Treatment Planning Competencies for Medical Physicists

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Objectives from the Abstract:

Identify learning resources about treatment planning appropriate for medical physicists.
Discuss competencies in treatment planning, which include interpretation of the physician's prescription, rigid and deformable image registration, contouring guidelines and dose tolerances for normal tissue structures, planning techniques appropriate for common treatment types and avoidance regions, and management of plan objectives used in inverse planning.

This is a SAMS presentations. Some of the facts presented would be useful to keep in your short term memory.

Disclosures

- Nothing to disclose.

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I have no conflicts of interest to disclose.

Delivery	Example Devices	Example Planning Systems
Conventional Linac	Elekta Versa Varian TrueBeam, Clinac ViewRay	Eclipse, Pinnacle3, RayStation, Monaco, iPlan and Elements, ViewRay TPS
Ring Gantry	TomoTherapy Halcyon	TomoPlan Eclipse
Solid Angle Delivery	Elekta GammaKnife Accuray CyberKnife Zapp	Leskell Gamma Plan Accuray Precision Plan ---
Superficial/ Intraoperative	Mobetron Xoft Axxent Zeiss	IntraOp's Radiance 3D --- ---
Proton / Heavy Ion	Varian / Mevion / iBA	Eclipse, Raystation, Pinnacle3
Brachytherapy	LDR / HDR	Oncentra, Eclipse, Variseed,

The major categories of external beam radiation therapy are listed here. Additionally, LDR and HDR brachytherapy presents nearly as many treatment planning techniques as there are applicators. The resources for learning prescribing techniques and contouring are applicable across the modalities described here, while resources for normal tissue toxicities may have less cross-modality validity and modality specific resources should be sought out. The presentations in this session will focus on treatment planning for a conventional linear accelerator.

Outline

- Competencies for medical physicists and expectations for medical physics residents
  - Residency requirements
  - Competency assessment
- Resources
  - Clinical protocols
  - Contouring guides
  - Normal tissue tolerance
  - Vendor manuals and training
  - Other resources

Competencies

Residency Requirements

CAMPEP: Standards for Accreditation of Residency Educational Programs in Medical Physics. Revised May 2019. Major sections:

- System calibration and quality control
- Treatment planning and delivery
- Safety
- Informatics

The document shown here presents the categories to be covered in medical physics resident education.

Competencies

Minimum treatment planning requirements for completing a residency in radiation oncology physics (CAMPEP)

Treatment Planning Techniques

- Step-and-shoot and sliding window IMRT
- Tumor localization and International Commission on Radiation Units and Measurements (ICRU) target definitions [e.g. gross tumor volume (GTV), clinical target volume (CTV), planning target volume (PTV)]
- Normal tissue anatomical contouring
- 2D and 3D treatment planning
- IMRT/VMAT planning/optimization/QA
- Small field planning/optimization/QA
- Site specific treatment planning – multiple applications
- Dose limits to sensitive structures
- Brachytherapy treatment plans and QA
- Clinical applications of various radiation treatments

General Medical Physicist Knowledge

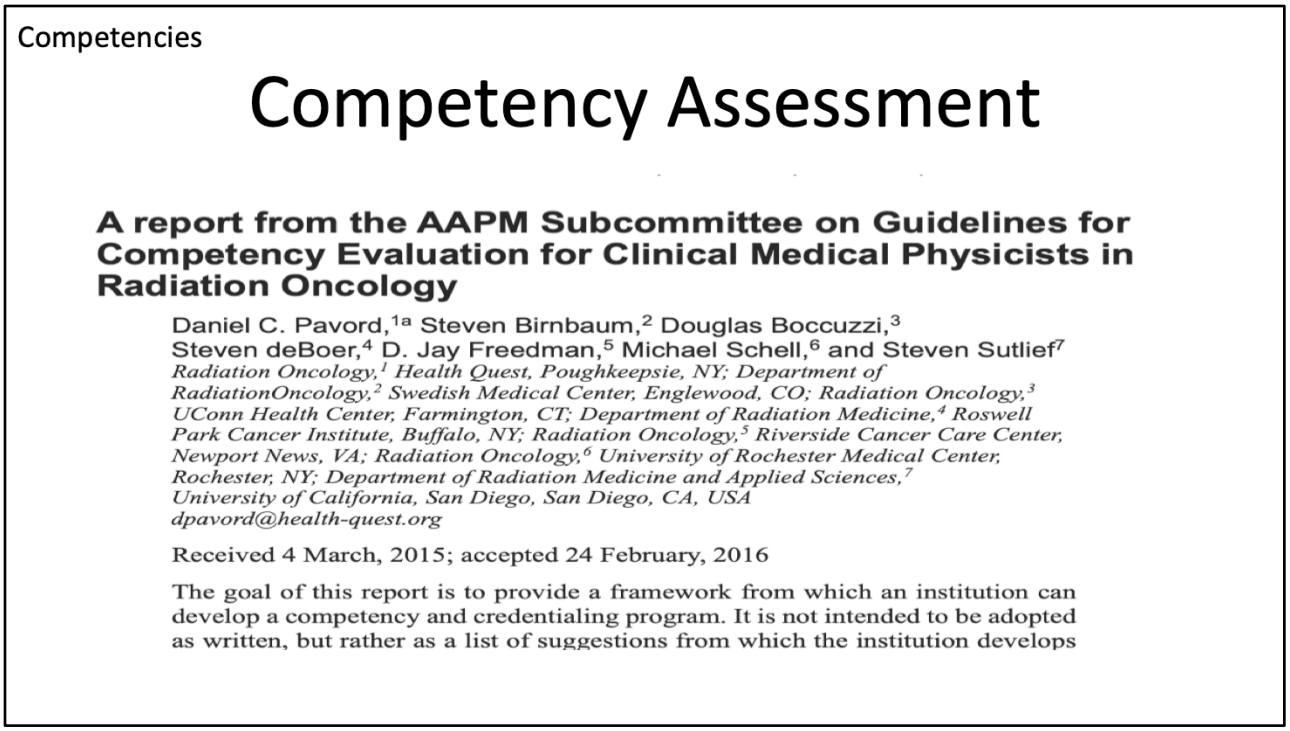
- Treatment simulation techniques (e.g. patient positioning, immobilization)
- Beam properties (photons, electrons)
- Beam modifiers [e.g., bolus, compensators, wedges (i.e., physical, dynamic, universal)]
- Treatment planning algorithms
- Monitor unit calculations/influencing factors
- Monitor unit calculations/configurations (e.g. SSD setup, SAD setup, extended distance setup, off axis calculations, and rotational beams)
- Plan evaluation [e.g., dose volume histogram (DVH), conformity index, homogeneity index, biological evaluators]
- Treatment records

