Rotation 1: Clinical Rotation Schedule and Objectives

Rotation 1: Workflow, Equipment, and Dosimetry

Introduction to radiation and workplace safety
Introduction to professionalism and ethics
Introduction to the radiation oncology workflow
Introduction to equipment and QA
Dosimeters and dosimetry systems

Chief Mentor: Tripp Jones
Rotation Assistants: David Thomas, Leah Schubert
Duration: July through mid-August (1.5 months)
Rotation Q&A Focus: Theory and Operation of Radiation Detectors

The resident will complete orientation through the university and within the department. The resident will be given a resident binder containing the necessary information and introduction to the department as well as a checklist of initial items the resident needs to complete. After orientation, the next two weeks of this rotation are spent participating in clinic visits, treatment simulation, and treatment delivery in the clinic. The goal is for the resident to become familiar with the daily activities and the treatment flow of the clinic. The rest of the rotation is spent participating in QA activities to become familiar with the operation and performance of radiation generating equipment and radiation measurement systems within the department.

The resident shall attend the required educational conferences, lectures, and departmental meetings. Attendance of these courses and conferences occur throughout the resident's two-year training.

Some rare clinical procedures or commissioning tasks happen on a less frequent basis. The resident will participate in these types of activities throughout the resident's two-year training.

Learning Objectives:

1. Become oriented with the university, department, and workflow and complete all necessary items for working in the department
2. Complete university orientation training online modules via the UCD Access website
3. Gain the knowledge and skills for professional and ethical behavior in the hospital setting by completing the introductory curriculum.
4. Learn about the role of the radiation oncology physicist. Learn about professional societies, regulating bodies, and how the physicist interacts with these groups in various clinical situations.

5. Become familiar with the department workflow by observing the process of patient care, simulation, planning, and treatment. Learn the basic concepts of treatment planning and gain operational knowledge of the Eclipse treatment planning system.
6. Participate in monthly QA, annual QA, and IMRT QA activities. This will familiarize the resident with the operations and performances of common equipment in radiation oncology.
7. Learn the practical use and theory of dosimeters and in vivo dosimetry, including ion chambers, diodes, and TLDs

Primary clinical responsibilities:

1. Perform monthly QA with supervision on the Truebeam 1, Truebeam 2 and CT simulators by the end of the rotation.
2. Perform IMRT QA with supervision on the linear accelerators within the department by the end of the rotation.
3. Perform OSLD in vivo readouts, calibration, and system maintenance. During this rotation, the resident should also be present in the treatment room during the placement of OSLDs whenever physics is needed. The resident will read out the measurements and determine expected doses. Under supervision of the clinical primary physicist, the resident will email and follow up with the physicians by the end of the rotation. This will continue through the resident's first year.
4. Assist staff physicists in the management of detector ADCL calibrations.
5. Shadow HDR morning QA with staff/residents and co-sign QA form. Complete HDR safety/operations training with HDR faculty first (schedule a time with them) and sign on annual HDR training log book.
6. Shadow backup radioactive package receiving with staff/resident. Complete DOT and Radiation Safety training modules first and give certificates to Program Coordinator.
7. Participate in machine troubleshooting, repair and maintenance with physics staff as the opportunity arises. This will continue throughout the resident's two year training.

Required Reading:

Profession

1. AAPM Report 109: Code of Ethics for the American Association of Physicists in Medicine, 2019.

Simulation

2. Dieterich, et al, Practical Radiation Oncology Physics Chapter 13: Simulation for Radiotherapy Treatment Planning, 1st ed, Elsevier, 2015.
3. Dieterich, et al, Practical Radiation Oncology Physics Chapter 7: Immobilization Techniques in Radiotherapy, 1st ed, Elsevier, 2015.

