

## Molecular Imaging in Medicine Track Resident Handbook

Welcome to the Molecular Imaging in Medicine (MIM) residency track. This is the starting point for your engagement in the MIM residency track, with all the opportunities, facilities, and resources we have available for you at Emory University. This track has been carefully designed to provide the best training and research experience possible, but also has sufficient flexibility to allow reasonable modifications for your specific goals. This manual will give you a broad idea of the track and serve as a reference during your training. It is also a “living manual” that will be adapted over time with your feedback. All questions are best directed to the MIM Director (currently, Dr. David Brandon) who will serve as your primary point of contact.

The MIM track was created as an alternative pathway to train a well-rounded radiologist to gain a strong foundation in the clinical and research aspects of Nuclear Medicine and Molecular Imaging. The MIM track may be completed in 4 clinical years (MIM4) or in an enhanced track which provides an additional year of research training and experience (MIM5).

Over the last 10 -15 years, there has been increasing interest in building a training program that combines Diagnostic Radiology with Nuclear Medicine, with a special focus on Molecular Imaging techniques and research. Our experience has been that dual boarded practitioners are in great demand since there continues to be robust growth in Nuclear Medicine and Molecular Imaging, with new radiotracer development, novel hybrid imaging modalities delivered to the clinic, and new therapies introduced. Thus, there is a clear necessity for well-prepared imaging physicians.

In the MIM track you will have the opportunity to work with state-of-the-art equipment in collaboration with renowned physicians and scientists in Diagnostic Radiology, Nuclear Medicine and Molecular Imaging. This is a special opportunity for you and we welcome you into this training track.

### **What is the importance of and what are the opportunities associated with dual board certification training?**

After completing your MIM track, you should be eligible for both American Board of Nuclear Medicine (ABNM) certification and American Board of Radiology (ABR) certification. Dual board certification should enhance your qualifications and skills to a higher levels compared with your peers, including the ability to administer advanced nuclear medicine therapies.

### **You will not miss out on any opportunities for training by enrolling in the MIM track!**

In fact, just the opposite. First, the training at Emory in all aspects of Diagnostic Radiology is robust. The extra time spent in Nuclear Medicine rotations will not take away from your ability to become competent in all facets of diagnostic imaging. Second, in the past, a graduating Radiology Resident would typically have to make a decision about his or her one subspecialty of value for fellowship after training. Thus, a year of Nuclear Radiology Fellowship (which is still available) would, for example, compete with a decision for MR or Breast Imaging Fellowship. The recent changes in the Diagnostic Radiology board certification pathway created the required flexibility to develop the MIM track, offering a special opportunity to obtain training for advanced Nuclear Medicine and still undergo a fellowship for another

subspecialty (or mini-fellowships for multiple subspecialties) in the 15 month “gap” created after completion of Diagnostic Radiology training and the final ABR Certifying Examination<sup>1,2</sup>.

Most importantly, not only will successful completion of your training provide you with a technical skillset not everybody will have, it will also demonstrate that you have other important qualities such as constancy, perseverance and knowledge that should be sought by potential employers looking for exceptional individuals.

### **Exciting developments in Nuclear Medicine and Molecular Imaging**

Nuclear Medicine and Molecular Imaging is a constantly evolving and innovative field. As a MIM track resident you will be directly exposed to these innovations beyond the routine clinical imaging and therapy that Diagnostic Radiology residents are exposed to during their required Nuclear Medicine training months. Not only will you get cutting edge exposure to new clinical and research radiotracers, you will also have firsthand opportunities to work with state-of-the art equipment that most institutions do not possess, such as advanced PET and SPECT multimodality imaging platforms, small animal PET-CT, advanced MR molecular imaging capabilities, an onsite cyclotron, expertise in radiotracer development, and a licensed radiopharmacy for clinical and research radiotracers.

### **What is my place in relation to DR residents, NM residents, NR fellows/residents, PET fellows?**

You are still a Diagnostic Radiology (DR) resident in the Emory Diagnostic Radiology Residency Program; the current Emory DR Residency Program Director is Dr. Chris Ho. Being in the MIM track enhances that program with an additional defined curriculum, but you will still share much of your training experiences with your fellow DR residents. While on clinical Nuclear Medicine (NM) rotations, you will function as a resident. Depending on what year you are in, you may be going to lectures with the Nuclear Medicine residents/Nuclear Radiology fellows (see next section). During your research time, you will be asked to take a small amount of call (this should help maintain your skills).

