pubs/reports/RPT_55.pdf.

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- Report No. 54: Stereotactic Radiosurgery. http://www.aapm.org/pubs/reports/RPT_54.pdf.
- Report No. 51: Dosimetry of Interstitial Brachytherapy Sources. Medical Physics, Vol. 22, Issue 2. http://www.aapm.org/pubs/reports/RPT_51.pdf.
- Report No. 50: Fetal Dose from Radiotherapy with Photon Beams. Medical Physics, Vol. 22, Issue 1. http://www.aapm.org/pubs/reports/RPT_50.pdf.
- Report No. 49: Dosimetry of Auger-Electron-Emitting Radionuclides. Medical Physics, Vol. 21, Issue 12. http://www.aapm.org/pubs/reports/RPT_49.pdf.
- Report No. 48: The Calibration and Use of Plane-Parallel Ionization Chambers for Dosimetry of Electron Beams. Medical Physics, Vol. 21, Issue 8. http://www.aapm.org/pubs/reports/RPT_48.pdf.
- Report No. 47: AAPM Code of Practice for Radiotherapy Accelerators. Medical Physics, Vol. 21, Issue 4. http://www.aapm.org/pubs/reports/RPT_47.pdf.
- Report No. 46: Comprehensive QA for Radiation Oncology. Medical Physics, Vol. 21, Issue 4. http://www.aapm.org/pubs/reports/RPT_46.pdf.
- Report No. 45: Management of Radiation Oncology Patients with Implanted Cardiac Pacemakers. Medical Physics, Vol. 21, Issue 1. http://www.aapm.org/pubs/reports/RPT_45.pdf.
- Report No. 43: Quality Assessment and Improvement of Dose Response Models: Some Effects of Study Weaknesses on Study Findings. http://www.aapm.org/pubs/reports/RPT_43_150dpi.pdf (screen version). http://www.aapm.org/pubs/reports/RPT_43_300dpi.pdf (print version).
- Report No. 41: Remote Afterloading Technology. http://www.aapm.org/pubs/reports/RPT_41.pdf.
- Report No. 40: Radiolabeled Antibody Tumor Dosimetry. Medical Physics, Vol. 20, Issue 2. http://www.aapm.org/pubs/reports/RPT_40.pdf.
- Report No. 38: The Role of a Physicist in Radiation Oncology. http://www.aapm.org/pubs/reports/RPT_38.pdf.
- Report No. 37: Auger Electron Dosimetry. Medical Physics, Vol. 19, Issue 6. http://www.aapm.org/pubs/reports/RPT_37.pdf.
- Report No. 32: Clinical Electron-Beam Dosimetry. http://www.aapm.org/pubs/reports/rpt_32.pdf.
- Report No. 27: Hyperthermia Treatment Planning. http://www.aapm.org/pubs/reports/rpt_27.pdf.
- Report No. 26: Performance Evaluation of Hyperthermia Equipment. http://www.aapm.org/pubs/reports/rpt_26.pdf.
- Report No. 24: Radiotherapy Portal Imaging Quality. http://www.aapm.org/pubs/reports/rpt_24.pdf.
- Report No. 23: Total Skin Electron Therapy: Technique and Dosimetry. http://www.aapm.org/pubs/reports/rpt_23.pdf.
- Report No. 21: Specification of Brachytherapy Source Strength. http://www.aapm.org/pubs/reports/rpt_21.pdf.
- Report No. 19: Neutron Measurements Around High Energy X-Ray Radiotherapy Machines. http://www.aapm.org/pubs/reports/rpt_19.pdf.
- Report No. 17: The Physical Aspects of Total and a Half Body Photon Irradiation. http://www.aapm.org/pubs/reports/rpt_17.pdf.
- Report No. 16: Protocol for Heavy Charged-Particle Therapy Beam Dosimetry. http://www.aapm.org/pubs/reports/rpt_16.pdf.

Report No. 13: Physical Aspects of Quality Assurance in Radiation Therapy.
http://www.aapm.org/pubs/reports/rpt_13.pdf.

Report No. 7: Protocol for Neutron Beam Dosimetry.
http://www.aapm.org/pubs/reports/rpt_07.pdf.

Report OR-0: Information Transfer from Beam Data Acquisition Systems.
http://www.aapm.org/pubs/reports/OR_01.pdf.

Report OR-02: A protocol for the determination of absorbed dose from high-energy photon and electron beams. http://www.aapm.org/pubs/reports/OR_02.pdf.

16.3.2 American Association of Physicists in Medicine (AAPM) practice guidelines

Implementation of the validation testing in MPPG 5.a “Commissioning and QA of treatment planning dose calculations-megavoltage photon and electron beams.” J. Appl. Clin. Med. Phys.18: 115-127, 2017.
<http://onlinelibrary.wiley.com/doi/10.1002/acm2.12015/epdf>.

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16.3.3 American Association of Physicists in Medicine (AAPM) summer school proceedings

The AAPM Summer School proceedings are summarized below to as far back as 1990.

Image Guidance in Radiation Therapy: Techniques, Accuracy, and Limitations (2018 Summer School). Parham Alaei and George X. Ding, editors. AAPM Monograph No. 39. Madison, WI: Medical Physics Publishing, 2018.

Sample on-line chapter: “Overview of Image Guidance in Radiation Therapy.”

https://medicalphysics.org/documents/aapm_mono39_ch01.pdf.

Clinical Brachytherapy Physics, AAPM Monograph No. 38. (2017 Summer School). M. J. Rivard, L. Beaulieu, and B. R. Thomadsen (Eds).

Sample on-line chapter: “High-dose-rate Brachytherapy for Prostate.”

https://www.medicalphysics.org/documents/aapm_mono38_ch05.pdf.

Principles and Practice of Proton Beam Therapy (2015 AAPM summer school). Indra J. Das and Harald Paganetti, editors. AAPM Medical Physics Monograph No. 37. Madison, WI: Medical Physics Publishing, 2015.

Sample on-line chapter, “Introduction and History of Proton Therapy” available at:

https://www.medicalphysics.org/documents/AAPM_No37_Chapter1.pdf.

Quality and Safety in Radiotherapy: Learning the New Approaches in Task Group 100 and Beyond (2013 AAPM summer school). B. R. Thomadsen, P. Dunscombe, E. Ford, S. Huq, T. Pawlicki, and S. Sutlief, editors. AAPM Medical Physics Monograph No. 36. Madison, WI: Medical Physics Publishing, 2013.

Sample on-line chapter: “Risk Assessment Using the TG-100 Methodology.”

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Uncertainties in External Beam Radiation Therapy (2011 AAPM summer school). J. R. Palta and T. R. Mackie, editors. AAPM Medical Physics Monograph No. 35. Madison, WI: Medical Physics Publishing, 2011.

Sample on-line chapter: “Limits of Precision and Accuracy of Radiation Delivery Systems.”

https://medicalphysics.org/documents/uncertain_CH10.pdf.

Clinical Dosimetry Measurements in Radiotherapy (2009 AAPM summer school). D. W. O. Rogers and J. E. Cygler, editors. Madison, WI: Medical Physics Publishing, 2011.

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https://medicalphysics.org/documents/aapm_mono34_CH09.pdf.

The Physics and Applications of PET/CT Imaging (AAPM 2008 summer school). D. Cody and O. Mawlawi, editors. Madison, WI: Medical Physics Publishing, 2008.

Integrating New Technologies into the Clinic: Monte Carlo and Image-Guided Radiation Therapy. (2006 AAPM summer school). AAPM Medical Physics Monograph No. 32. B. H. Curran, J. M. Balter, and I. J. Chetty, editors. Madison, WI: Medical Physics Publishing, 2006.

Sample on-line chapter, “Monte Carlo Non-Adaptive 4-D Treatment Planning in Conformal

Radiation Therapy: Why, How, and What to Look For,” available at:

<http://www.medicalphysics.org/documents/Rosu2.pdf>.

Specifications, Performance Evaluations, and Quality Assurance of Radiographic and Fluoroscopic Systems in the Digital Era. (2004 AAPM summer school). AAPM Medical Physics Monograph No. 30. L. Goldman and M. Yester, editors. Madison, WI: Medical Physics Publishing, 2006.

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Brachytherapy Physics, 2nd edition. (AAPM 2005 summer school). B. R. Thomadsen, M. J. Rivard, and W. M. Butler. AAPM Medical Physics Monograph No. 31. Madison, WI: Medical Physics Publishing, 2005.

Sample on-line Chapter 31, “Post Implant Evaluation,” available at:
https://medicalphysics.org/documents/Brachy_Ch31.pdf.

Intensity-Modulated Radiation Therapy: The State of the Art. (2003 AAPM summer school). J. R. Palta and T. R. Mackie, editors. AAPM Medical Physics Monograph No. 29. Madison, WI: Medical Physics Publishing, 2003.

Sample on-line chapter, “IMRT Delivery System QA,” available at:
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General Practice of Radiation Oncology Physics in the 21st Century. (2000 AAPM summer school). A. S. Shiu and D. E. Mellenberg, editors. AAPM Medical Physics Monograph No. 26. Madison, WI: Medical Physics Publishing, 2000.

Practical Digital Imaging and PACS (1999 AAPM summer school). AAPM Medical Physics Monograph No. 25. A. Seibert, L. Filipow, and K. P. Andriole, editors. Madison, WI: Medical Physics Publishing, 1999.

Teletherapy: Present and Future (1996 AAPM summer school). T.R. Mackie and J. R. Palta, editors. Madison, WI: Medical Physics Publishing, 1996.

The Physics of MRI. (1992 AAPM summer school). M. J. Bronskill and P. Sprawls. AAPM Medical Physics Monograph No. 21. (CD-ROM format). Madison, WI: Medical Physics Publishing, 2007.

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Advances in Radiation Oncology Physics: Dosimetry, Treatment Planning, and Brachytherapy. (1990 AAPM summer school). J. A. Purdy, editor. Medical Physics Monograph No. 19. (CD-ROM format). Madison, WI: Medical Physics Publishing, 2007.