4. Treatment Planning in Radiation Oncology. 2nd Edition, F. M. Khan, 2007, Chapter 1, Chapter 5.
5. The Physics of Radiation Therapy. 4th Edition, F. M. Khan, 2010, Chapter 6.
6. Handbook of Radiotherapy Physics Theory and Practice. Mayles 2007, Chapter 15
7. Handbook of Radiotherapy Physics Theory and Practice. Mayles 2007, Chapter 16
8. The Essential Physics of Medical Imaging, 2nd Edition, J.T. Bushberg, pp. 157-163 or Christensen's Physics of Diagnostic Radiology, 4th Edition, Curry et al, 1990, Chapters 10-11.

Detectors

9. Dieterich, et al, Practical Radiation Oncology Physics Chapter 3: In Vivo Dosimetry, 1st ed, Elsevier, 2015.
10. AAPM TG 191: Clinical use of luminescent dosimeters: TLDs and OSLDs, 2019.
11. AAPM TG 235: Radiochromic film dosimetry: An update to TG55, 2020.

Recommended Reading:

1. Introduction to Radiological Physics and Radiation Dosimetry. F.H.Attix, 1986, Chapter 12.
2. AAPM Report 56 (TG-35): Medical Accelerator Safety Considerations, 1993.
3. AAPM Report 142 (TG-142): Quality assurance of medical accelerators, 2009.
4. AAPM Report 218 (TG-218): Tolerance Limits and Methodologies for IMRT Measurement-Based Verification QA, 2018.
5. AAPM Report 233 (TG-233): Performance Evaluation of Computed Tomography Systems, 2019.

Evaluation Scheme: Passing evaluation by the rotation mentor

ROTATION 1: MASTER TASK LIST	
KNOWLEDGE	
Become aware of the roles of physicists, professional societies, and regulating bodies by reviewing relevant required readings and discussing with rotation mentor	
Identify professionalism skills needed to practice clinical medical physics, with the goal of establishing and cultivating those skills during the two years in the program	
SKILLS	
Independently operate the CT simulators and linacs	
Independently perform OSLD in vivo dosimetry readouts and system management. Complete the in vivo dosimetry competency form.	
Independently perform IMRT QA. Complete the IMRT QA competency form.	
Independently perform monthly QA on the Truebeam 1 and Truebeam 2	
ASSIGNMENTS / CLINICAL CASES	
Complete the New Resident Orientation and Checklist (located in the Resident Binder)	
Sign up for the AAPM Leadership Fundamentals Cohorts (go to AAPM website for signup)	
Sign up for the AAPM Mentorship Program (optional) (go to AAPM website for signup)	
Complete the Diversity, Equity, and Inclusion curriculum (to be scheduled)	
Complete introductory workplace safety training online modules University Skillsoft modules: a. Bloodborne Pathogens b. HIPAA Regulations c. Information Security and Privacy Awareness d. Discrimination and Sexual Harassment Hospital ULearn modules: a. Radiation Safety Training b. DOT Radioactive Materials Shipping and Receiving AAPM Professionalism & Ethics Modules a. Conflict of Interest b. Relationships with Vendors c. Ethics of Research d. Publication Ethics e. Personal Behavior, Peer Review, Negotiations f. Human Subjects Research g. Professionalism in Everyday Practice: A Physician Charter h. Ethics in Graduate and Resident Education	

i. Physician-Physician and Physician-Patient Interactions j. Historical Evolution and Principles of Medical Professionalism	
Participate in the shipping, receiving, and QA of regular calibrations for radiation detectors	
Participate in annual QA of the Arc Check and Delta 4 devices	
Shadow HDR morning QA (complete HDR operations/safety training with faculty first)	
Shadow radioactive package receiving (complete DOT training module with RSO first)	
TOPIC-SPECIFIC CHECKLISTS TO COMPLETE	
• Patient Care • Simulation • Introduction to Quality Assurance Program • Ionization Chambers • Diodes, TLDs, Film	