About half of the elements in the treatment planning and delivery requirements are about treatment planning. Qualified medical physicists should have skill with these techniques.

See pages 11 and 12 of this document: CAMPEP: Standards for Accreditation of Residency Educational Programs in Medical Physics. Revised May 2019.

Competencies

Competency Assessment



A report from the AAPM Subcommittee on Guidelines for Competency Evaluation for Clinical Medical Physicists in Radiation Oncology

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The goal of this report is to provide a framework from which an institution can develop a competency and credentialing program. It is not intended to be adopted as written, but rather as a list of suggestions from which the institution develops

In 2016 the AAPM Subcommittee on Guidelines for Competency Evaluation for Clinical Medical Physicist in Radiation Oncology published their recommendations in the JACMP. The document lays out a framework for performing ongoing competency assessment.

Evaluation of these competencies can be done through audits of work product, such as the plan PDF.

“Competency tests should emphasize knowledge, skills, and behavior. As with credentialing, this must be documented. The type and frequency of each competency must be detailed. The frequency should be determined by each facility but should be at least once per year.”

Competencies

Competency sample list

TABLE 1. Sample list of competency assessments and minimum number of procedures performed per year.

Procedure	*Type of Competency*	*Minimum Number of Procedures per Year*
Second check of treatment plan	Audit	12
Chart check	Audit	50
Patient specific IMRT QA	Audit	4
Treatment planning general	Audit	12
Treatment planning special procedure	Audit	4
Routine equipment QA	Observation	1
Output calibration	Outside audit (IROC or RDS)	1
Radioactive source strength calibration	Observation	1
Brachytherapy	Observation	4
Intraoperative radiation therapy	Observation	4
SRS/SBRT	Observation	4
Radiation Safety	Quiz	NA

The document contains a sample list of competency assessment frequencies. This example list contains the recommendation that medical physicists should perform a minimum of twelve general treatment plans each year to maintain their competency. This may seem excessive, but considering the range of different types of treatment plans we review each year, it is reasonable be familiar with the steps involved in creating these different plan categories.

The sample list also recommends that a medical physicist should complete four special procedure treatment plans each year. It would be useful to store these two sample recommendations in your short term memory.

Competencies

Competencies

- Contour evaluation
- Physician's prescription
- Image registration
- Dose tolerances
- Treatment plan types

The knowledge categories listed here are integral to treatment planning and the qualified medical physicist should have adequate competence in them.

Resources

Resources

- Contouring guides
- Normal tissue tolerance
- Clinical protocols
- Vendor manuals and training
- Other resources

To achieve the competencies just described, the resource on the following slides may be of value.

Resources

Contouring Guides

- RTOG Contouring Atlases (examples from more than two dozen listed):
  - Consensus Panel Contouring Atlas For The Delineation Of The Clinical Target Volume In The Postoperative Treatment Of Pancreatic Cancer
  - Upper Abdominal Normal Organ Contouring Guidelines, RTOG Consensus Panel, 2013
  - Hippocampal Contouring: A Contouring Atlas for RTOG 0933
- Journal articles (examples):
  - Recommendation for a contouring method and atlas of organs at risk in nasopharyngeal carcinoma patients receiving intensity-modulated Radiotherapy. Ying Sun et al. R & O.
  - Development of a standardized method for contouring the larynx and its substructures. Mehee Choi.
- Presentations (examples):
  - Radiation Therapy Contouring: CNS and Cardiac/Thoracic. Jonathan Knisely & Mary Feng. AAPM Annnual Meeting 2013
  - Head and Neck Contouring. John Wu, AAPM Annual Meeting 2011.

There are many resources for learning normal anatomy tissue contouring. Consensus recommendations often are created by clinical trials groups, such as RTOG. These guides include upper abdominal normal organs, hippocampus.
https://www.rtog.org/CoreLab/ContouringAtlases.aspx

Outside of the clinical trails guidelines, there are a number of journal articles describing normal tissue contouring.

Lastly, several excellent presentations can be found in the AAPM virtual library and elsewhere.

Resources

Normal tissue tolerance

- Emami
- QUANTEC (PENTEC for pediatrics)
- Hypofractionation (Timmerman / TG-101)
- Conversion to dose from 2Gy/fx (EQD2)

Back in the 1990s, a popular reference for normal tissue tolerances for conventional therapy was published by Dr. Emami. With the advent of IMRT and advancements in modeling, the QUANTEC project undertook a systematic review of the data and published their results in 2010 in the Red Journal. Their tolerances are summarized in a Wikibooks page. For SBRT treatments, TG-101 is a useful resource which uses results published earlier by Dr. Timmerman and others. It is useful to convert hypofractionation doses to 2Gy/fx equivalent doses using the EQD2 equation for making composite dose assessments.

References:

Tolerance of normal tissue to therapeutic irradiation. Emami B, Lyman J, Brown A, Coia L, Goitein M, Munzenrider JE, Shank B, Solin LJ, Wesson M. Int J Radiat Oncol Biol Phys. 1991 May 15;21(1):109-22.