16.3.4 American College of Radiology–American Society for Radiation Oncology (ACR–ASTRO) practice guidelines

ACR-ASTRO Practice Parameter for the Performance of Total Body Irradiation. https://www.astro.org/uploadedFiles/_MAIN_SITE/Patient_Care/Clinical_Practice_Statements/Content_Pieces/ACRASTRO-PracticeParameterTBI.pdf.

ACR Practice Parameter for the Performance of Brain Stereotactic Radiosurgery. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/stereobrain.pdf?la=en>.

ACR-ABS Practice Parameter for Electronically-Generated, Low-Energy Radiation Sources (ELS). <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/els.pdf?la=en>.

ACR Practice Parameter for Continuing Medical Education (CME), 2017. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/cme.pdf?la=en>.

ACR-AAPM Practice Parameter on the Expert Witness in Medical Physics, 2013. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/expertwitnessmp.pdf?la=en>.

ACR-AAPM-SIIM Practice Parameter for Electronic Medical Information Privacy and Security, 2014. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/elec-info-privacy.pdf?la=en>.

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ACR-ASTRO Practice Parameter for Radiation Oncology, 2014. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/radonc.pdf?la=en>.

ACR-ASTRO Practice Parameter for the Performance of Proton Beam Radiation Therapy, 2014. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/proton-therapy-ro.pdf?la=en>.

ACR Practice Parameter for Intensity Modulated Radiation Therapy (IMRT), 2016. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/imrt-ro.pdf?la=en>.

ACR Practice Parameter for 3D External Beam Radiation Planning and Conformal Therapy, 2016. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/3d-conformal.pdf?la=en>.

ACR-ABS Practice Parameter for the Performance of Radionuclide-Based High-Dose-Rate Brachytherapy, 2015. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/hdr-brachyro.pdf?la=en>.

ACR-ABS Practice Parameter for Transperineal Permanent Brachytherapy of Prostate Cancer, 2015. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/brachy-prostate.pdf?la=en>.

ACR Practice Parameter for the Performance of Therapy with Unsealed Radiopharmaceutical Sources, 2015. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/unsealedsources.pdf?la=en>.

ACR-AAPM Technical Standard for the Performance of Radiation Oncology Physics for External Beam Therapy, 2015. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/ext-beam-ts.pdf?la=en>.

ACR-AAPM Technical Standard for the Performance of Lowdose-Rate Brachytherapy Physics, 2015. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/ldr-brachyts.pdf?la=en>.

ACR-AAPM Technical Standard for the Performance of Highdose-Rate Brachytherapy Physics, 2015. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/hdr-brachyts.pdf?la=en>.

ACR-AAPM Technical Standard for Medical Physics Performance Monitoring of Image-Guided Radiation Therapy (IGRT), 2014. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/irgt-ts.pdf?la=en>.

ACR-ASTRO Practice Parameter for Image-Guided Radiation Therapy (IGRT), 2014. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/IGRT-RO.pdf?la=en>.

ACR-ASTRO Practice Parameter for the Performance of Stereotactic Body Radiation Therapy, 2014. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/sbrt-ro.pdf?la=en>.

ACR-SIR Practice Parameter for Radiomobilization with Microsphere Brachytherapy Device (RMBD) for Treatment of Liver Malignancies, 2014. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/rmbd.pdf?la=en>.

16.3.5 Canadian Partnership for Quality Radiotherapy (CPQR) technical quality control guidelines

These guidelines can be found at: <http://www.cpqr.ca/programs/technical-quality-control>. Standards on the CPQR website include:

Data Management Systems (Jan. 2017)

Safety Systems (Jul. 2016)

Computed Tomography Simulators (Jul. 2016)

CyberKnife (Jul. 2016)

Accelerator-Integrated Cone-Beam Systems for Verification Imaging (Apr. 2015)

Patient-Specific Dosimetric Measurements for IMRT. (Feb. 2015)

Reference Dosimetry. (Feb. 2015)

Volumetric Modulated Arc Therapy. (Feb. 2015)

Accelerator Integrated Cone Beam Systems for Verification Imaging. (April 2013)

Medical Linear Accelerators and Multileaf Collimators. (Feb. 2015)

Treatment Planning Systems. (Feb. 2015)

Brachytherapy Remote Afterloaders. (Feb. 2015)

Major Dosimetry Equipment. (Feb. 2015)

Conventional Radiotherapy Simulators. (Feb. 2015)

Kilovoltage X-Ray Radiotherapy Machines. (Feb. 2015)

Other documents are listed but are undergoing external review.

16.3.6 European Atomic Energy Community (EURATOM)

The EURATOM website is: <http://ec.europa.eu/programmes/horizon2020/en/h2020-section/euratom>.

European Commission radiation protection series publications can be found at:

<https://ec.europa.eu/energy/en/radiation-protection-publications>.

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<https://ec.europa.eu/energy/sites/ener/files/documents/rp184.pdf>.

European Guidance on Estimating Population Doses from Medical X-Ray Procedures and annexes. EURATOM Report 154. Luxembourg: European Communities, 2008.

http://ddmed.eu/_media/background_of_ddm1:rp154.pdf.

EU Scientific Seminar 2003, Medical Overexposures. EURATOM Report 149. Luxembourg: European Communities, 2008. <https://ec.europa.eu/energy/sites/ener/files/documents/149.pdf>.

Effects of in utero exposure to ionising radiation during the early phases of pregnancy. EURATOM Report 131. Luxembourg: European Communities, 2002.

<https://ec.europa.eu/energy/sites/ener/files/documents/131.pdf>.

Low Dose Ionizing Radiation and Cancer Risk. EURATOM Report 125. Luxembourg: European Communities, 2001. <https://ec.europa.eu/energy/sites/ener/files/documents/125.pdf>.

Guidelines on education and training in radiation protection for medical exposures. EURATOM Report 116. Luxembourg: European Communities, 2000.

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16.3.7 European Society for Radiotherapy and Oncology (ESTRO) publications

16.3.7.1 ESTRO physics booklets

Booklet 10 – Independent Dose Calculations – Concepts and Models. M. Karlsson, A. Ahnesjö, D. Georg, T. Nyholm, and J. Olofsson. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 2010. <http://www.estro.org/binaries/content/assets/estro/school/publications/booklet-10---independent-dose-calculations---concepts-and-models.pdf>.

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Booklet 9 – Guidelines for the Verification of IMRT. B. Mijnheer and D. Georg, editors. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 2008. <http://www.estro.org/binaries/content/assets/estro/school/publications/booklet-9---guidelines-for-the-verification-of-imrt.pdf>.

Booklet 8 – A Practical Guide to Quality Control of Brachytherapy Equipment. J. Venselaar and J. Pérez-Calatayud, editors. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 2004. <http://www.estro.org/binaries/content/assets/estro/school/publications/booklet-8---a-practical-guide-to-quality-control-of-brachytherapy-equipment.pdf>.

Booklet 7 – Quality Assurance of Treatment Planning Systems – Practical Examples for Non-IMRT Photon Beams. B. Mijnheer, A. Olszewska, C. Fiorino, G. Hartmann, T. Knöös, J.-C. Rosenwald, and H. Welleweerd. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 2004. <http://www.estro.org/binaries/content/assets/estro/school/publications/booklet-7---quality-assurance-of-treatment-planning-systems---practical-examples-for-non-imrt-photon-beams.pdf>.

Booklet 6 – Monitor Unit Calculation for High Energy Photon Beams – Practical Examples. B. Mijnheer, A. Bridier, C. Garibaldi, K. Torzsok, and J. Venselaar. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 2001. <http://www.estro.org/binaries/content/assets/estro/school/publications/booklet-6---monitor-unit-calculation-for-high-energy-photon-beams---practical-examples.pdf>.

http://estro-education.org/publications/Documents/Booklet_n6PhysicsforClinRTcorected17May2011.pdf.

Booklet 5 – Practical Guidelines for the Implementation of in vivo Dosimetry with Diodes in External Radiotherapy with Photon Beams (Entrance Dose). D. P. Huyskens, R. Bogaerts, J. Verstraete, M. Loof, H. Nyström, C. Fiorino, S. Broggi, N. Jornet, M. Ribas, and D. I. Thwaites. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 2001. <http://www.estro.org/binaries/content/assets/estro/school/publications/booklet-5---practical-guidelines-for-the-implementation-of-in-vivo-dosimetry-with-diodes-in-external-radiotherapy-with-photon-beams-entrance-dose.pdf>.

Booklet 4 – Practical Guidelines for the Implementation of a Quality System in Radiotherapy. J. W. H. Leer, A. L. McKenzie, P. Scalliet, and D. I. Thwaites. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 1998. <http://www.estro.org/binaries/content/assets/estro/school/publications/booklet-4---practical-guidelines-for-the-implementation-of-a-quality-system-in-radiotherapy.pdf>.

Booklet 3 – Monitor Unit Calculation for High Energy Photon Beams. A. Dutreix, B.E. Bjärngard, A. Bidier, B. Mijnheer, J. E. Shaw, and H. Svensson. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 1997.

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Booklet 2 – Recommendations for a Quality Assurance Programme in External Radiotherapy. P. Aletti and P. Bey, editors. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 1995. <http://www.estro.org/binaries/content/assets/estro/school/publications/booklet-2---recommendations-for-a-quality-assurance-programme-in-external-radiotherapy.pdf>.

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16.3.7.2 ESTRO handbooks

The GEC ESTRO Handbook of Brachytherapy. A. Gerbaulet, R. Pötter, J.-J. Mazon, H. Meertens, and E. Van Limberge, editors. Brussels, Belgium: European Society for Therapeutic Radiology and Oncology (ESTRO), 2002.

16.3.8 Institute of Physics and Engineering in Medicine (IPEM) reports

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Medical Cyclotrons (including PET Radiopharmaceutical Production). Report 105. S Evans, editor. London: Institute of Physics and Engineering in Medicine (IPEM), 2011.