Nuclear Medicine training can be provided via multiple pathways. Thus, it is helpful to understand the various types of trainees. Currently one may become fully Nuclear Medicine certified through the American Board of Nuclear Medicine (ABNM) and/or the American Board of Radiology (ABR) Nuclear Radiology pathways. We believe ABNM certification is the more robust pathway as many more Nuclear Medicine practitioners are ABNM boarded than certified in the ABR pathway (via the Nuclear Radiology subspecialty certification process). You will be able to make this choice for yourself after successfully completing the MIM track<sup>2,3</sup>.

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<sup>1</sup> Harolds JA, Oates ME, Guiberteau MJ, Ghesani M, Scanlon MH, Iagaru AH. New training pathways to dual certification in nuclear medicine and radiology. J Nucl Med. 2015;56(6):17N-8N.

<sup>2</sup> Oates ME, Guiberteau MJ. Adoption of the 16-month American Board of Radiology pathway to dual board certifications in nuclear radiology and/or nuclear medicine for diagnostic radiology residents. Acad Radiol. 2014;21(10):1348-56

<sup>3</sup> Oates ME. Integrated residency training pathways of the future: diagnostic radiology, nuclear radiology, nuclear medicine, and molecular imaging. Journal of the American College of Radiology : JACR. 2012;9(4):239-44

Definitions of related trainees:

**DR resident:** Traditional 4 year Accreditation Council for Graduate Medical Education (ACGME) pathway Diagnostic Radiology resident, expected to lead to ABR Diagnostic Radiology certification. DR residents take the ABR Diagnostic Radiology Core Exam at the end of the R3 year, and the final Certifying Examination 15 months after completion of DR residency training. DR residents are not ABNM or ABR Nuclear Radiology eligible without additional training, take relatively “limited” Nuclear Medicine (currently 4 required months), and are only eligible to administer certain radiotherapeutics. Call is distributed and organized by the DR Chief Residents under the guidance of the DR program director.

**NM residents:** Traditional Nuclear Medicine (without DR) is a 3 year ACGME pathway residency program, and graduates should be eligible for the ABNM board exam the October after completing training. Their resident call is separate from DR residents. NM residents have a morning lecture schedule. They have 6 months of dedicated cross sectional imaging training, but not as much in depth or breadth compared with DR. NM residents receive more extensive training in Nuclear Medicine and Molecular Imaging than DR residents and are eligible to perform complex radiopharmaceutical therapies.

**NR fellows:** Diagnostic Radiology residents who, after 4 years of DR do 1 year of ACGME pathway Nuclear Radiology fellowship, becoming eligible for the ABNM board exam as well as the ABR Nuclear Radiology certificate. These fellows function here as a NM resident in terms of rotation schedule, lectures and call. In the same fashion as NM residents, NR fellows are trained and eligible to perform complex radiopharmaceutical therapies.

**PET fellows:** PET fellows here are typically NM residents who seek one year of focused PET/CT training after finishing nuclear medicine residency. As junior faculty, PET fellows have teaching and research responsibilities, and may have graduated attending responsibilities as the year progresses. The year may involve some call duty as needed. PET fellowship is a non-ACGME pathway and an additional board or certificate is not obtained.

### **How will I know what I am supposed to do? Where do I begin?**

The Department of Radiology and Imaging Sciences and Emory University has created a robust orientation program for your training and other resources available to you across our system. After your Diagnostic Radiology orientation, you will attend a half-day MIM specific orientation where you will get an opportunity to meet many faculty you will be working with in the next 4-5 years as well as some other trainees. In this orientation, your MIM specific schedule will be reviewed with you. We will also arrange a tour of the clinical and research facilities involving Nuclear Medicine and Molecular Imaging and you will be given a special tour of the Center for Systems Imaging where the cyclotron and research radiopharmacy are located. You will also be given orientation mini-lectures on key concepts in Nuclear Medicine as well an introduction to current Nuclear Medicine research at Emory.