IJROPB March 01, 2010.Volume 76, Issue 3, Supplement, S1-S160. Quantitative Analyses of Normal Tissue Effects in the Clinic. https://www.redjournal.org/issue/S0360-3016(10)X0002-5

Stereotactic body radiation therapy: the report of AAPM Task Group 101. Benedict SH, Yenice KM, Followill D, Galvin JM, Hinson W, Kavanagh B, Keall P, Lovelock M, Meeks S, Papiez L, Purdie T, Sadagopan R, Schell MC, Salter B, Schlesinger DJ, Shiu AS,

Resources

AAPM TG-101 Table 3

TABLE III. Summary of suggested dose constraints for various critical organs. Note that for serial tissues, the volume-dose constraints are given in terms of the critical maximum tissue volume that should receive a dose equal or greater than the indicated threshold dose for the given number of fractions used. For parallel tissue, the volume-dose constraints are based on a critical minimum volume of tissue that should receive a dose equal to or less than the indicated threshold dose for the given number of fractions used.

		One fraction		Three fractions		Five fractions		
Serial tissue	Max critical volume above threshold	Threshold dose (Gy)	Max point dose (Gy)[a]	Threshold dose (Gy)	Max point dose (Gy)[a]	Threshold dose (Gy)	Max point dose (Gy)[a]	End point (≥Grade3)
Optic pathway	<0.2 cc	8	10	15.3 (5.1 Gy/fx)	17.4 (5.8 Gy/fx)	23 (4.6 Gy/fx)	25 (5 Gy/fx)	Neuritis
Cochlea			9		17.1 (5.7 Gy/fx)		25 (5 Gy/fx)	Hearing loss
Brainstem (not medulla)	<0.5 cc	10	15	18 (6 Gy/fx)	23.1 (7.7 Gy/fx)	23 (4.6 Gy/fx)	31 (6.2 Gy/fx)	Cranial neuropathy
Spinal cord and medulla	<0.35 cc <1.2 cc	10 7	14	18 (6 Gy/fx) 12.3 (4.1 Gy/fx)	21.9 (7.3 Gy/fx)	23 (4.6 Gy/fx) 14.5 (2.9 Gy/fx)	30 (6 Gy/fx)	Myelitis
Spinal cord subvolume (5–6 mm above and below level treated per Ryu)	<10% of subvolume	10	14	18 (6 Gy/fx)	21.9 (7.3 Gy/fx)	23 (4.6 Gy/fx)	30 (6 Gy/fx)	Myelitis
Cauda equina	<5 cc	14	16	21.9 (7.3 Gy/fx)	24 (8 Gy/fx)	30 (6 Gy/fx)	32 (6.4 Gy/fx)	Neuritis
Sacral plexus	<5 cc	14.4	16	22.5 (7.5 Gy/fx)	24 (8 Gy/fx)	30 (6 Gy/fx)	32 (6.4 Gy/fx)	Neuropathy
Esophagus[b]	<5 cc	11.9	15.4	17.7 (5.9 Gy/fx)	25.2 (8.4 Gy/fx)	19.5 (3.9 Gy/fx)	35 (7 Gy/fx)	Stenosis/fistula
Brachial plexus	<3 cc	14	17.5	20.4 (6.8 Gy/fx)	24 (8 Gy/fx)	27 (5.4 Gy/fx)	30.5 (6.1 Gy/fx)	Neuropathy
Heart/pericardium	<15 cc	16	22	24 (8 Gy/fx)	30 (10 Gy/fx)	32 (6.4 Gy/fx)	38 (7.6 Gy/fx)	Pericarditis
Great vessels	<10 cc	31	37	39 (13 Gy/fx)	45 (15 Gy/fx)	47 (9.4 Gy/fx)	53 (10.6 Gy/fx)	Aneurysm
Trachea and large bronchus[b]	<4 cc	10.5	20.2	15 (5 Gy/fx)	30 (10 Gy/fx)	16.5 (3.3 Gy/fx)	40 (8 Gy/fx)	Stenosis/fistula
Bronchus-smaller airways	<0.5 cc	12.4	13.3	18.9 (6.3 Gy/fx)	23.1 (7.7 Gy/fx)	21 (4.2 Gy/fx)	33 (6.6 Gy/fx)	Stenosis with atelectasis
Rib	<1 cc <30 cc	22	30	28.8 (9.6 Gy/fx) 30.0 (10.0 Gy/fx)	36.9 (12.3 Gy/fx)	35 (7 Gy/fx)	43 (8.6 Gy/fx)	Pain or fracture
Skin	<10 cc	23	26	30 (10 Gy/fx)	33 (11 Gy/fx)	36.5 (7.3 Gy/fx)	39.5 (7.9 Gy/fx)	Ulceration
Stomach	<10 cc	11.2	12.4	16.5 (5.5 Gy/fx)	22.2 (7.4 Gy/fx)	18 (3.6 Gy/fx)	32 (6.4 Gy/fx)	Ulceration/fistula
Duodenum[b]	<5 cc <10 cc	11.2 9	12.4	16.5 (5.5 Gy/fx) 11.4 (3.8 Gy/fx)	22.2 (7.4 Gy/fx)	18 (3.6 Gy/fx) 12.5 (2.5 Gy/fx)	32 (6.4 Gy/fx)	Ulceration
Jejunum/ileum[b]	<5 cc	11.9	15.4	17.7 (5.9 Gy/fx)	25.2 (8.4 Gy/fx)	19.5 (3.9 Gy/fx)	35 (7 Gy/fx)	Enteritis/ obstruction
Colon[b]	<20 cc	14.3	18.4	24 (8 Gy/fx)	28.2 (9.4 Gy/fx)	25 (5 Gy/fx)	38 (7.6 Gy/fx)	Colitis/fistula
Rectum[b]	<20 cc	14.3	18.4	24 (8 Gy/fx)	28.2 (9.4 Gy/fx)	25 (5 Gy/fx)	38 (7.6 Gy/fx)	Proctitis/fistula
Bladder wall	<15 cc	11.4	18.4	16.8 (5.6 Gy/fx)	28.2 (9.4 Gy/fx)	18.3 (3.65 Gy/fx)	38 (7.6 Gy/fx)	Cystitis/fistula
Penile bulb	<3 cc	14	34	21.9 (7.3 Gy/fx)	42 (14 Gy/fx)	30 (6 Gy/fx)	50 (10 Gy/fx)	Impotence
Femoral heads (right and left)	<10 cc	14		21.9 (7.3 Gy/fx)		30 (6 Gy/fx)		Necrosis
Renal hilum/vascular trunk	<2/3 volume	10.6	18.6 (6.2 Gy/fx)			23 (4.6 Gy/fx)		Malignant hypertension