Dosimetry for Radionuclide Therapy. Report 104. London: Institute of Physics and Engineering in Medicine (IPEM), 2011.

Mathematical Techniques in Nuclear Medicine. Report 100. London: Institute of Physics and Engineering in Medicine (IPEM), 2011.

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Quality Assurance of Ultrasound Imaging Systems. Report 102. Stephen Russell, editor. London: Institute of Physics and Engineering in Medicine (IPEM), 2010.

Phototherapy Physics: Principles, Dosimetry, Sources and Safety. Report 101. B. L. Diffey, D. K. Taylor, G. C. Hart, H. J. Vreman, R. J. Wong, and A. Carmichael. London: Institute of Physics and Engineering in Medicine (IPEM), 2010.

DICOM Image and Data Management for Nuclear Medicine, Physiological Measurements, Radiotherapy and Ultrasound. Report 99. I. Beange, B. Bhatia, J. Shakeshaft, and P. Verma. London: Institute of Physics and Engineering in Medicine (IPEM), 2010.

Guidance for the Clinical Implementation of Intensity Modulated Radiation Therapy. Report 96. H. James, A. Beavis, G. Budgell, C. Clark, D. Convery, J. Mott, D. Dearnaley, R. Perry, and C. Scrase. London: Institute of Physics and Engineering in Medicine (IPEM), 2008.

Risk Management and its Application to Medical Device Management. Report 95. L. Blache, P. Robbins, S. Brown, P. Jones, T. Liu, and J. LeFever. London: Institute of Physics and Engineering in Medicine (IPEM), 2008.

Acceptance Testing and Commissioning of Linear Accelerators. Report 94. London: Institute of Physics and Engineering in Medicine (IPEM), 2007.

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On Target: Ensuring Geometric Accuracy in Radiotherapy. The Royal College of Radiologists, Society and College of Radiographers, Institute of Physics and Engineering in Medicine, National Patient Safety Agency, and British Institute of Radiology, 2008.

[http://www.rcr.ac.uk/docs/oncology/pdf/BFCO\(08\)5_On_target.pdf](http://www.rcr.ac.uk/docs/oncology/pdf/BFCO(08)5_On_target.pdf).

Working with Patients. IPEM Guidelines for Good Practice. London: Institute of Physics and Engineering in Medicine (IPEM). <http://www.ipem.ac.uk/Portals/0/Images/Working%20With%20Patients%20-%20Guidelines%20for%20Good%20Practice.pdf>.

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http://www.rcr.ac.uk/docs/oncology/pdf/BFCO083_IRMER.pdf.

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16.3.9 International Atomic Energy Agency (IAEA) reports and documents

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Radiotherapy in Cancer Care: Facing the Global Challenge. E. Rosenblatt, E. Zubizarreta (Eds). Vienna: International Atomic Energy Agency (IAEA). 2017.

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Leadership and Management for Safety. IAEA Safety Standards. General Safety Requirements No. GSR Part 2. Vienna: International Atomic Energy Agency (IAEA). 2016.

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http://www-pub.iaea.org/MTCD/publications/PDF/TCS-58_web.pdf.

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- Inequity in Cancer Care: A Global Perspective. IAEA Human Health Reports No. 3. Vienna: International Atomic Energy Agency (IAEA). 2011. http://www-pub.iaea.org/MTCD/publications/PDF/Pub1471_web.pdf.
- The Transition from 2-D Brachytherapy to 3-D High Dose Rate Brachytherapy. Vienna: International Atomic Energy Agency (IAEA). 2015. <http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1681web-80878722.pdf>.
- Implementation of High Dose Rate Brachytherapy in Limited Resource Settings. Vienna: International Atomic Energy Agency (IAEA). 2015. <http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1670web-5444797.pdf>.
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- Dosimetry in Diagnostic Radiology for Paediatric Patients. IAEA Human Health Series No. 24. Vienna: International Atomic Energy Agency (IAEA), 2013. http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1609_web.pdf.
- Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists. IAEA Human Health Series No. 25. Vienna: International Atomic Energy Agency (IAEA), 2013. http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1610_web.pdf.
- Joint Radiation Emergency Management Plan of the International Organizations, EPR–JPLAN (2013). Vienna: International Atomic Energy Agency (IAEA), 2013. http://www-pub.iaea.org/MTCD/Publications/PDF/EPRJplan2013_web.pdf.
- DIRAC (DIrectory of RAdiotherapy Centres). Registry of radiotherapy hospitals and clinical institutions having radionuclide and high-energy teletherapy machines. Vienna: International Atomic Energy Agency (IAEA). <http://nucleus.iaea.org/HHW/DBStatistics/DIRAC/index.html>.

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Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. Interim edition. General Safety Requirements. Vienna: International Atomic Energy Agency (IAEA), 2011. http://www-pub.iaea.org/MTCD/Publications/PDF/p1531interim_web.pdf.

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16.3.10 International Atomic Energy Agency (IAEA) training materials

Radiation Oncology Physics: A Handbook for Teachers and Students. E.B. Podgorsak, editor. PowerPoint slide sets for each of the 16 chapters. Vienna: International Atomic Energy Agency (IAEA), 2005. Slide set updated in 2007. <http://www-naweb.iaea.org/NAHU/DMRP/slides.html>.

Diagnostic and Interventional Radiology. 23-module PowerPoint slide set along with practicals. Vienna: International Atomic Energy Agency (IAEA). https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/1_TrainingMaterial/Radiology.htm.

Paediatric Radiology: Training material developed in collaboration with Image Gently. 10-module PowerPoint slide set. Vienna: International Atomic Energy Agency (IAEA). https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/1_TrainingMaterial/PaediatricRadiology.htm.

Radiation Protection in PET/CT. 12-lecture PowerPoint slide set. Vienna: International Atomic Energy Agency (IAEA). https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/1_TrainingMaterial/PETCT.htm.

Prevention of Accidental Exposures in Radiotherapy. 22-lecture PowerPoint slide set. Vienna: International Atomic Energy Agency (IAEA). https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/1_TrainingMaterial/AccidentPreventionRadiotherapy.htm.

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Radiation Protection in Nuclear Medicine. 14-module PowerPoint slide set. Vienna: International Atomic Energy Agency (IAEA). https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/1_TrainingMaterial/NuclearMedicine.htm.

Radiation Protection in Cardiology. 14-lecture PowerPoint slide set. Vienna: International Atomic Energy Agency (IAEA). https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/1_TrainingMaterial/Cardiology.htm.

Radiation Protection in Digital Radiology. 10-module PowerPoint slide set. Vienna: International Atomic Energy Agency (IAEA). https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/1_TrainingMaterial/DigitalRadiology.htm.

Radiation Protection for Doctors Using Fluoroscopy Outside Radiology (Urologists, Gastroenterologists, Orthopaedic Surgeons, etc.). 9-module PowerPoint slide set. Vienna: International Atomic Energy Agency (IAEA). https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/1_TrainingMaterial/Non-radiologistsNon-cardiologists.htm.

16.3.11 International Commission of Radiation Units and Measurements (ICRU) reports

The ICRU reports are now available on-line through the AAPM website (for AAPM members) at <http://www.aapm.org/pubs/ICRU/?d=d>.

Prescribing, Recording, and Reporting of Stereotactic Treatments with Small Photon Beams. ICRU Report 91, Bethesda, MD: International Commission On Radiation Units and Measurements (ICRU), 2017.

Key Data for Ionizing-Radiation Dosimetry: Measurement Standards and Applications. ICRU Report 90, Bethesda, MD: International Commission On Radiation Units and Measurements (ICRU), 2016.

Prescribing, Recording and Reporting Brachytherapy for Cervix Cancer Therapy. ICRU Report 89, Bethesda, MD: International Commission On Radiation Units and Measurements (ICRU), 2016.

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Measurement and Reporting of Radon Exposures. ICRU 88. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 2016.

Radiation Dose and Image-Quality Assessment in Computed Tomography. ICRU Report 87. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 2012.

Quantification and Reporting of Low-Dose and Other Heterogeneous Exposures. ICRU Report 86. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 2011.

Fundamental Quantities and Units for Ionizing Radiation. ICRU Report 85. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 2011.

Prescribing, Recording, and Reporting Photon-Beam Intensity-Modulated Radiation Therapy (IMRT). ICRU Report 83. Bethesda, MD: International Commission On Radiation Units and Measurements (ICRU), 2010.

Prescribing, Recording, and Reporting Proton-Beam Therapy, ICRU Report 78. Washington D.C.: International Commission on Radiation Units and Measurements (ICRU), 2007.

Measurement Quality Assurance for Ionizing Radiation Dosimetry. ICRU Report 76. Journal of the ICRU 1–3 (2006).

Prescribing, Recording, and Reporting Electron Beam Therapy. ICRU Report 71. Bethesda, MD: International Commission On Radiation Units and Measurements (ICRU), 2004.

Image Quality in Chest Radiography. ICRU Report 70. Bethesda, MD: International Commission On Radiation Units and Measurements (ICRU), 2003.

Prescribing, Recording, and Reporting Photon Beam Therapy (Supplement to ICRU Report 50). ICRU Report 62. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 1999.

Dose and Volume Specification for Reporting Interstitial Therapy. ICRU Report 58. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 1997.

Prescribing, recording, and reporting photon beam therapy. ICRU Report 50. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 1993.

Phantoms and Computational Models in Therapy, Diagnosis and Protection. ICRU Report 48. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 1992.

Tissue Substitutes in Radiation Dosimetry and Measurement. ICRU Report 44. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 1989.

Use of Computers in External Beam Radiotherapy Procedures with High-Energy Photons and Electrons. ICRU Report 42. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 1987.

Dose and Volume Specification for Reporting Intracavitary Therapy. ICRU Report 38. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 1985.