Staff Signature _____ Date: _____

Resident Signature _____ Date: _____

ROTATION 1: PATIENT CARE	
KNOWLEDGE	
Be aware of the various treatment options and medical responsibilities for cancer patients, both within the radiation oncology department and throughout the cancer center	
Gain an appreciation of the radiation oncology field from the physician's, nurse's and patient's perspectives	
SKILLS	
Exhibit appropriate conversations and behaviors near patients	
ASSIGNMENTS / CLINICAL CASES	
Observe patient visits with the Radiation Oncologist. Identify the differences between new patient consult visits, on-treatment visits, and follow up visits.	
Observe clinical care activities with Radiation Oncology Nurses. Identify the roles of nurses in patient care.	
Attend tumor boards while shadowing physicians. Coordinate with the medical residents to determine when and where to go.	
Observe all steps in the treatment process (consult, simulation, treatment planning, and treatment). If possible, try to follow at least 2 patients from consult, to simulation, treatment planning, and treatment.	

Staff Signature _____ Date: _____

Resident Signature _____ Date: _____

New Patient Exam

Performances: Complete this form if you observed a **New Patient Exam**. Identify the patient's name, diagnosis, stage of disease, and treatment techniques to be used - noting the major anatomical structures.

1. Date of Observation: _____
2. Diagnosis: _____
   _____
3. Stage of Disease: _____
   _____
4. Describe treatment to date and the proposed treatment technique:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Resident signature: _____ Date / _____

Clinical Instructor name: _____ Date / _____

On-Treatment Visit

Performances: Complete this form if you observed an **on-treatment visit** with a current patient**.** Identify the patient's name, diagnosis, stage of disease, treatment technique, number of treatments and dose received, and reaction noted.

1. Date of Observation: _____
2. Diagnosis: _____

   _____
3. Stage of Disease: _____

   _____
4. Describe the treatment technique:

_____

_____

5. Number of Treatments and Dosage Received to Date:

_____

_____

6. Reaction Description (tumor response and/or normal tissue reaction):

_____

_____

_____

_____

_____

_____

Resident signature: _____ Date ____

Clinical Instructor name: _____ Date ____

Follow-Up Exam

Performances: Complete this form if you observed a **Follow-up Exam**. Identify the patient's name, diagnosis, stage of disease, treatment technique, doses given and current status of patient's health.

1. Date of Observation: _____
2. Diagnosis: _____

   _____
3. Stage of Disease: _____

   _____
4. Area(s) of Treatment:

_____

_____

5. Total Dose(s) Administered:

_____

6. Discuss the Current Status of the Patient's Health and any past and/or present side effects due to treatment:

_____

_____

_____

_____

_____

_____

Resident signature: _____ Date _____

Clinical Instructor name: _____ Date_____

Nurse Clinical Care

Performances: Complete this form if you observed a **Nurse Clinical Care activity** (eg education visit, special procedure, etc). Identify the patient's name, diagnosis, stage of disease, treatment technique, doses given and current status of patient's health.

1. Date of Observation: _____
2. Diagnosis: _____
3. Stage of Disease: _____
4. Describe the Clinical Care Given:

Resident signature: _____ Date _____

Clinical Instructor name: _____ Date_____

ROTATION 1: SIMULATION	
KNOWLEDGE	
Become aware of conventional simulators (ie non-CT-based simulators): equipment components, what QA tests are required, and in what clinical situations would they be used	
Know the CT simulation process and techniques for various standard disease sites	
Describe the immobilization devices and patient positions used for various standard disease sites	
Understand the uses of different types of images acquired during simulation, and how those images are generated	
SKILLS	
Independently operate the CT simulator in clinical mode	
Successfully complete the Simulation & Treatment Competency Form, during which the therapists will evaluate your performance during a patient simulation	
ASSIGNMENTS / CLINICAL CASES	
Participate in the warm-up and morning QA of the CT simulator	
Participate in the fabrication or use of immobilization devices, including the following: • Alpha cradle • Wingboard • Breast board • Head mask • Abdominal compression	
Observe the use of contrast and learn what different types of contrast are used for	
Observe the acquisition and reconstruction of scans used for motion management (4DCT, gating/DIBH)	
Participate in the simulation of various treatment sites and complete the Treatment & Simulation Site Worksheet.	