AAPM TG-101 on SBRT contains recommendations for normal tissue tolerances. It would be worth keeping in your short term memory that these recommendations are mostly unvalidated and incorporate a measure of educated guessing.

From TG-101:
“Table III summarizes tolerance doses from the University of Texas Southwestern and the University of Virginia. The doses are mostly unvalidated, and while most are based on toxicity observation and theory, there is a measure of educated guessing involved as well. Additional information may be found in several published reports, including Indiana University’s lung SBRT experience, Karolinska Hospital’s SBRT experience, and a recent report from Stanford University. Because of the sparseness of long-term follow-up for SBRT, it should be recognized that the data in both Table III and the published reports represent, at best, a first approximation of normal tissue tolerance. When proceeding in areas where there is a lack of published literature for toxicity and complications, this report recommends that formal institutional guidelines and prospective trials be implemented.

Recommendation: Normal tissue dose tolerances in the context of SBRT are still evolving and only a limited experience exists from which to draw recommendations. Except in the setting of IRB approved Phase I protocols, critical organ tolerance doses based on the SBRT experience in the
evolving peer-reviewed literature must be respected.”

Resources

Clinical protocols

- Alliance For Clinical Trials in Oncology
- ClinicalTrials.Gov
- COG - Children's Oncology Group
- ECOG - ACRIN Cancer Research Group
- EORTC - European Organization for Research and Treatment of Cancer
- ETCTN - Experimental Therapeutics Clinical Trials Network
- NCI - National Cancer Institute
- NCTN - National Clinical Trials Network
- NRG Oncology
- PBTC - Pediatric Brain Tumor Consortium
- PTCOG - Particle Therapy Cooperative Group
- RTOG - Radiation Therapy Oncology Group
- SWOG Cancer Research Network

RTOG has a wealth of clinical trial documents that contain useful information.

This list was barrowed from here:
https://www.medicaldosimetry.org/resources/helpful-links/

Resources

Example of Protocol Sections

6.0 RADIATION THERAPY
6.1 Dose Specifications (3D conformal and IMRT)
6.4 Treatment Volumes (3D Conformal and IMRT)
6.5 Normal Organ Dose Volume Considerations (3D, IMRT)
6.6 3D Conformal Beam Arrangements
6.7 IMRT
6.10 Compliance Criteria for Both IMRT and 3D Conformal
6.10.1 Volume Definitions
6.10.2 Per Protocol for Target Structures
6.10.3 Organs at Risk Dose Limits

RTOG protocols have a standardized section numbering framework that makes it easy to locate specific information.

Resources

Vendor manuals and training

- Elekta — Elekta Care Community
- Varian — myVarian
- Accuray — AERO
- Philips — Philips InCenter
- RaySearch — RaySearch Community/Self Service
- BrainLab — User Guide Portal

Each of the major treatment planning system vendors has a customer portal where manuals and additional information can be found.

Resources

Other resources

- AAPM Presentations
- ASTRO Presentations
- Youtube and Vimeo
- i.treatsafely: Clinical Processes Series
- econtour.org: educational modules

There are dozens of videos in the AAPM Virtual Library that provide treatment planning guidance.

ASTRO videos are restricted to those who attended the conference at which they were presented.

On YouTube “Radiation Knowledge” has a nice set of videos.
https://www.youtube.com/channel/UCgjpYithXBucvlvTZfozACQ/videos
Since most of the Youtube content is targeted at patients, it is difficult to find in-depth material.

AAPM has uploaded a lot of material to Vimeo.

i.treatsafely is an excellent resource, but tends to be heavy on Eclipse videos with a lack of resources for other treatment planning systems.

Recommendations

- Get resources on prescribing
  - Clinical trial guides, NCCN guidelines, books
- Brush up on anatomy and contouring
  - Anatomy apps, practice websites
- Keep your own list of normal tissue tolerances
  - TG-101, QUANTEC, Timmerman, Emami
- Read the manuals
  - Be familiar with available vendor manuals and safety bulletins
- Continual learning
  - AAPM online library, i.treatsafely.org
- Test your hypotheses about your treatment planning system

The End

For more information, see the handout for this presentation.

Thank you for attending our session!

Treatment Planning Resources for Medical Physicists (2019-07-15)

Table of Contents

Books (incomplete list)