Dose specification for reporting external beam therapy with photons and electrons. ICRU Report 29. Bethesda, MD: International Commission on Radiation Units and Measurements (ICRU), 1978.

Determination of Absorbed Dose in a Patient Irradiated by Beams of X or Gamma Rays in Radiotherapy Procedures. ICRU Report 24. Washington, D.C.: International Commission on Radiation Units and Measurements (ICRU), 1976.

16.3.12 International Commission on Radiological Protection reports

Radiological Protection from Cone Beam Computed Tomography (CBCT). ICRP Publication 129. Ann. ICRP 44(1), 2015.

Radiological Protection in Ion Beam Radiotherapy. ICRP Publication 127. Ann. ICRP 43(4), 2014.

Compendium of Dose Coefficients Based on ICRP Publication 60. ICRP Publication 119. International Commission on Radiological Protection (ICRP). Annals of the ICRP 41 (Suppl.) (2012).

ICRP Statement on Tissue Reactions/Early and Late Effects of Radiation in Normal Tissues and Organs – Threshold Doses for Tissue Reactions in a Radiation Protection Context, ICRP Publication 118. International Commission on Radiological Protection (ICRP), Annals of the ICRP 41 (2012).

Preventing Accidental Exposures from New External Beam Radiation Therapy Technologies, ICRP Publication 112. International Commission on Radiological Protection (ICRP). Annals of the ICRP 39 (2009).

Nuclear Decay Data for Dosimetric Calculations, ICRP Publication 107. International Commission on Radiological Protection (ICRP). Annals of the ICRP 38 (2008).

2007 Recommendations of the International Commission on Radiological Protection (Users Edition), ICRP Publication 103 (Users Edition). International Commission on Radiological Protection (ICRP). Annals of the ICRP 37 (2007).

Assessing Dose of the Representative Person for the Purpose of the Radiation Protection of the Public, ICRP Publication 101a. International Commission on Radiological Protection (ICRP). Annals of the ICRP 36 (2006)

Radiation Safety Aspects of Brachytherapy for Prostate Cancer Using Permanently Implanted Sources, ICRP Publication 98. International Commission on Radiological Protection (ICRP). Annals of the ICRP 35 (2005).

Prevention of High-Dose-Rate Brachytherapy Accidents, ICRP Publication 97. International Commission on Radiological Protection (ICRP). Annals of the ICRP 35 (2005).

Release of Patients after Therapy with Unsealed Radionuclides, ICRP Publication 94. International Commission on Radiological Protection (ICRP). Annals of the ICRP 34 (2004).

Relative Biological Effectiveness, Radiation Weighting and Quality Factor, ICRP Publication 92. International Commission on Radiological Protection (ICRP). Annals of the ICRP 33 (2003).

Prevention of Accidental Exposures to Patients Undergoing Radiation Therapy, ICRP Publication 86. International Commission on Radiological Protection (ICRP). Annals of the ICRP 30 (2000).

16.3.13 Italian Association of Medical Physicists/Associazione Italiana di Fisica Medica (AIFM)

Intensity Modulated Radiation Therapy (IMRT): Dosimetric and Computational Aspects. AIFM Report No. 3, 2006. https://www.fisicamedica.it/sites/default/files/documenti/2006_n3_ReportAIFM.pdf.

16.3.14 National Committee on Radiation Protection (NCRP) reports

The following is a listing of relevant reports from the U.S. National Committee of Radiation Protection (NCRP) since 1980. All NCRP reports since 1971 are now available on-line through the AAPM website (for AAPM members) at <http://www.aapm.org/pubs/NCRP/>. The NCRP has also published a number of "Commentaries," which appear at the end of this section.

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- NCRP Report No. 174. Preconception and Prenatal Radiation Exposure: Health Effects and Protective Guidance. Bethesda, MD: NCRP Publications, 2013.
- NCRP Report No. 173. Investigation of Radiological Incidents. Bethesda, MD: NCRP Publications, 2012.
- NCRP Report No. 172 – Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for the United States. Bethesda, MD: NCRP Publications, 2012.
- NCRP Report No. 171 – Uncertainties in the Estimation of Radiation Risks and Probability of Disease Causation. Bethesda, MD: NCRP Publications, 2012.
- NCRP Report No. 170 – Second Primary Cancers and Cardiovascular Disease After Radiation Therapy. Bethesda, MD: NCRP Publications, 2011.
- NCRP Report No. 164 – Uncertainties in Internal Radiation Dose Assessment. Bethesda, MD: NCRP Publications, 2009.
- NCRP Report No. 163 – Radiation Dose Reconstruction: Principles and Practices. Bethesda, MD: NCRP Publications, 2009.
- NCRP Report No. 162 – Self Assessment of Radiation-Safety Programs. Bethesda, MD: NCRP Publications, 2009.
- NCRP Report No. 161. II – Management of Persons Contaminated With Radionuclides: Scientific and Technical Bases. Bethesda, MD: NCRP Publications, 2008.
- NCRP Report No. 161. I – Management of Persons Contaminated With Radionuclides: Handbook. Bethesda, MD: NCRP Publications, 2008.
- NCRP Report No. 160 – Ionizing Radiation Exposure of the Population of the United States. Bethesda, MD: NCRP Publications, 2009.
- NCRP Report No. 159 – Risk to the Thyroid from Ionizing Radiation. Bethesda, MD: NCRP Publications, 2008.
- NCRP Report No. 158 – Uncertainties in the Measurement and Dosimetry of External Radiation. Bethesda, MD: NCRP Publications, 2007.
- NCRP Report No. 157 – Radiation Protection in Educational Institutions. Bethesda, MD: NCRP Publications, 2007.
- NCRP Report No. 155 – Management of Radionuclide Therapy Patients. Bethesda, MD: NCRP Publications, 2006.
- NCRP Report No. 151 – Structural Shielding Design and Evaluation for Megavoltage x-Ray and Gamma-Ray Radiotherapy Facilities. Bethesda, MD: NCRP Publications, 2005.
- NCRP Report No. 149 – A Guide to Mammography and Other Breast Imaging Procedures. Bethesda, MD: NCRP Publications, 2004.
- NCRP Report No. 147. Structural Shielding Design for Medical X-Ray Imaging Facilities. Bethesda, MD: NCRP Publications, 2004.
- NCRP Report No. 144. Radiation Protection for Particle Accelerator Facilities. Bethesda, MD: NCRP Publications, 2003.
- NCRP Report No. 140 – Exposure Criteria for Medical Diagnostic Ultrasound. Bethesda, MD: NCRP Publications, 2002.

Radiation Oncology Medical Physics Resources for Working, Teaching, and Learning

NCRP Report No. 136 – Evaluation of the Linear-Nonthreshold Dose-Response Model for Ionizing Radiation. Bethesda, MD: NCRP Publications, 2001.

NCRP Report No. 134 – Operational Radiation Safety Training. Bethesda, MD: NCRP Publications, 2000. NCRP.

Report No. 128 – Radionuclide Exposure of the Embryo/Fetus. Bethesda, MD: NCRP Publications, 1998. NCRP

Report No. 127 – Operational Radiation Safety Program. Bethesda, MD: NCRP Publications, 1998.

NCRP Report No. 126 – Uncertainties in Fatal Cancer Risk Estimates Used in Radiation Protection. Bethesda, MD: NCRP Publications, 1997.

NCRP Report No. 124 – Sources and Magnitude of Occupational and Public Exposures from Nuclear Medicine Procedures. Bethesda, MD: NCRP Publications, 1996.

NCRP Report No. 122 – Use of Personal Monitors to Estimate Effective Dose Equivalent and Effective Dose to Workers For External Exposure to Low-LET Radiation. Bethesda, MD: NCRP Publications, 1995.

NCRP Report No. 117 – Research Needs for Radiation Protection. Bethesda, MD: NCRP Publications, 1993.

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NCRP Report No. 082 – SI Units in Radiation Protection and Measurements. Bethesda, MD: NCRP Publications, 1985.

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Commentary No. 009. Considerations Regarding the Unintended Radiation Exposure of the Embryo, Fetus or Nursing Child, 1994.

16.3.15 Netherlands Commission on Radiation Dosimetry/Nederlandse Commissie voor Stralingsdosimetrie (NCS) reports

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Quality Assurance for Tomotherapy Systems. Report 27, April 2017.

<http://radiationdosimetry.org/ncs/documents/quality-assurance-for-tomotherapy-systems>.

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Human Exposure to Ionising Radiation for Clinical and Research Purposes: Radiation Exposure and Risk Estimates. Report 26, May 2016. http://radiationdosimetry.org/documents/ncs/human-exposure-to-ionising-radiation-for-clinical-and-research-purposes-radiation-dose-risk-estimates?worker=add_footer&text=The+NCS+report+has+been+&file=files/documents/0000096/264-ncs-report-26-radiation-dose-and-risk-estimates.pdf.

Process Management and Quality Assurance for Intracranial Stereotactic Treatment. Report 25. October 2015. http://radiationdosimetry.org/ncs/documents/process-management-and-quality-assurance-for-intracranial-stereotactic-treatment?worker=add_footer&text=The+NCS+report+has+been&file=files/documents/0000095/263-ncs-stereo-report20151108.pdf.

Code of Practice for the Quality Assurance and Control for Volumetric Modulated Arc Therapy. Report 24 of the Netherlands Commission on Radiation Dosimetry. <http://radiationdosimetry.org/ncs/documents/code-of-practice-for-the-quality-assurance-and-control-for-vmat>.

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Code of practice for personal dosimetry of professionals wearing protective clothing during radiological procedures. Report 19 of the Netherlands Commission on Radiation Dosimetry. <http://radiationdosimetry.org/files/documents/0000012/66-ncs-rapport-19-cop-personal-dosimetry-protective-clothing.pdf>.

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16.4 Educators' Resource Guides and General Training Materials

Contouring and treatment planning courses. University of California San Diego (UCSD), Radiation Oncology Learning Center: ucsd.radonclearningcenter.org/ucsdfreeonlinecourses.