Staff Signature _____ Date: _____

Resident Signature _____ Date: _____

Additional Comments:

ROTATION 1: PATIENT TREATMENT	
KNOWLEDGE	
Understand the treatment process for various standard disease sites	
Discuss patient and staff safety considerations in the treatment room including radiation, mechanical (modifiers, collisions), electrical, and ozone concerns	
Describe the tests performed for morning QA and why, and tolerances and actions limits of test results	
SKILLS	
Independently operate linacs (treatment and imaging) in clinical mode and service mode	
Successfully complete the Simulation & Treatment Competency Form, during which the therapists will evaluate your performance during a patient treatment.	
ASSIGNMENTS / CLINICAL CASES	
Participate in the warm-up and daily QA of all linacs	
Participate in the treatments of various disease sites and complete the Treatment & Simulation Site Worksheet.	
Observe new start patient therapist procedures and new start imaging	
Observe imaging of patients for setup verification	
Assist in taking OSLD readings for treatment delivery verification	
Observe the operation of the ARIA R&V system to gain awareness of software functions.	

Staff Signature _____ Date: _____

Resident Signature _____ Date: _____

Additional Comments:

Rotation 1 Simulation and Treatment Competency Form

Treatment & Simulation Competency/Training Assessment Tool
Medical Physics Resident: Rotation 1

Name: _____ **Unit:** Radiation Oncology

Title: Medical Physics Resident **Hire Date:** _____

KEY

- The Competency/Training Assessment Tool is used when residents rotate on the linacs and CT sim during Rotations 1 and 2
- The machine therapist will initial the form once the resident demonstrates the required skill or knowledge

CLINICAL ASSIGNMENTS	PERFORMANCE CRITERIA	Shown to the Resident (Initials)	Resident's Competency Assessed & Validated	
			*Initials	*Date
CT Simulation	Equipment: identify the location of devices & immobilization in the room			
	Sim Request: place patient devices on the table per the sim request			
	Patient instruction: explain what is communicated to the patient			
	Patient setup: align the patient on the table			
	Immobilization: assist in fabricating immobilization			
	Observe contrast administration: explain when contrast is needed			
	Observe tattooing and marking the patient: explain what marks are used			
	Observe imaging: explain why different image modalities are used			
	Observe imaging: explain why different image acquisition parameters are used			
Linac Treatment	Equipment: identify the location of devices & immobilization in the room			
	Setup notes: place patient devices on the table per the setup notes			
	Patient instruction: explain what is communicated to the patient			
	Patient setup: align the patient on the table, place devices			
	Patient setup: move table to isocenter per plan, read SSDs			
	Observe IGRT: explain the basic IGRT workflow			
	Observe treatment: explain the basic treatment workflow			
Independent Task to be Completed by the End of Rotation 1	Perform morning warmup and daily QA on the CT simulator			
	Perform morning warmup and daily QA on Truebeam 1			
	Perform morning warmup and daily QA on Elekta 3			
	End-to-end project: Scan, plan, and treat the Rando phantom			

Rotation 1 Simulation and Treatment Site Worksheet

Treatment & Simulation Site Worksheet
Medical Physics Resident: Rotation 1

Name: _____ **Unit:** Radiation Oncology

Title: Medical Physics Resident **Hire Date:** _____

KEY
·While rotating on the linacs and CT simulators, the resident will fill out this worksheet for the different treatment sites observed

Machine	Treatment Site	How was the patient positioned and why?	What immobilization was used and why?	
CT Simulation	Brain			
	Head and neck			
	Breast			
	Lung			
	Abdomen			
	Pelvis			
	Extremity			
	Electron			
	Craniospinal			
	Pediatric			

Machine	Treatment Site	How did the therapist move the patient to the treatment isocenter?	What imaging modality was used and what anatomical structures were aligned?	What beam arrangement was used to treat the patient?
Linac Treatment	Brain			
	Head and neck			
	Breast			
	Lung			
	Abdomen			
	Pelvis			
	Extremity			
	Electron			
	Craniospinal			
	Pediatric			