1. General Radiation Oncology
    a. Handbook of Evidence-Based Radiation Oncology, by Eric K. Hansen, Mack Roach III, Editors. Springer; 3rd ed. 2018 edition
    b. Essentials of Clinical Radiation Oncology: -, by Matthew C. Ward | Dec 15, 2017. Demos.
    c. Perez & Brady's Principles and Practice of Radiation Oncology, by Halperin MD, Dr. Edward C., Wazer MD, Dr. David E., et al. | Oct 9, 2018. LLW
    d. Radiation Oncology: A Question-Based Review, by Borislav Hristov, Lin MD PhD, Steven H, et al. | Sep 14, 2018.
    e. Fundamentals of Radiation Oncology: Physical, Biological, and Clinical Aspects, by Hasan Murshed | Mar 15, 2019.
    f. Radiation Oncology Question Review, Second Edition – Radiation Oncology Board Review Guide by Expert Radiation Oncologists from Cleveland Clinic Taussig Cancer Institute, by Michael Weller | Oct 28, 2018.
    g. Pocket Radiation Oncology, by Chad Tang and Ahsan Farooqi.
    h. Absolute Clinical Radiation Oncology Review, by Daniel M. Trifiletti and Nicholas G. Zaorsky | Jan 23, 2019.
    i. Radiation Oncology Management Decisions, by Chao MD, K.S. Clifford, Perez MD, Dr. Carlos A., et al. | Oct 4, 2018.
    j. Clinical Radiation Oncology, by Gunderson MD MS FASTRO, Leonard L. and Tepper MD, Joel E. | Sep 9, 2015
    k. Clinical Radiation Oncology: Indications, Techniques, and Results, by Small Jr., William, Nancy J. Tarbell, et al. | Apr 17, 2017
2. Specialized Radiation Oncology
    a. Stereotactic Radiosurgery and Stereotactic Body Radiation Therapy (SBRT), by Dwight E Heron, Saiful Huq, et al. | Sep 28, 2018. Demos.

    b. Stereotactic Radiosurgery and Stereotactic Body Radiation Therapy: A Comprehensive Guide, by Daniel M. Trifiletti, Samuel T. Chao, et al. | Jul 2, 2019
3. Site-specific Radiation Oncology
    a. Head and Neck Cancer: Multimodality Management, by Jacques Bernier | Aug 23, 2016.
    b. Adult CNS Radiation Oncology: Principles and Practice, by Eric L. Chang, Paul D. Brown, et al. | Jul 28, 2018.
    c. Contemporary Oral Oncology: Diagnosis and Management, by Moni Abraham Kuriakose | Jul 12, 2018.
    d. Radiation Therapy for Gastrointestinal Cancers, by Theodore Hong and Prajnan Das | Feb 16, 2017
    e. Oncologic Imaging: Soft Tissue Tumors, by Heung Sik Kang, Sung Hwan Hong, et al. | Jul 26, 2017
    f. Gynecologic Radiation Oncology: A Practical Guide, by Patricia Eifel and Ann H. Klopp | Aug 27, 2016
    g. Radiation Oncology for Pediatric CNS Tumors, by Anita Mahajan and Arnold Paulino | Oct 31, 2017, Springer
4. Toxicity Management
    a. Skin Care in Radiation Oncology: A Practical Guide, by Barbara Fowble, Sue S. Yom, et al. | Sep 16, 2016.
    b. Radiation Therapy Treatment Effects: An Evidence-based Guide to Managing Toxicity, by Bridget F. Koontz | Sep 18, 2017
    c. Radiation Treatment and Radiation Reactions in Dermatology, by Renato G. Panizzon and M. Heinrich Seegenschmiedt | Dec 17, 2014
5. Brachytherapy
    a. Brachytherapy: An International Perspective (Medical Radiology), by Paolo Montemaggi, Mark Trombetta, et al. | Apr 22, 2016. Springer.
    b. Handbook of Image-Guided Brachytherapy, by Jyoti Mayadev, Stanley H. Benedict, et al. | Mar 22, 2017.
6. Treatment Planning and Medical Dosimetry.
    a. Review of Medical Dosimetry: A Study Guide, by William Amestoy | Mar 3, 2015.
    b. Medical Dosimetry Certification Study Guide, Second Edition. K.N. Govinda Rajan.
    c. Target Volume Delineation for Conformal and Intensity-Modulated Radiation Therapy (Medical Radiology), by Nancy Y. Lee, Nadeem Riaz, et al.
    d. Strategies for Radiation Therapy Treatment Planning, by Xia PhD, Ping, Godley PhD, Andrew, et al. | Oct 28, 2018
    e. Handbook of Treatment Planning in Radiation Oncology, by Videtic MD CM FRCPC, Gregory, Woody MD, Neil, et al. | Aug 14, 2014
    f. Khan's Treatment Planning in Radiation Oncology, by Khan Ph.D, Faiz M., Gibbons Ph.D, John P., et al. | Jun 14, 2016

AAPM Presentations in the Virtual Library

1. **General**
    a. 2018 AM - Introduction of Lynn Verhey and Treatment Planning in Medical Physics 3.0 - Presented by Bruce Curran
    b. 2014 AM - From the Art to the State of the Art: Inverse Planning and IMRT - Presented by Thomas Bortfeld
    c. 2010 AM - IMRT and VMAT Inverse Planning with Compressed Sensing Techniques - Presented by Dr. Lei Xing
    d. 2011 AM - Leibel Memorial Symposium: Advanced IMRT Planning and Delivery and Future Directions - Presented by Dr. C. Clifton Ling
    e. 2011 AM - Leibel Memorial Symposium: Advanced IMRT Planning and Delivery and Future Directions - Presented by Dr. Thomas J. LoSasso
    f. 2011 AM - Leibel Memorial Symposium: Advanced IMRT Planning and Delivery and Future Directions - Presented by Dr. Thomas R. Bortfeld
    g. 2014 AM - More Than Pretty Pictures: 3D Treatment Planning and Conformal Therapy - Presented by Benedick Fraass
    h. 2014 SS - The Importance of 4D Simulation, Planning and Delivery - Presented by Krishni Wijesooriya
    i. 2012 SCM - Therapy 2 - VMAT for Dummies: Concepts, Clinical Implementation and Treatment Planning - Presented by Dr. Rajat Kudchadker
    j. 2012 SCM - Therapy 2 - VMAT for Dummies: Concepts, Clinical Implementation and Treatment Planning - Presented by Dr. Richard Popple
    k. 2014 AM - Treatment Planning and Delivery Features of New Generation of Digital Linacs - Presented by Lei Xing
    l. 2017 AM - Treatment Planning and IGRT Credentialing for NRG SBRT Trials - Presented by Hania Abdulraouf Al-Hallaq
    m. 2009 AM - Treatment Planning of Complex Cases: Strategies and Tradeoffs - Presented by Margie A. Hunt
    n. 2009 AM - Treatment Planning of Complex Cases: Strategies and Tradeoffs - Presented by Teamour S Nurushev
    o. 2016 AM - Treatment planning process management and optimization in clinical environment - Presented by Wenzheng Feng
    p. 2011 SS - Uncertainties in Treatment Planning and Dose Computation - Presented by Jeff Siebers
2. **Site**
    a. Intracranial
        i. 2017 AM - Small Volume Dose Limits in Planning Brain/spine SRS/SBRT - Presented by Lijun Ma,
        ii. 2015 AM - Strategies and Technologies for Cranial Radiosurgery Planning: Gamma Knife - Presented by David Schlesinger
        iii. 2015 AM - Strategies and Technologies for Cranial Radiosurgery Planning: MLC-Based Linac- Presented by Grace Gwe-Ya Kim