A report from the AAPM Subcommittee on Guidelines for Competency Evaluation for Clinical Medical Physicists in Radiation Oncology. *J. Appl. Clin. Med. Phys.* 7: 3-14, 2016. <http://onlinelibrary.wiley.com/doi/10.1120/jacmp.v17i4.5804/full>.

Monograph on Radiation Physics Practicals (for Medical Physics Students). S. Sathiyar http://www.ampi.org.in/wp-content/uploads/2014/12/PRACTICAL_MANUAL-S-Sathiyar.pdf.

AAPM Educators Resource Guides. <http://www.aapm.org/education/ERG/>.

European Training and Education for Medical Physics Experts in Radiology (EUTEMPE-RX). <http://www.eutempe-rx.eu/>.

European Training and Education in Radiation Protection (EUTERP). <http://www.euterp.eu/>.

EMERALD/EMIT on-line Medical Physics courses. <http://emerald2.eu/cd/emerald2/>.

On-line Ethics and Professionalism Modules. <http://www.aapm.org/education/onlinemodules.asp>.

HeadNeckBrainSpine, a website intended for those interested in neuroradiology anatomy and learning from neuroradiology cases. <http://www.headneckbrainspine.com/index.php>.

Radiation Oncology Medical Physics Resources for Working, Teaching, and Learning

IAEA PowerPoint slides for IAEA Physics Handbooks (Radiation Oncology Physics, Diagnostic Radiology Physics, Nuclear Medicine Physics): <http://www-naweb.iaea.org/NAHU/DMRP/slides.html>.

IAEA e-Learning modules on Quality Assurance for SPECT systems:

https://humanhealth.iaea.org/HHW/MedicalPhysics/e-learning/QA_SPECT/index.html.

<https://nucleus.iaea.org/HHW/MedicalPhysics/e-learning/index.html>.

RSNA/AAPM On-line Physics Modules. <http://www.aapm.org/education/webbasedmodules.asp>.

Medical Physics Clinical Skills Workbook for Therapy Physics, 2012.

http://www.rosalindfranklin.edu/Portals/3/Documents/Clinical_Skills_Workbook_ONLINE_VERSION__Revised_10-23-12A%5B1%5D.pdf.

Training, Education and Assessment Program for Radiation Oncology Medical Physics. Australasian College of Physical Scientists and Engineers in Medicine.

<https://www.acpsem.org.au/whatacpsemdoes/training-education-assessment-programs>.

Teaching Medical Physics. Institute of Physics

http://www.iop.org/education/teacher/resources/teaching-medical-physics/page_54690.html.

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Radiation Oncology Trainee's notes. <http://ozradonc.wikidot.com/start>.

Self-Scoring Quizzes. <http://weber.ucsd.edu/~dkjordan/resources/quizzes/quizzes.html>.

Multimedia Educational Resource for Learning and Online Teaching (MERLOT). <http://www.merlot.org/>.

Medical Dosimetry Certification Study Guide. K. N. G. Rajan. Madison, WI: Medical Physics Publishing, 2004.

Compilation of Radiobiology Practice Examinations: For Residents in Diagnostic Radiology and Radiation Oncology. J. D. Chapman, S. Shahabi, and B.A. Chapman. Madison, WI: Advanced Medical Publishing, 2000.

The Q Book—The Physics of Radiotherapy X-Rays: Problems and Solutions. P. Metcalfe, T. Kron, and P. Hoban. Madison, WI: Medical Physics Publishing, 1998.

Therapy Physics Review. B. Paliwal, Madison, WI: Medical Physics Publishing, 1996.

Compilation of Radiological Physics Examinations, Radiation Therapy, Volume 1. (RAPHEX – Radiological Physics Examination) S. V. Brownie and S. Shahabi, editors. Madison, WI: Advanced Medical Publishing, 1995.

16.5 Journals

American Journal of Roentgenology (AJR)

Applied Radiation and Isotopes (Appl Radiat Isot)

Australasian Physical & Engineering Sciences in Medicine (Australas Phys Eng Sci Med)

Biomedical Imaging and Intervention Journal (Biomed Imaging Interv J)

Brachytherapy

British Journal of Radiology (Br J Radiol)

Cancer

Cancer Journal (Cancer J.)

Cancer/Radiothérapie (Cancer Radiother.)

Clinical Oncology (Clin. Oncol.)

European Journal of Cancer (Eur. J. Cancer)

European Journal of Radiology (Eur. J. Radiol.)

Frontiers in Oncology (Front. Oncol.) Freely available open access journal available at: <http://www.frontiersin.org/oncology>.

Frontiers in Radiation Oncology (Front. Radiat. Oncol.) Freely available open access journal at: http://www.frontiersin.org/Radiation_Oncology.

Frontiers in Radiation Therapy and Oncology (Front. Radiat. Ther. Oncol.)

Health Physics (Health Phys.)

International Journal of Medical Physics, Clinical Engineering and Radiation Oncology (Int. J. Med. Phys. Clin. Eng. Radiat. Oncol.). Freely available open access journal at: <http://www.scirp.org/journal/ijmpcero/>.

International Journal of Radiation Oncology, Biology, Physics (Int. J. Radiat. Oncol. Biol. Phys.)

Journal of Applied Clinical Medical Physics (J. Appl. Clin. Med. Phys.) Freely available open access journal at: <http://www.jacmp.org/index.php/jacmp>.

Journal of Cancer Research and Therapeutics (J. Cancer Res. Ther.) Freely available open access journal at: <http://www.cancerjournal.net/>.

Journal of Clinical Oncology (J. Clin. Oncol.)

Journal of the ICRU (J. ICRU)

Journal of Medical Imaging and Radiation Oncology (J. Med. Imaging Radiat. Oncol.)

Journal of Medical Physics (J. Med. Phys.)

Journal of Radiotherapy in Practice (J. Radiother. Pract.)

Journal of Research of the National Institute of Standards and Technology (J. Res. Natl. Inst. Stan.). Freely available open access journal at: <http://www.nist.gov/nvl/jres.cfm>.

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Journal of the American College of Radiology (J. Am. Coll. Radiol.)
Canadian Association of Radiologists Journal (Can. Assoc. Radiol. J.)
Lancet
Medical Dosimetry (Med. Dosim.)
Medical Engineering and Physics (Med. Eng. Phys.)
Medical Physics (Med. Phys.). Medical Physics open access papers:
<http://www.medphys.org/>.
Nuclear Instruments and Methods (Nucl. Instrum. Methods)
Physica Medica: European Journal of Medical Physics (Phys. Medica.)
Physics in Medicine and Biology (Phys. Med. Biol.)
Practical Radiation Oncology (Pract. Radiat. Oncol.)
Radiation Measurement (Radiat. Meas.)
Radiation Protection Dosimetry (Radiat. Prot. Dosim.)
Radiation Oncology (Radiat. Oncol.) Freely available open access journal at: <http://www.ro-journal.com/>.
Radiation Research (Radiat. Res.)
Radiology
Radiotherapy and Oncology (Radioth. Oncol.)
Seminars in Radiation Oncology (Semin. Radiat. Oncol.)
Strahlentherapie und Onkologie (Strahlenther. Onkol.) German Journal but contains many articles in English.
Tumori

16.6 Reports and Websites on Safety Considerations and Errors in Radiation Therapy

European Commission. Radiation Protection No. 181. General Guidelines on Risk Management in External Radiotherapy. 2015. <https://ec.europa.eu/energy/sites/ener/files/documents/RP181.pdf>.
Technical Supplement to Radiation Protection No. 181. General Guidelines on Risk Management in External Beam Radiotherapy.
<https://ec.europa.eu/energy/sites/ener/files/documents/AnnexeGuidelinesRP181.pdf>.
RO-ILS: Radiation Oncology Incident Learning System. Co-sponsored by AAPM and ASTRO.
<https://www.astro.org/Clinical-Practice/Patient-Safety/ROILS/Index.aspx>.
European Basic Safety Standards for Ionizing Radiation Protection. COUNCIL DIRECTIVE 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom.
<https://ec.europa.eu/energy/sites/ener/files/documents/CELEX-32013L0059-EN-TXT.pdf>.
Safety in Radiation Oncology (SAFRON). (Radiation oncology incident reporting system developed by the International Atomic Energy Agency, IAEA). Requires registration.
<https://rpop.iaea.org/RPOP/RPoP/Content/News/safron.htm>.

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Safety Is No Accident: A Framework for Quality Radiation Oncology and Care. A.L. Zietman, J.R. Palta, and M. L. Steinberg, editors. American Society for Radiation Oncology (ASTRO). 2012. http://www.astro.org/uploadedFiles/Main_Site/Clinical_Practice/Patient_Safety/Blue_Book/SafetyisnoAccident.pdf.

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Radiation Therapy Safety: The Critical Role of the Radiation Therapist. (White Paper) T. G. Odle and N. Rosier for the ASRT Education and Research Foundation Health Care Industry Advisory Council Subcommittee on Patient Safety and Quality in Radiation Therapy, 2012.

Manual for ACRO Accreditation. July 2013. American College of Radiation Oncology (ACRO), Bethesda, MD, 2013. <http://www.acro.org/Accreditation/ACROAccreditationManual.pdf>.

Recommendations for safer radiotherapy: what's the message? P. Dunscombe. *Front. Radiat. Oncol.* 2: Article 129, 1–6, 2012. http://www.frontiersin.org/Radiation_Oncology/10.3389/fonc.2012.00129/full.

Radiation Oncology Practice Standards: A Tripartite Initiative. 2011. The Royal Australian and New Zealand College of Radiologists (RANZCR), Australian Institute of Radiography (AIR), The Australasian College of Physical Scientists and Engineers in Medicine (ASPSEM). <http://www.ranzcr.edu.au/quality-a-safety/radiation-oncology/tripartite-radiation-oncology-practice-standards>.