ROTATION 1: INTRODUCTION TO QA PROGRAM	
KNOWLEDGE	
QA Program: understand the differences between quality assurance, quality control, quality management, and quality improvement	
Equipment and Process QA: understand what equipment and processes require QA and at what frequency	
Patient Specific QA: understand different methods of patient specific QA	
SKILLS	
Operational knowledge of the linacs and turn on/off procedures	
Perform IMRT QA and monthly QA tests	
ASSIGNMENTS / CLINICAL CASES	
Participate in daily QA of the CT simulators, Truebeam 1, and Truebeam 2	
Participate in monthly QA of the CT simulators, Truebeam 1and Truebeam 2	
Participate in patient-specific IMRT QA. Complete IMRT QA competency form	
Participate in QA of measurement systems (ion chambers, electrometers, well chambers, survey meters) by becoming involved in the clinical management of radiation detectors (contact the physicist responsible for this program).	

Staff Signature _____ Date: _____

Resident Signature _____ Date: _____

Additional Comments:

Rotation 1 IMRT QA Competency Form

IMRT QA Competency Form

Name:

CLINICAL ASSIGNMENTS	PERFORMANCE CRITERIA			Shown to the Trainee		Trainee's Competency Assessed	
				Trainee's Initials & Date	Preceptor's Initials & Date	Trainee's Initials & Date	Preceptor's Initials & Date
Deliver IMRT-QA	Set up QA phantom appropriately						
	Connect to QA software and load patient QA plan						
	Deliver plan in QA mode						
	Shut down machine according to department procedures						
Analyze QA plan	Use analysis software (SNC Patient and Delta4).						
	Use correct Gamma criteria to analyse the QA results						
Documentation	Print pdf report						
	Upload to Patient's chart in ARIA						
	Update the IMRT-QA task in ARIA						
	Communicate with Physics as below.						
Patient IMRT-QA Troubleshooting	If a plan fails to pass Dept Gamma Criteria, the trainee will perform the following actions;	1. Check your phantom setup					
		2. Check correct QA plan is being used for comparison. Re-export from TPS if necessary.					
		3. Recalc QA plan using finer grid settings					
		4. If ARCCheck; Generate QA plan for Delta4 and remeasure using D4.					
		5. If still failing, Communicate with Physics as below.					
Machine Troubleshooting	If a fault occurs:	1. Print screen, and name screenshot appropriately (description of fault).					
		2. Attempt to clear the fault.					
		3. Communicate with Physics as below.					
Communication Requirements	**Trainee will email next day's CP with list of all QA's performed.**						
	Any Machine issues that cannot be immediately resolved:	The Trainee will contact and receive instructions from a physicist in the following order:	1. Late physicist if still in dept.				
			2. Next day's CP.				
			3. Machine physicist				
			4. Any other physicist.				
	Any IMRT-QA's that do not pass after troubleshooting;	Trainee to contact:	Next day's CP by email.				
	Any IMRT-QA's that do not pass after troubleshooting AND are due the next day:	Trainee to contact and receive instructions from a physicist in the following order:	1. Next day's CP.				
			2. Any other physicist.				

ROTATION 1: GAS-FILLED IONIZATION CHAMBERS	
KNOWLEDGE	
Learn the construction and operation of cylindrical ionization chambers	
Learn the construction and operation of parallel-plate ionization chambers	
Learn the construction and operation of beam monitor ionization chambers	
Learn the construction and operation of survey meter ionization chambers	
Understand the differences between open and sealed ionization chambers (impact of pressure/temperature, in what application/equipment they are used and why)	
Learn the design and operation of electrometers	
Know how ionization chambers and electrometers are calibrated and what tests should be performed prior to and after calibration	
Learn about problems that can occur while using ionization chambers and electrometers and steps in troubleshooting	
Learn the theory operation, use in clinical applications, limits of operation of survey meters and Geiger Mueller counters	
BF_3 Counter: learn theory of operation, methods of neutron measurements, use in clinical applications	
SKILLS	
Exhibit proper use and care of ion chambers, electrometers, and cables	
ASSIGNMENTS / CLINICAL CASES	
Measure $C_{T,P}$ for an ion chamber. Know the typical value for this clinic.	
Perform measurements using GM counters and survey meters	
Perform linac room shielding survey with GM counters, survey meters, and neutron detectors (mentor or chief resident to assist)	