b. Head and Neck
    i. 2009 AM - Imaging and Treatment Planning for Adaptive Radiotherapy in the Head and Neck - Presented by Jan-Jakob Sonke
    ii. 2009 AM - Imaging and Treatment Planning for Adaptive Radiotherapy in the Head and Neck - Presented by Kristy K. Brock
    iii. 2009 AM - Imaging and Treatment Planning for Adaptive Radiotherapy in the Head and Neck - Presented by Lei Dong
    iv. 2009 AM - Imaging and Treatment Planning for Adaptive Radiotherapy in the Head and Neck - Presented by Vincent Gregoire
    v. 2011 AM - Planning, QA, and the Role of Imaging of Localization for Head and Neck Treatments - Presented by Dr. Charles S. Mayo
    vi. 2011 AM - Planning, QA, and the Role of Imaging of Localization for Head and Neck Treatments - Presented by Dr. Lei Dong
    vii. 2011 AM - Planning, QA, and the Role of Imaging of Localization for Head and Neck Treatments - Presented by Dr. Stephen K. Fry
    viii. 2011 AM - Planning, QA, and the Role of Imaging of Localization for Head and Neck Treatments - Presented by Dr. Yolanda I Garces
    ix. 2011 AM - Planning, QA, and the Role of Imaging of Localization for Head and Neck Treatments - Presented by Panel Discussion
    x. 2011 AM - This House Believes That the Use of Functional Imaging for Treatment Planning of Head and Neck Tumors Needs to Be Carefully Considered - Presented by Vincent Gregoire
c. Lung
    i. 2014 SS - Lung Planning - Presented by Kristi Hendrickson
    ii. 2014 AM - Lung SBRT: 4DCT, Planning and QA - Presented by Krishni Wijesooriya
    iii. 2016 AM - Spatial Distributions of Radiation Induced Pulmonary Changes Can Be Modeled and Utilized for Image-Guided Planning and Therapy to Improve Pulmonary Function Preservation and Hence the Therapeutic Ratio for Lung Cancer - Presented by John Bayouth
d. Breast
    i. 2015 SCM - Basics of Breast Planning - Presented by Rebecca Howell
    ii. 2013 AM - Treatment Planning Considerations for Breast Cancer - Presented by Jean Moran
    iii. 2013 AM - Clinical Implications of Treatment Planning for Breast Cancer Radiotherapy - Presented by Julia White
e. GI

i. 2014 SS - GI Planning - Presented by Minsong Cao

f. Prostate
    i. 2014 SS - Prostate Planning - Presented by Minsong Cao
g. Pelvis
    i. 2011 AM - Planning, QA, and the Role of Imaging of Localization for Pelvis Treatments - Presented by Ms. Ann A. Lawyer
    ii. 2011 AM - Planning, QA, and the Role of Imaging of Localization for Pelvis Treatments - Presented by Ms. Jennifer Lynn Johnson
    iii. 2011 AM - Planning, QA, and the Role of Imaging of Localization for Pelvis Treatments - Presented by Panel

3. Protons

a. 2015 AM - Proton Treatment Planning - Presented by Mark Pankuch
b. 2018 AM - Proton Planning - Presented by Katja Langen
c. 2014 AM - Imaging for Proton Treatment Planning and IGRT - Presented by Jon Kruse
d. 2013 AM - Imaging Needs for Proton Therapy: Treatment Planning - Presented by Lei Dong
e. 2012 SCM - Proton Therapy Planning: From Physics to Clinical Realities - Presented by Dr. Stefan Both
f. 2018 AM - Proton Treatment Planning in the Presence of Uncertainties - Presented by Stella Flampouri
g. 2012 AM - Proton Treatment Planning Issues - Presented by Brian Winey
h. 2012 AM - Proton Treatment Planning Issues - Presented by Judith Adams
i. 2012 AM - Proton Treatment Planning Issues - Presented by Stefan Both
j. 2012 AM - Proton Treatment Planning Issues - Presented by X. Ronald Zhu
k. 2013 AM - Proton Treatment Planning: Double Scattering - Presented by Brian Winey
l. 2014 AM - Treatment Planning Consideration in Proton Therapy - Presented by Mark Pankuch
m. 2015 SS - Treatment Planning for SFUD - Presented by X. Ronald Zhu
n. 2015 SS - Treatment Planning for SFUD - Presented by Lei Dong, PhD
o. 2016 AM - Proton Treatment Planning and Beam Optimization - Presented by Mark Pankuch
p. 2014 AM - Development and delivery of biologically optimized treatment plans in proton radiotherapy - Presented by Alejandro Carabe-Fernandez
q.