Preventing Accidental Exposures from New External Beam Radiation Therapy Technologies. ICRP Publication 112. International Commission on Radiological Protection (ICRP). *Annals of the ICRP* 39. Oxford, Pergamon Press, 2009.

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Radiotherapy Risk Profile: Technical Manual. Geneva: World Health Organization, 2008. http://www.who.int/patientsafety/activities/technical/radiotherapy_risk_profile.pdf.

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Radiation Oncology Safety Education and Information System (ROSEIS) under the auspices of the European Society for Radiotherapy and Oncology (ESTRO). <https://roseis.estro.org/>

TreatSafely. Improving Quality and Safety for Patient Medicine. Includes free on-line learning lecture series. <http://www.treatsafely.org/>.

Institute for Healthcare Improvement (includes quality improvement tools). <http://www.ihl.org>.

A Reference Guide for Learning from Incidents in Radiation Treatment. HTA Initiative #22. Alberta Heritage Foundation for Medical Research, October 2006. <http://www.ihe.ca/advanced-search/a-reference-guide-for-learning-from-incidents-in-radiation-treatment>.

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Safety Culture Policy Statement. U.S. Nuclear Regulatory Commission (NRC). <http://pbadupws.nrc.gov/docs/ML1117/ML11173A052.pdf>.

Conceptual Framework for International Classification for Patient Safety, Final Technical Report. v1.1. January 2009. World Health Organization (WHO).
http://www.who.int/patientsafety/taxonomy/icps_full_report.pdf.

16.7 Miscellaneous Resources

16.7.1 Patient protection

Canadian Patient Safety Institute. <http://www.patientsafetyinstitute.ca/English/Pages/default.aspx>.

Protection of Pregnant Patients during Diagnostic Medical Exposures to Ionising Radiation: Advice from the Health Protection Agency, the Royal College of Radiologists and the College of Radiographers. Documents of the Health Protection Agency: Radiation, Chemical and Environmental Hazards, 2009.
<http://www.ipem.ac.uk/Portals/0/Images/Protection%20of%20pregnant%20patients.pdf>.

UK National Patient Safety Agency. <http://www.npsa.nhs.uk/>.

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AAPM/ASTRO 24-25 June 2010. Free access to presentations to AAPM members and conference participants. Cost for non-members and non-participants. <http://www.aapm.org/meetings/2010SRT/default.asp>.

16.7.2 Policy statements/special procedures

AAPM Policy Statements: Professional/Educational/Science.
<http://www.aapm.org/org/policies/policy.asp?type=PP>.

Management of Radiation Oncology Patients with a Pacemaker or ICD. *Radiat. Oncol.* 7:198–doi:10.1186/1748-717X-7-198. <http://www.ro-journal.com/content/pdf/1748-717X-7-198.pdf>.

16.7.3 Conference proceedings

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16.7.4 Radiological emergency response

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Disaster Preparedness for Radiology Professionals: Response to Radiological Terrorism. A Primer for Radiologists, Radiation Oncologists, and Medical Physicists. Government Version 3.0. American College of Radiology (ACR), 2006. <http://www.acr.org/~media/ACR/Documents/PDF/Membership/Legal%20Business/Disaster%20Preparedness/Primer.pdf>.

Procedures for Medical Emergencies Involving Radiation. Modified from K. Miller and M. Erdman. *Health Physics Considerations in Medical Radiation Emergencies, Operational Radiation Safety*. *Health Phys* 87 (Suppl 1):S19–S24 (2006). Adopted: 2006. http://hpschapters.org/sections/homeland/documents/Dec_31_Reformatted_MRE_Chart.pdf.

16.7.5 Miscellaneous

Encyclopaedia of Medical Physics. S. Tabakov, F. Milano, S-E. Strand, C. Lewis, and P. Sprawls, editors. Boca Raton, FL: Taylor and Francis, 2012.

The Invisible Passenger: Radiation Risks for People Who Fly, 2nd edition. R. J. Barish. Madison, WI: Advanced Medical Publishing, 2008.

Making Sense of Radiation: A Guide to Radiation and Its Health Effects. Published by Sense About Science in collaboration with the British Institute of Radiology, the Institute of Physics and Engineering in Medicine, and the Institution of Medical Engineers, 2008. <http://senseaboutscience.org/wp-content/uploads/2016/11/Makingsenseofradiation.pdf>.

Global Task Force on Radiotherapy for Cancer Control. www.gtfcc.org.

GlobalRT: GTFRC Young Leaders Initiative. <http://globalrt.org/>.

16.8 On-line Resources

2017 HRS expert consensus statement on magnetic resonance imaging and radiation exposure in patients with cardiovascular implantable electronic devices. <https://www.astro.org/Patient-Care/Clinical-Practice-Statements/Cardiac-Implantable-Electronic-Device/>.

American Association of Medical Physicists (AAPM) CT Lexicon. http://www.aapm.org/pubs/CTProtocols/documents/CTTerminologyLexicon_2012-03-20.pdf.

American Association of Medical Physicists (AAPM) Medical Physics Resource Page. <http://www.aapm.org/links/medphys/default.asp>.

American Society for Radiation Oncology (ASTRO) Model Policies. <https://www.astro.org/Daily-Practice/Reimbursement/Model-Policies/Model-Policies/>.

Chart Rounds: Chartrounds brings together academic disease site specialists from leading cancer treatment institutions and connects them with the Chartrounds network of over 1300 physicians and medical physicists. On a scheduled basis, discuss patient management and treatment plans with trusted colleagues in real time. <https://www.chartrounds.com/default.aspx>.

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Radiation Oncology Medical Physics Resources for Working, Teaching, and Learning

Dosimetry parameters for source models used in brachytherapy. <http://www.uv.es/braphyqs/>.

eContour, a contouring resource from University of California, San Diego. <http://eContour.org/>

EMITEL e-Encyclopaedia of Medical Physics and Multi Lingual Dictionary Terms.
<http://www.emitel2.eu/emitwwsql/index-login.aspx>.

EMITEL: Medical Physics Dictionary. <http://emitdictionary.co.uk/emitdictionary/index.htm>.

Figures in Radiation History.
<https://ehs.msu.edu/lab-clinic/rad/hist-figures/index.html>.

Global Oncology. Global Cancer Project Map. <http://globalonc.org/Projects/global-cancer-project-map/>.

Histogram Analysis in Radiation Therapy (HART). <http://hart.research.uic.edu/>.

International Atomic Energy Agency (IAEA) Radiation Protection of Patients (RPOP).
<https://rpop.iaea.org/RPoP/RPoP/Content/index.htm>.

International Atomic Energy Agency (IAEA) Human Health Campus.
<http://nucleus.iaea.org/HHW/Home/more.html>.

International Organization of Medical Physicists (IOMP) resource page with bibliographic data.
<http://www.iomp.org/?q=node/34>.

IROC Houston Quality Assurance Center (formerly known as the Radiological Physics Center).
<http://rpc.mdanderson.org/rpc/>.

Medical Physics Resources. Integrated Environment Management, Inc.: <http://www.iem-inc.com/>.

Medical Physics Web. <http://medicalphysicsweb.org/>.

National Health Service (UK). National Cancer Action Team. National Radiotherapy Implementation Group Report. Image Guided Radiotherapy (IGRT): Guidance for implementation and use. 2012.
<https://www.sor.org/sites/default/files/document-versions/National%20Radiotherapy%20Implementation%20Group%20Report%20IGRT%20Final.pdf>.

NIST Reference on Constants, Units, and Uncertainty. <http://physics.nist.gov/cuu/index.html>.

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Radiation Therapy Oncology Group (RTOG) Study Protocols.
<http://www.rtog.org/ClinicalTrials/ProtocolTable.aspx>.

The Radiation Information Network. <http://www.physics.isu.edu/radinf/>.

ResearchGate. (Social networking site for scientists – includes medical physics, radiation therapy, and imaging professionals and topics.) <http://www.researchgate.net/>.

RT Answers (for patients ... developed by ASTRO). <http://www.rtanswers.org/home/>.

Surveillance Epidemiology and End Results (SEER). National Cancer Institute, U.S. National Institutes of Health. (Provides information on cancer statistics) <http://seer.cancer.gov/>.

SEER Self Instructional Manuals for Tumor Registrars. <http://seer.cancer.gov/training/manuals/>.

TDF Plan: BED Calculations. <http://www.eyephysics.com/tdf/BEDCalcs.htm>.

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).
<http://www.unscear.org/>.

U.S. National Nuclear Data Center. <http://www.nndc.bnl.gov/>.

US National Quality Forum. The National Quality Forum (NQF) is a not-for-profit, nonpartisan, membership-based organization that works to catalyze improvements in healthcare. <http://www.qualityforum.org/Home.aspx>.

16.9 Mailing Lists/Discussion Forums

American Medical Physics mailing list. <http://lists.wayne.edu/cgi-bin/wa?A0=MEDPHYSUSA>.

Global Medical Physics mailing list. <http://lists.wayne.edu/cgi-bin/wa?A0=MEDPHYS>.

16.10 Guide to Medical Physics Practice

Guide to Medical Physics Practice. American College of Radiology. <http://www.acr.org/Membership/Legal-Business-Practices/Group-Practice-Resources/Guide-to-Medical-Physics-Practice>.

What Do Medical Physicists Do? AAPM website. http://www.aapm.org/medical_physicist/default.asp.

Technical Standards for Medical Physics Practice. American College of Radiology (ACR). <http://www.acr.org/Quality-Safety/Standards-Guidelines/Technical-Standards-by-Modality/Medical-Physics>.

16.11 On-line Medical Physics-related Staffing Information

Staffing in Radiotherapy: An Activity Based Approach. Vienna: International Atomic Energy Agency (IAEA), 2015. <http://www-pub.iaea.org/books/IAEABooks/10800/Staffing-in-Radiotherapy-An-Activity-Based-Approach>.

