Essential elements for competency: didactic, scientific and clinical

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Disclosures

- AAPM President-elect in waiting
- Vice-chair of AAPM Education Council
- Chair of AAPM Education and Training of Medical Physics
- President of Society of Directors of Academic Medical Physics Programs
- Financial - none

Problem

- Non-standardized academic education prior to working into the clinical environment
- Substantial on-the-job training necessary following academic training

Didactic Training

AAPM REPORT NO. 197
(Revision of AAPM Report No. 79)

Academic Program Recommendations for Graduate Degrees in Medical Physics

Report of the Education and Training of Medical Physicists Committee

April 2009

Didactic Training

AAPM 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

Supplement to
Report TG-197 Academic Program Recommendations
for Graduate Degrees in Medical Physics

Didactic Training

Recommendations

The AAPM Working Group on Revision of Report No. 44 recommends that *The Essential Medical Physics Didactic Elements for Physicists Entering the Profession through an Alternative Pathway* should encompass the following graduate-level core topics:

1. Radiological Physics and Dosimetry
2. Radiation Protection and Radiation Safety
3. Fundamentals of Imaging in Medicine
4. Radiobiology
5. Anatomy and Physiology
6. Radiation Therapy Physics

The course content should follow the guidelines given in AAPM Report No. 197 and will require a total of 18 credit hours of study to provide adequate depth and breadth. Delivery of the required

Clinical Training

AAPM REPORT NO. 90
(Revision of AAPM Report No. 36)

Essentials and Guidelines for Hospital-Based Medical Physics Residency Training Programs

Report of the Subcommittee on Residency Training and Promotion

of the

Education and Training of Medical Physics Committee of the AAPM Education Council

August 2006

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Breadth of clinical training

{months}	Primary Rotation	Mentor
0.5	Orientation	JEB
2	Dosimetric system acceptance testing/Commissioning/QA	JEB
2	Linear Accelerator Acceptance Testing / Commissioning / Annual QA	JM/TW
2	Brachytherapy	JM/YK
2	Treatment machine calibration (TG51) & Monitor Unit Calculations	EP/AS
1.5	TPS Modeling / Acceptance / Commissioning	JEB
2	Treatment Planning	JEB
2	Intensity Modulated Radiation Therapy (IMRT)	AS
1	Treatment Simulation Process	TW
2	Stereotactic radiosurgery	EP
2	Special Procedures: Total Body Irradiation, Total skin electrons (TSE) & Intraoperative radiation therapy (IORT)	TW
1	Imaging for planning and treatment verification	RF
1	Image Guided Radiation Therapy (IGRT)	JEB/SM
1	Shielding/Room Design/Radiation Protection Survey / Radiation Safety	EP/SM
2	Vacation / Sick Leave / Family Leave / Conferences	

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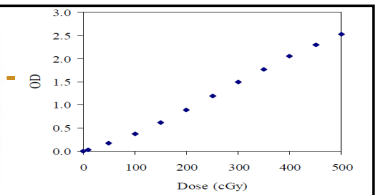


Figure 19. EDR2 film. Sensitometric curve for 6 MV photons taken at d_{max}.

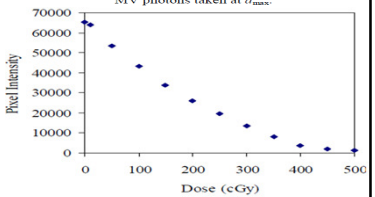


Figure 21. EDR2 film. Scanner sensitometric curve for 6 MV photons taken at d_{max}.

Clinical Training - Example

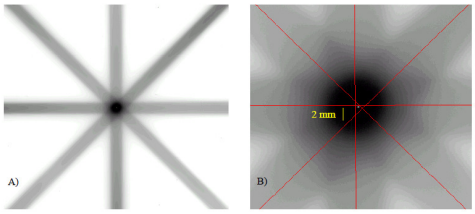


Figure 4. A) Overview of star shot pattern for determining radiation isocenter and B) close-up revealing intersection of each projection and the pin prick representing mechanical isocenter.

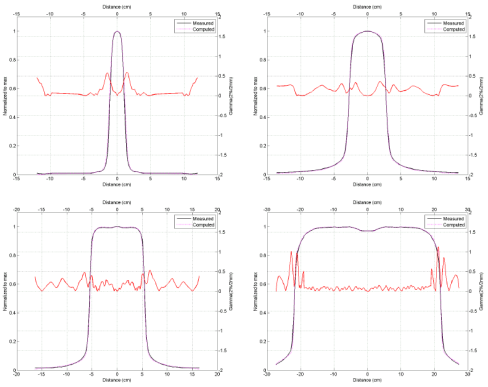


Figure 5. Comparison between measured and computed cross-plane profiles at a depth of 10 cm for 2x2 (top left), 5x5 (top right), 10x10 (bottom left), and 40x40 cm^2 (bottom right) fields. Red colored line represents gamma at 2%/2mm (global).