4. Brachytherapy

a. 2018 SCM - MRI for HDR Treatment Planning - Presented by Joann Prisciandaro
b. 2017 SS - Brachytherapy Treatment Planning - Presented by Bruce Libby

5. **Vendor**
    a. Philips - Pinnacle
        i. 2018 AM - Clinical Experience with Philips Auto-Planning - Christian Roenn
        ii. 2010 AM - Efficient Outcomes-Driven IMRT Treatment Planning Using Commercial Treatment Planning Systems - Presented by Dr. Joseph O. Deasy (Pinnacle)
    b. Eclipse
        i. 2018 SCM - If Only My Planning System Could...Using Scripting to Push the Envelope On Clinical Capabilities of Treatment Planning Systems - Presented by Charles Mayo (Eclipse)
        ii. 2010 AM - Efficient Outcomes-Driven IMRT Treatment Planning Using Commercial Treatment Planning Systems - Presented by Dr. Charles S. Mayo (Eclipse)
    c. Monaco
        i. 2010 AM - Efficient Outcomes-Driven IMRT Treatment Planning Using Commercial Treatment Planning Systems - Presented by Markus Alber (Monaco)
    d. General
        i. 2010 AM - Efficient Outcomes-Driven IMRT Treatment Planning Using Commercial Treatment Planning Systems - Presented by Allen Li
        ii. 2010 AM - Efficient Outcomes-Driven IMRT Treatment Planning Using Commercial Treatment Planning Systems - Presented by X. Allen Li (TG-166)
6. **SBRT**
    a. 2016 AM - SBRT Treatment Planning and Delivery - Presented by Yong Yang
    b. 2012 AM - SBRT Treatment Planning: Practical Considerations - Presented by Linda Hong
    c. 2018 AM - SBRT Planning - Presented by Cynthia Fu-Yu Chuang
    d. 2015 SBRT - Clinical Targets and Treatment Planning I - Presented by Ning Wen
    e. 2015 SBRT - Clinical Targets and Treatment Planning I - Presented by Salim Siddiqui
    f. 2015 SBRT - Clinical Targets and Treatment Planning II - Presented by Martha Matuszak
    g. 2015 SBRT - Clinical Targets and Treatment Planning II - Presented by Mary Feng
    h. 2015 AM - Treatment Simulation, Planning and Delivery for SBRT - Presented by Yong Yang
7. **Pediatric**
    a. 2014 AM - Challenges for Pediatric Treatment Planning and Delivery - Presented by Arthur Olch
    b. 2014 SS - CNS - Brain and Spine Planning - Presented by Ryan Foster
    c. 2014 AM - Pediatric Radiation Therapy: Simulation, Planning Guidelines, Image Guidance, and Proton Therapy - Presented by Chia-Ho Hua

d. 2009 AM - Pediatric Radiotherapy Treatment Planning and Delivery - Presented by Arthur J. Olch
e. 2015 AM - Pediatric Treatment Planning I: Overview of Planning Strategies and Challenges - Presented by Arthur Olch
f. 2015 AM - Pediatric Treatment Planning II: Applications of Proton Beams for Pediatric Treatment - Presented by Chia-Ho Hua

8. Imaging and Registration

a. 2014 SCM - Image Registration for Treatment Planning - Presented by Dongxu Wang
b. 2017 AM - Image-Based Treatment Planning and Dosimetry - Presented by Srinivas Cheenu Kappadath
c. 2006 SS - Imaging for Radiation Treatment Planning * - Presented by Craig W. Stevens

9. MR

a. 2013 AM - MR Guided Tx Planning - Presented by Yue Cao
b. 2017 AM - MR Image Processing, Registration & Planning for Extra-Cranial Radiotherapy - Presented by Jing Cai
c. 2015 AM - MR Imaging for Treatment Planning: What Every Physicist Should Know - Presented by Kiaran McGee
d. 2016 AM - MR-Driven RT Planning - Presented by Minsong Cao
e. 2014 AM - RT Planning - Presented by Tufve Nyholm (MR)
f. 2009 AM - Strengths and Limitations of Anatomical and Spectroscopic MRI in Radiation Oncology Treatment Planning - Presented by John E. Bayouth
g. 2018 AM - Treatment Planning Issues with MRI - Presented by Carri Glide-Hurst
h. 2018 AM - MR-Only Treatment Planning and MR-SIM - Presented by Neelam Tyagi

10. PET

a. 2011 AM - PET Imaging of Tumor Microenvironment for Radiation Treatment Planning - Presented by Dr. Andrei B. Pugachev
b. 2016 AM - Pitfalls and Remedies in PET/CT Imaging for RT Planning - Presented by Tinsu Pan
c. 2010 AM - Positron Emission Tomography Imaging for Radiation Treatment Planning - Presented by Dr. Andrei B. Pugachev

11. Knowledge-based planning

a. 2018 AM - Automated Treatment Planning Process Through Radiation Planning Assistant - Presented by Laurence Edward Court
b. 2015 SCM - Automated Treatment Planning to Improve Plan Quality - Presented by Ping Xia
c. 2015 AM - Knowledge Modeling For Clinical Treatment Planning - Presented by Qing-Rong Jackie Wu
d. 2017 AM - Machine Learning for Image Analysis and Treatment Planning - Presented by Lei Xing
e. 2014 AM - Modeling Expert Clinical Knowledge In Treatment Planning - Presented by Q. Jackie Wu
f. 2018 AM - Automated Contour Segmentation for Treatment Planning: Challenges and Potentials - Presented by Minsong Cao

g. 2018 AM - Automation in Treatment Plan QA: Toward Self-Driving Patient Care - Presented by Kelly Younge
h. 2016 AM - Automated treatment planning for low-resource settings - Presented by Laurence Edward Court
i. 2012 AM - Automated Treatment Planning Using a Database of Prior Patient Treatment Plans - Presented by Todd McNutt
j. 2012 AM - Automatic Treatment Planning - An MCO Perspective - Presented by David Craft
k. 2012 AM - Automatic Treatment Planning for IMRT, VMAT and IMPT - Presented by Xiaodong Zhang
l. 2014 AM - Clinical Experience with Knowledge-Based Treatment Planning - Presented by Lindsey Olsen
m. 2015 AM - Clinical Usage of Knowledge Based Treatment Planning - Presented by Xiaodong Zhang
n. 2018 AM - Automated Treatment Planning Process Through Radiation Planning Assistant - Presented by Laurence Edward Court
o. 2018 AM - Clinical Experience with Automated Multicriteria Optimization - Presented by Ben J. Heijmen
p. 2018 AM - Clinical Experience with Rapidplan-Eclipse - Presented by Mohammad Hussein
q. 2015 AM - Clinical Usage of Knowledge Based Treatment Planning - Presented by Xiaodong Zhang
r. 2018 AM - Experience with Automated Planning in Busy International Clinic Setting - Alejandro Cuadra.