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Erratum: <http://onlinelibrary.wiley.com/doi/10.1120/jacmp.v13i2.3915/full>

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Safety Is No Accident: A Framework for Quality Radiation Oncology and Care. A. L. Zietman, J. R. Palta, and M. L. Steinberg, editors. American Society for Radiation Oncology (ASTRO), 2012.

https://http://www.astro.org/uploadedFiles/Main_Site/Clinical_Practice/Patient_Safety/Blue_Book/Safetyis-noAccident.pdf.

Projecting the Radiation Oncology Workforce in Australia. D. Schofield, E. Callander, M. Kimman, J. Scuteri, and L. Fodero. *Asian Pac. J. Cancer Prev.* 13:1159–1166 (2012).

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Medical Physicist Workforce Study. Health Workforce Australia. 2012.

<https://www.acpsem.org.au/documents/item/91>.

Workforce Study of Medical Physicists in the U.S. M. Langelier and G. Forte. Center for Health Workforce Studies School of Public Health, University at Albany, Rensselaer, NY, 2010.

http://www.aapm.org/pubs/protected_files/surveys/workforce/Synthesis.pdf.

Future trends in the supply and demand for radiation oncology physicists. M. D. Mills, J. Thornewill, and R. J. Esterhay. *J. Appl. Clin. Med. Phys.* 11:209–219 (2010).
<http://onlinelibrary.wiley.com/doi/10.1120/jacmp.v11i2.3005/full>.

A grid to facilitate physics staffing justification. E. E. Klein. *J. Appl. Clin. Med. Phys.* 11:263–273 (2010).
<http://onlinelibrary.wiley.com/doi/10.1120/jacmp.v11i1.2987/full>.

A 2009 survey of the Australasian clinical medical physics and biomedical engineering workforce. W. H. Round. *Australas Phys. Eng. Sci. Med.* 33:153–162 (2010).
<http://researchcommons.waikato.ac.nz/handle/10289/4245>.

Victorian Medical Radiations Workforce Supply and Demand Projections (2010–2030). H. Zhang. Modelling, GIS and Planning Products Unit, Victorian Government, Department of Health, Melbourne, Victoria, Australia, 2010. [http://docs.health.vic.gov.au/docs/doc/8327D7F888AC8588CA25785C000BE4DD/\\$FILE/medical-radiation.pdf](http://docs.health.vic.gov.au/docs/doc/8327D7F888AC8588CA25785C000BE4DD/$FILE/medical-radiation.pdf).

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Criteria for the staffing levels in a Medical Physics Department. Policy Statement. The European Federation of Organisations for Medical Physics (EFOMP), 1997.

16.12 Medical Physics Graduate Schools

CAMPEP Accredited Medical Physics Graduate Programs. <http://www.campep.org/campeplstgrad.asp>.

CAMPEP Accredited Residency Programs in Medical Physics. <http://www.campep.org/campeplstres.asp>.

Non-CAMPEP Accredited Programs in Medical Physics. <http://www.aapm.org/education/noncampep.asp>.

Canadian universities offering graduate programs in Medical Physics.

<https://www.comp-ocpm.ca/english/membership-services/for-students/graduate-programs.html>.

Canadian institutions offering medical physics residency programs.

<https://www.comp-ocpm.ca/english/career-education/career-resources/residency-programs.html>.

Ontario Medical Physics Residency Programs.

<https://www.cancercare.on.ca/cms/one.aspx?pageId=9352>.

16.13 Medical Physics Jobs

AAPM Career Services. <http://careers.aapm.org/>.

Health Physics-related Employment Website. <http://www.physics.isu.edu/radinf/hpjob.htm>.

Job Rapido. <http://ca.jobrapido.com/>.

Physics Today jobs. <http://jobs.physicstoday.org/>.

16.14 Medical Physics-related Organizations

American Association of Physicists in Medicine (AAPM). <http://www.aapm.org/>.

American College of Radiology (ACR). <http://www.acr.org/>.

American Society for Radiation Oncology (ASTRO). <https://www.astro.org/>.

Argentinian Society of Medical Physicists/Sociedad Argentina de Física Médica (SAFIM).
<http://www.safim.org.ar/home.php>.

Asia-Oceania Federation of Organizations for Medical Physics (AFOMP). <http://www.afomp.org/>.

Association of Medical Physicists of India (AMPI). <http://ampi.org.in/>.

Association of Medical Physicists in Russia (AMPHR). <http://www.amphr.ru/engl.php>.

Australasian College of Physical Scientists and Engineers in Medicine (ACPSEM).
<http://www.acpsem.org.au/>.

Australasian Radiation Protection Society (ARPS). <http://www.arps.org.au/>.

Austrian Society for Medical Physics/Österreichische Gesellschaft für Medizinische Physik (ÖGMP).
<http://www.oegmp.at/>.

Bangladesh Medical Physics Association (BMPA). <http://bmpaweb.org/>.

Belgian Hospital Physicists Association (BHPA). <http://www.bhpa.eu/>.

Brazilian Association of Medical Physics/Associação Brasileira de Física Médica (ABFM).
<http://www.abfm.org.br/>.

Bulgarian Society of BioMedical Physics and Engineering (BSBPE). <http://bsbpe.org/>.

Canadian College of Physicists in Medicine (CCPM). <http://www.ccpm.ca/>.

Canadian Organization of Medical Physicists (COMP). <http://www.medphys.ca/>.

Canadian Radiation Protection Association (CRPA). <http://www.crpa-acrp.org/>.

Chinese Society of Medical Physics (CSMP). <http://www.csmp.org.cn/>.

Chinese Society of Medical Physics, Taipei (CSMPT).

Cyprus Association of Medical Physics and BioMedical Engineering (CAMPBE).
<http://www.campbe.org/>.

Czech Association of Medical Physicists/Ceská společnost fyziků v medicíně (CSFM).
<http://www.csfm.cz/index.php?text=39>.

Danish Society for Medical Physics (DSMF). <http://www.dsmf.org/>.

European Federation of Organisations for Medical Physics (EFOMP). <http://www.efomp.org/>.

European Organization for Research and Treatment of Cancer (EORTC). <http://www.eortc.org/>.

European Society for Radiotherapy and Oncology (ESTRO). <http://estro.org/>.

Federation of African Medical Physics Organisations (FAMPO). <http://www.federation-fampo.org/>.

Radiation Oncology Medical Physics Resources for Working, Teaching, and Learning

Finnish Association of Medical Physicists. <http://www.sairaalaafysikot.fi/>.

French Society of Medical Physics/Société Française de Physique Médicale (SFPM).
<https://www.sfpm.fr/>.

German Society of Medical Physics/Deutsche Gesellschaft für Medizinische Physik (DGMP).
<http://www.dgmp.de/>.

Ghana Society for Medical Physics. <http://www.gsmpghana.org/>.

Health Physics Society (HPS). <http://hps.org/>.

Hellenic Association of Medical Physicists (HAMP), Greece. <http://www.efie.gr/index.php?lang=en>.

Hong Kong Association of Medical Physics (HKAMP). <http://www.hkamp.org/app/hkamp/index.html>.

Indonesian Medical Physics and Biophysics Association (HFMBI).
<https://sites.google.com/site/medphysindonesia/>.

Institute of Physics and Engineering in Medicine (IPEM). <http://www.ipem.ac.uk/>.

International Centre for Theoretical Physics (ICTP). <http://www.ictp.it/>.

International Organization of Medical Physicists (IOMP). <http://iomp.org/>.

International Radiation Protection Association (IRPA). <http://www.irpa.net/>.

Iranian Association of Medical Physicists (IAMP). <http://www.iamp.ir/>.

Irish Association of Physicists in Medicine (IAPM). <http://www.theiapm.ie/>.

Italian Association of Medical Physicists/Associazione Italiana di Fisica Medica (AIFM).
http://www.fisicamedica.it/aifm/01_home/index.php.

Japan Society of Medical Physics (JSMP). <http://www.jsmp.org/english/>.

Jordanian Association for Physicists in Medicine (JAPM).

Korean Society of Medical Physics (KSMP). <http://www.ksmp.or.kr/>.

Latin American Association of Medical Physicists/Asociación Latinoamericana de Física Médica (ALFIM). <http://www.alfim.net/>.

Macedonian Association for Medical Physics and Biomedical Engineering.
<http://www.zmfbi.org.mk/zmfbi/home.html>.

Malaysian Association of Medical Physics (MAMP). <http://mampweb.wixsite.com/info/join-mamp>.

Medical Physics for World Benefit (MPWB). www.MPWB.org.

Mephida. <http://www.mephida.com/>.

Middle East Federation of Organizations of Medical Physics (MEFOMP). <http://mefomp.org/>.

Moroccan Association of Medical Physics/Association Marocaine de Physique Médicale (AMPM).
<http://www.asso-ampm.com/>.

Nepalese Association of Medical Physicists (NAMP). <http://namp.com.np/>.

Netherlands Society of Clinical Physicists/Nederlandse Vereniging voor Klinische Fysica (NVKF). (Website is in Dutch). <http://www.nvkf.nl/>.

Nordic Association of Clinical Physics (NACP). <http://www.nacp-nordisk.org/>.

Nordic Society for Radiation Protection (NSFS). <http://www.nsf.org/>.