Staff Signature _____ Date: _____

Resident Signature _____ Date: _____

Additional Comments:

ROTATION 1: DIODES, TLDS, OSLDS, FILM, DIAMOND, SCINTILLATORS	
KNOWLEDGE	
Diodes: learn the theory of operation and different types, factors affecting response, use in clinical applications, calibration methods	
TLDs: learn the theory of operation, glow curves, pre- and post-annealing, readout, factors affecting response, use in clinical applications, calibration methods	
OSLDs: learn the theory of operation, factors affecting response, use in clinical applications, calibration methods	
Radiochromic film: learn the theory of operation, use in clinical applications, film scanner requirements, calibration methods, dynamic range	
Diamond detectors: learn the theory of operation, factors affecting response, use in clinical applications, calibration methods	
Scintillators: learn the theory of operation, factors affecting response, use in clinical applications, calibration methods	
MOSFETs: learn the theory of operation, factors affecting response, use in clinical applications, calibration methods	
In vivo dosimetry: describe the appropriate detectors used for in vivo dosimetry and compare various pros/cons	
In vivo dosimetry: discuss the rationale and various clinical situations in which in vivo dosimetry is performed	
SKILLS	
Independently prepare, readout, and interpret results of OSLDs for patient in vivo dosimetry	
ASSIGNMENTS / CLINICAL CASES	
Participate in reader QA and preparation of new OSLD batches	
Perform readout and reporting for in vivo dosimetry using OSLDs (contact the assigned clinical physicist). Complete the in vivo dosimetry competency checklist	

Staff Signature _____ Date: _____

Resident Signature _____ Date: _____

Additional Comments:

Rotation 1 In Vivo Dosimetry Competency Form

In Vivo Dosimetry Competency Form							
Name:							
CLINICAL ASSIGNMENTS	**PERFORMANCE CRITERIA**			**Shown to the Trainee**		**Trainee's Competency Assessed**	
				Trainee's Initials & Date	**Preceptor's Initials & Date**	**Trainee's Initials & Date**	**Preceptor's Initials & Date**
Read Out Nanodots	Perform daily QA of the nanodot reader						
	Select correct calibration curve						
	Read out nanodots						
Analyze Nanodot Results	Determine expected results and compare with readings for the following sites:	1. External beam plans (compare with plan)					
		2. Electrons (compare with hand calc)					
		3. TBI (compare with hand calc before the afternoon fraction)					
		4. TSE (compare with Rx dose)					
		5. Pacemakers/IECD/other devices (compare with standard limits)					
Communication and Follow Up	Demonstrate appropriate wording in emails sent to MD's						
	Demonstrate appropriate documentation in patient chart						
	If readings are >10% from expected, immediately follow communication requirements						
	If repeated nanodots are required, communicate appropriately, be present for the measurement (if applicable), and document accordingly						
	If treatment is changed according to nanodots, communicate to CP to ensure plan/chart parameters are changed and notify therapists about the change						
Nanodot Program Management	Prepare new/re-used batches of nanodots						
	Order new batches of nanodots						
	Generate calibration curve (if applicable)						
	Troubleshoot nanodot reader if malfunctioning						
Communication Requirements	Any nanodot results > 10% from expected	BEFORE emailing the MD, the Trainee will verbally contact and receive instructions from a physicist in the following order:	1. CP of the day				
			2. Next day's CP if > 5 pm				
			3. Any other physicist				