12. Adaptive and time-constrained planning

a. 2016 AM - Assure the quality of treatment planning when time is constrained - Presented by Jenghwa Chang
b. 2015 AM - Maintain the Quality of Treatment Planning for Time-Constraint Cases - Presented by Jenghwa Chang
c. 2016 AM - Assure the quality of treatment planning when time is constrained - Presented by Jenghwa Chang
d. 2010 AM - Treatment Planning Based On CBCT Images Acquired for On-line Position Verification - Presented by Dr Daniel Letourneau
e. 2010 AM - Treatment Planning Based On CBCT Images Acquired for On-line Position Verification - Presented by Dr. Jean Pouliot,
f. 2010 AM - Treatment Planning Based On CBCT Images Acquired for On-line Position Verification - Presented by Dr. Lei Xing
g. 2018 AM - Treatment Planning Considerations for Adaptive Radiotherapy - Presented by Qing-Rong Jackie Wu

13. Biological Planning

a. 2015 AM - Biological Treatment Planning - Presented by Colin Orton
b. 2012 SCM - Biologically Based Radiation Treatment Planning - Presented by Dr. X. Allen Li
c. 2012 AM - Practical Issues for Biologically Based Treatment Planning - Presented by X. Allen Li

Mobile Device Apps for Radiation Oncology

Mobile apps for radiation oncology tend to quickly come and go. For example, the following paper has an extensive list of apps looked at in 2017, but in 2019 these apps for the most part do not appear in the App Store, at least in the US: Apps for Radiation Oncology. A Comprehensive Review, J.J. Calero, L.F. Oton, and C.A. Oton, Transl Oncol. 2017 Feb; 10(1): 108–114.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5300110/

Take a look at X-Anatomy, RadOnc Reference, and EQD2/BED calculators.

i.treatsafely.org

The following are useful treatment planning videos available on i.treatsafely.org.

1. Prostate
    a. Beam Arrangement and Planning Templates for Prostate IMRT
    b. Setting the Isocenter for Prostate IMRT
    c. Contouring Normal Tissues for Prostate IMRT
    d. Optimization for Prostate IMRT - 3
    e. Optimization for Prostate IMRT - 1
    f. Evaluating the Calculated Dose Distribution in Prostate IMRT
    g. Contouring Optimization Structures for Prostate IMRT
    h. Optimization for Prostate IMRT - 2
2. Breast
    a. Setting the Isocenter - Breast Field-in-Field
    b. Final Dose Evaluation - Breast Field-in-Field
    c. Adding and Shaping Subfields - Breast Field-in-Field
    d. Field Setup - Breast Field-in-Field
    e. Contouring - Breast Field-in-Field
3. Lung
    a. Setting the Isocenter for Lung SBRT
    b. Final Dose Review for Lung SBRT
    c. Beam Arrangement for Lung SBRT
    d. Contouring Optimization Structures for Lung SBRT
    e. Contouring Normal Tissues for Lung SBRT
    f. Applying Couch Angles (Kicks) - Lung SBRT
    g. Dose Review and Adjustment for Lung SBRT - 1
    h. Dose Review and Adjustment for Lung SBRT - 2
4. Eclipse
    a. IMRT Planning in Eclipse
    b. Basic 3D Planning in Eclipse
    c. Plan Analysis in Eclipse
    d. Monitoring the Planning Process
    e. Getting Started with Eclipse
    f. Contouring in Eclipse
    g. Eclipse Overview

5. HDR
    a. HDR GYN - Importing Images and Image Registration
    b. HDR Vaginal Cylinder - Part 2 - Treatment Planning
    c. GYN HDR - Digitization and planning
6. Halcyon
    a. Halcyon - Treatment Planning - Prostate - Final Optimization
    b. Halcyon - Treatment Planning - Prostate - Plan Review
    c. Halcyon - Treatment Planning - Prostate - Optimization
    d. Halcyon - Treatment Planning - Prostate - Contouring and Beam Setup
    e. Halcyon Treatment Planning - Breast Irregular Surface Compensator
    f. Halcyon Treatment Planning - Breast FIF
    g. Halcyon Treatment Planning - Breast IMRT
    h. Halcyon Treatment Planning - IMRT GYN
    i. Halcyon Treatment Planning - AP-PA Hip
7. Quality
    a. Bias in the Clinical Decision Making - 01
    b. Bias in the Clinical Decision Making - 02
    c. Physical Biases
    d. Incident Re-creation - Physics and Beam Data Management

Additional References

1. Head and Neck Anatomy
    a. http://headneckbrainspine.com/
2. Econtour
    a. https://www.econtour.org
3. Radiation Assistant
    a. http://www.radiologyassistant.nl/en/p42023a885587e/welcome-to-the-radiology-assistant.html
4. AAMD multiple PowerPoints
    a. http://medicaldosimetry.org/meetings/archives.cfm
5. Prostate Contouring:
    a. http://www.prostadoodle.com/
6. Contouring Atlas for GI Radiotherapy Planning
    a. https://medicine.umich.edu/dept/radonc/education-training/resources-references/contouring-atlas-gi-radiotherapy-planning
7. ASTRO resident educational resources
    a. https://www.astro.org/Affiliate/ARRO/Resident-Resources/Educational-Resources
8. ARROCase
    a. https://www.astro.org/ARROcase.aspx