Radiation Oncology Medical Physics Resources for Working, Teaching, and Learning

- North American Chinese Medical Physicist Association (NACMPA). <http://www.nacmpa.org/nacmpa1/index.htm>.
- Norwegian Association of Medical Physicists (NFMF). <http://www.medfys.no/home/>.
- Philippine Association for Radiation Protection (PARP). <http://parpinc.wordpress.com/>.
- Physicien Médical Sans Frontières (PMSF, French Medical Physicists Without Borders). <http://www.pmsf.asso.fr/>.
- Portugese Society of Physicists, Division of Medical Physics. <http://dfm.spf.pt/>.
- Radiological Society of North America (RSNA). <http://www.rsna.org/>.
- Romanian College of Medical Physicists (CFMR): <http://www.cfmr.ro/>.
- Saudi Medical Physics Society (SMPS). <http://www.smeps.org.sa/>.
- Mexican Society of Physicists/Division of Medical Physics (Sociedad Mexicana de Física/División de Física Médica). <http://www.divisionfisicamedica.mx/>.
- Society of Euro-American Medical Physicists (SEAMP). <http://seamp.org/>.
- South African Association of Physicists in Medicine and Biology (SAAPMB). <http://www.saapmb.net/>.
- South-East Asian Federation of Organizations for Medical Physics (SEAFOMP). <https://sites.google.com/a/sci.ui.ac.id/seafomp/>.
- Spanish Society of Medical Physics (SEFM). <http://www.sefm.es/>.
- Sri Lanka Medical Physics Association (SLMPA).
- Swedish Society for Radiation Physics. <http://www.radiofysik.org/>.
- Swiss Society of Radiobiology and Medical Physics (SSRMP). <http://www.sgsmp.ch/>.
- Thai Medical Physicist Society (TMPS). <http://www.tmps.or.th/submainpages/main.html>.
- Union for International Control of Cancer (Union Internationale Contre le Cancer, UICC). <http://www.uicc.org/>.
- Vietnam Association of Medical Physics (VAMP).
- World Health Organization (WHO). <http://www.who.int/en/>.

16.15 Medical Physics and Radiation Oncology-related Aid and Non-government Organizations

- Above and Beyond Cancer. <http://aboveandbeyondcancer.org/>.
- AMPATH. <http://www.ampathkenya.org/>.
- Association Cancérologues sans Frontières (French for “Oncologists Without Borders.”) <http://www.cancerologuesansfrontieres.com/>.
- African Organization for Research and Training in Cancer (AORTC). <http://www.aortic-africa.org/>.
- International Campaign for Establishment and Development of Oncology Centers (ICEDOC) (and ICE-DOC’s Experts in Cancer Without Borders). <https://icedoc.net/>.
- International Network for Cancer Treatment and Research (INCTR). <http://www.inctr.org/>.

Radiation Oncology Medical Physics Resources for Working, Teaching, and Learning

Medical Physicists Without Borders. www.MPWB.org.

Partners in Health. <http://www.pih.org/>.

Physicien Médical Sans Frontières (PMSF) (French for “Medical Physicists Without Borders.”)
<http://www.pmsf.asso.fr/>.

Radiating Hope. <http://www.radiatinghope.org/>.

Union for International Control of Cancer (Union Internationale Contre le Cancer, UICC).
<http://www.uicc.org/>.

World Cancer Research Fund International (WCRF). <http://www.wcrf.org/>.

16.16 Regulatory Information

Canadian Nuclear Safety Commission. <http://www.nuclearsafety.gc.ca/>.

U.S. Environmental Protection Agency (EPA) Radiation Protection Programs.
<http://www.epa.gov/radiation/>.

U.S. Food and Drug Administration – Radiation-Emitting Products.
<http://www.fda.gov/Radiation-EmittingProducts/default.htm>.

U.S. Nuclear Regulatory Commission. <http://www.nrc.gov/>.

Standards for Protection Against Radiation. U.S. Nuclear Regulatory Commission.
<http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/full-text.html>.

Regulatory Resources from Medical Physics Consultants, Inc. <http://www.mpcphysics.com/resources.cfm>.

16.17 Publications Search Websites

Google Scholar. Scientific journal search engine. <http://scholar.google.com/>.

FreeFullPDF. Free medical/scientific publications. <http://www.freefullpdf.com/>.

PubMed. “An alternative interface to the PubMed medical literature database.” <http://www.hubmed.org/>.

Medical Physics. Open access papers.
<http://scitation.aip.org/content/aapm/journal/medphys/info/open-access>.

MedlinePlus. “National Institutes of Health’s website for patients and their families and friends.”
<http://www.nlm.nih.gov/medlineplus/aboutmedlineplus.html>.

PubMed. U.S. National Library of Medicine. National Institutes of Health. Search engine for biomedical literature. <http://www.ncbi.nlm.nih.gov/pubmed>.

The Cochrane Library. “Independent high-quality evidence for health care decision making.”
<http://www.thecochranelibrary.com/view/0/index.html>.

16.18 Smart Phone Applications

Anatomy Atlas: Anatomy reference with lots of drawings.
<https://itunes.apple.com/us/app/anatomy-atlas/id295806778?mt=8>.

Anatomy Lite: Reference for people who want to know more about human anatomy.
<https://itunes.apple.com/us/app/anatomy-lite/id300369917?mt=8>.

Radiation Oncology Medical Physics Resources for Working, Teaching, and Learning

BED calculator: Calculates biologically effective dose (BED) based on the linear-quadratic model (LQ) model. <https://itunes.apple.com/au/app/bed-calculator-radiation-dose/id397088240>.

Brain MRI Atlas: Navigates through hundreds of labeled brain structures. <https://itunes.apple.com/us/app/brain-mri-atlas/id431556580?mt=8>.

Cancer in the Developing World. Oxford University. <https://itunes.apple.com/us/itunes-u/cancer-in-developing-world/id381702078?mt=10>.

Ctp-ROPE: Teaching tools for radiation oncology physics. Temperature-pressure corrections. http://download.cnet.com/Ctp-ROPE/3000-20415_4-75730169.html.

DoseCalc: Rapid calculation of parameters associated with use of radioisotopes. <https://itunes.apple.com/us/app/dosecalc/id305663994>.

Equivalent dose, EQD2, calculator: <http://www.buhl-development.dk/apps/eqd2/>.

Electron Stopping Power. <https://play.google.com/store/apps/details?id=dk.au.aptg.dEdx>.

eLQ: Radiation Therapy Dose Calculator. Linear Quadratic Model. <http://www.sfjro.fr/ilq/en/>.
See Pract. Radiat. Oncol. 1:212–13 (2011) for a description of this app.
[http://www.practicalradonc.org/article/S1879-8500\(11\)00155-X/fulltext](http://www.practicalradonc.org/article/S1879-8500(11)00155-X/fulltext).

FRCR Radiological Anatomy: <https://itunes.apple.com/us/app/frcr-radiological-anatomy/id552796538?mt=8>.

IAEA Isotope browser. <https://itunes.apple.com/us/app/isotope-browser/id943890538?mt=8> (iOS)
<https://play.google.com/store/apps/details?id=iaea.nds.nuclides> (Android)

IAEA smartphone app for cancer staging: <https://www.iaea.org/newscenter/news/towards-optimal-cancer-treatment-iaea-launches-new-smartphone-app-cancer-staging>.

Medical Physics Box. <https://itunes.apple.com/us/app-bundle/medical-physics-box/id917709770?mt=8>.

My Radiotherapy Experience. <http://radiotherapyxp.android.informer.com/>.

Nano, micro, milli convert: Converts some prefixes (nano, micro, milli, and none) to other prefixes. Also converts per second, per minute, per hour, and per year. <https://itunes.apple.com/us/app/nano-micro-milli-convert/id431603882>.

Quantitative Analyses of Normal Tissue Effects in the Clinic (QUANTEC) summary: https://en.wikibooks.org/wiki/Radiation_Oncology/Toxicity/QUANTEC.

Radiation Calculator: Developed to learn about many types of imaging studies and also to track your radiation exposure. <https://itunes.apple.com/us/app/radiation-calculator/id451907773>.

Radiation Oncologist Tool: Calculates Isoeffective dose in 2 Gy fractions and Isoeffective dose of schedule with multiple fractions per day. <https://itunes.apple.com/us/app/radiation-oncologist-tool/id440336064?mt=8>.

Radiation Protection Calculator: <http://www.radprocalculator.com/>.

Radiation Therapy Flash Card. <https://play.google.com/store/apps/details?id=org.campkim.radiationtherapyflashcard&hl=en>.

Radical Radiation Remedy. <http://www.radicalradiationremedy.com/>.

Radiological Anatomy For FRCR1: <https://play.google.com/store/apps/details?id=com.radrevision.frclanatomyrevisionapp>.

Radiology CT Anatomy: <https://play.google.com/store/apps/details?id=air.CT>.

Radiation Oncology Medical Physics Resources for Working, Teaching, and Learning

Radiotherapy and Oncology.

<https://itunes.apple.com/au/app/radiotherapy-and-oncology/id643019661?mt=8>.

RadOnc Reference. Calculates - General: Body Mass Index, Body Surface Area, Performance Status, Life Expectancy. Physics: BED Calculator, EQD2 Calculator. Breast: ASTRO APBI Guidelines.

<https://itunes.apple.com/au/app/radonc-reference/id563419791?mt=8>.

TDFCalc for iPhone. <http://eyephysics.com/tdf/iphone/>.

TG-51 App by Alan Mayville. <https://itunes.apple.com/us/app/tg-51/id1071013271?ls=1&mt=8>.

Tool to build process maps and checklists, in the spirit of AAPM TG-100, LIsts TO CHEck (litoche): www.litoche.com.

Two-dimensional Fourier transform of an image, 2D-Fourier: <https://itunes.apple.com/ca/app/2d-fourier/id459376080?mt=8>.

Winston-Lutz WebApp: https://www.reddit.com/r/MedicalPhysics/comments/56jnhs/winstonlutz_webapp_instructions_in_comments/.

Wolfram Radiation Protection Reference App calculates shielding requirements, CSDA ranges of different particles, equivalent doses, decay of radioisotopes, and unit conversions.

<https://itunes.apple.com/cn/app/wolfram-radiation-protection/id552507965?mt=8>.

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2. Van Dyk, J., J.J. Battista. "Assessment of Radiation Oncology Medical Physics Residents: The London, Ontario (Canada) Experience." In *Radiology Education: The Evaluation and Assessment of Clinical Competence*, K. M. Hibbert, R. K. Chhem, T. Van Deven, and S.-C. Wang, editors. Heidelberg: Springer-Verlag, 2012.