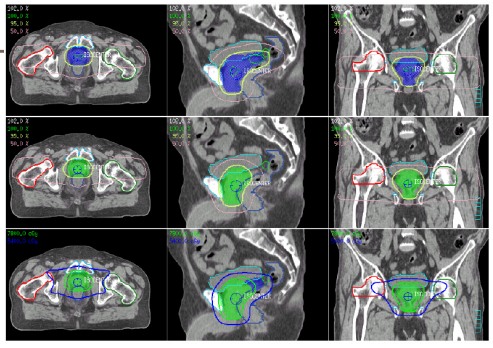


Figure 7. Axial (left), sagittal (middle), and coronal (right) views of the initial (first row), boost (second row), and composite (third row) 7-field plan. Initial PTV is shown in blue colorwash and boost PTV is shown in green colorwash. Dose is prescribed to the 95% isodose line. Absolute isodose lines in the composite plan represent prescription doses for each volume.

Clinical Training - Example

Table 7. Recommended dose limits for organs at risk during head and neck treatment. Limits listed are for standard fractionation (1.8-2Gy/fx).

	UIHC	QUANTEC		Emami					
	DVH	DVH	Complication	TD 5/5 (Gy) Volume			TD 50/5 (Gy) Volume		
	Parameters	Parameters	Rate (%)	1/3	2/3	3/3	1/3	2/3	3/3
Spinal cord	$d_{max} < 45$	$d_{max} = 50$	0.2 [1]	5cm	10cm	20cm	5cm	10cm	20cm
		$d_{max} = 60$	6 [1]	50	50	47	70	70	N/A
		$d_{max} = 69$	50 [1]						
Cochlea	V55 < 5%	$d_{mean} \leq 45$	< 30 [2]						
Parotid									
bi-lateral	$d_{mean} < 25$	$d_{mean} < 25$	< 20 [3]	N/A	32	32	N/A	46	46
unilateral		$d_{mean} < 20$	< 20 [3]						
Pharynx		$d_{mean} < 50$	< 20 [4]						
Larynx		$d_{mean} < 50$	< 30 [5]	N/A	45	45	N/A	N/A	80

[1] Endpoint: Myelopathy
[2] Endpoint: Sensory neural hearing loss
[3] Endpoint: Long term parotid salivary function reduced to < 25% of pre-RT level
[4] Endpoint: Symptomatic dysphagia and aspiration
[5] Endpoint: Aspiration

Clinical Training - Example

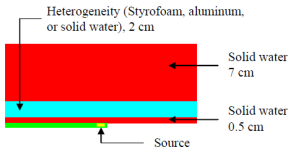


Figure 7. Geometry used for heterogeneity phantom.

Table 4. Comparison between MCNP5 and Acuros dose calculations in heterogeneous phantoms. Plans were developed with a source strength of 8.873 Ci and a dwell time of 600 seconds. Values shown are in Gy.

	2 cm water			2 cm air			2 cm aluminum			
r (cm)	Acuros	MCNP5	%dif	Acuros	MCNP5	%dif	Acuros	MCNP5	%dif	TG-43
1.5 (in hetero)	29.43	28.36	-3.64%	26.11	25.73	-1.45%	25.13	25.66	2.13%	29.58
3 (beyond hetero)	7.15	7.18	0.42%	7.58	7.49	-1.14%	6.79	6.90	1.59%	7.50
3.5 (beyond hetero)	5.20	5.17	-0.48%	5.55	5.46	-1.47%	4.91	5.06	3.08%	5.52

Demonstrating Clinical Competence

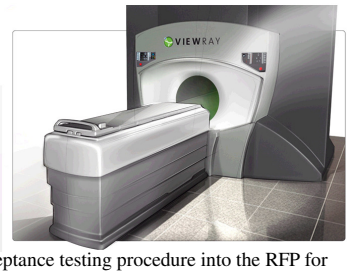
4D Imaging Process Date on which competence was determined _____

Anatomical Site	Required Observe	Actual Observe	Required Directly Supervised	Actual Directly Supervised	Required Remotely Supervised	Actual Remotely Supervised
Respiratory Training	≥ 1		≥ 3		≥ 1	
Image Acquisition and Reconstruction	≥ 1		≥ 3		≥ 1	
Determination of Gating Window	≥ 3		≥ 3		≥ 1	
Review of 4D Treatment Planning	≥ 1		≥ 3		≥ 1	
Supervision of Gated TX Delivery	≥ 1		≥ 3		≥ 1	

Scientific Training

ViewRay MRI & Radiation Therapy

Task Group-911?



How to write the acceptance testing procedure into the RFP for this equipment?

How to commission the new system to perform specific tasks?

Conclusions

- 4 states require licensure, 25 states require registration
- The CARE bill may require Board Certification to practice clinical medical physics
- Medical Physics Education has become consistent, well defined, and documented
- Those who successfully complete Graduate & Residency Programs can also pursue careers outside of clinical practice
  - Industry
  - Academia
  - Regulatory