At the time of your orientation, a special orientation packet will be provided to you which includes (some documents also available online):

1. Emory Specific Orientation Packet
2. VA checklist
3. Grady Manual

4. Dual eligibility checklist and how hours are counted document
5. Our choice of a textbook best suited for a MIM resident
6. ABR and ABNM documentation forms
7. Other training requirements and programs you will undergo such as access to advanced radiotracer reader training programs and Y-90 microsphere training checklists
8. Membership application for the Society of Nuclear Medicine and Molecular Imaging (SNMMI) which is currently free for residents. You will be emailed an active link to facilitate enrollment.

You will have the opportunity to attend the currently-3.5 day Radiation Emergency Medicine course from REAC/TS in Oak Ridge, TN<sup>4</sup>. This will occur in the R4 for MIM4 and R5 for MIM5 year during your physics rotation. This course will count towards your overall physics requirement to be eligible for inclusion at an advanced level on a facility nuclear materials license. Further details of these requirements will be explained to you during your orientation period. In addition, we will review how therapies can be documented on ABR and ABNM forms to meet specific requirements. You will also get experience with cardiac stress testing during your dedicated nuclear cardiology training rotation.

**Call:** You will take standard Diagnostic Radiology call. In the R4 year, 4 weeks of Nuclear Medicine call will be taken.

**Rotation schedules:** Rotation schedules are established in advance, though there is flexibility in terms of which months in each year you will have a specific rotation. A sample schedule is provided in Appendix 1, but will be individualized.

**Note for T32 Training program MIM5 Residents:** There may be an opportunity for exceptionally qualified candidates to participate in a National Institutes of Health T32 Training program. In this case, one consecutive year of research will be integrated with a rotation schedule similar to MIM4 (thus equaling 5 years total). In this very special situation, the research year will commence in July after the R3 year (ABR Core exam given in June). The R4 year will then commence at the end of the T32 research year. Thus, the rotation schedule will be a hybrid of the MIM4 with the educational opportunities of the MIM5.

### **Am I part of a greater community? Will I get mentorship?**

As a MIM resident you are part of the greater Nuclear Medicine and Diagnostic Radiology family. This extended group will include:

**Mentorship:** You will be assigned a mentor. If you do a Transitional Year (TY) Internship at Emory, you will be assigned a mentor midway through TY and meet at least once before the MIM residency formally starts. If you do not do your TY at Emory, you will be assigned a mentor early in your first year and meet once a quarter and twice per year thereafter.

**Quarterly MIM seminar:** You will have the opportunity to have regular meetings with other MIMs and NM residents and fellows such as in the quarterly MIM seminar. You will be expected to give a short clinical or research presentation once a year during this seminar which will satisfy the requirements for the DR imaging sciences rotation.

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<sup>4</sup> <http://orise.orau.gov/reacts/capabilities/continuing-medical-education/radiation-emergency-medicine.aspx>

**Journal Club:** You will participate in a combined NM/MIM Journal club, presenting a minimum of 1 paper in each academic year. These journal clubs are given in early morning or evening with meals provided, attended by clinical faculty and physicists. NM residents and fellows also participate.

**Networking:** You will have the opportunity to attend the SNMMI annual meeting ([www.snmmi.org](http://www.snmmi.org)) in a guided setting during your first year which will include participation in the Young Professional Committee (YPC) allowing you to further network nationally.

### **Educational Opportunities**

**Clinical Education:** There will be a concentrated lecture schedule with Nuclear Medicine lectures provided in nuclear medicine rotation months as noted in Appendix 2. You will be given the time to attend these lectures. You will have special physics lectures needed to fulfill your higher hour requirements in the R4 for MIM4 and R5 for MIM5 year. Mini-lectures will be given at the start of the year and with each first Nuclear Medicine rotation and will be available online. Opportunities such as the Radiation Emergency Medicine course are given by international experts. You will also have the opportunity to meet with visiting professors. In your final year of the MIM track (or in dedicated T32 year) you will also attend the regular Nuclear Medicine lectures on a wider variety of topics. These lectures are given twice a week in the mornings and you will be given time from your usual rotations (Nuclear Medicine or Diagnostic Radiology) to attend. A full calendar of these lectures will be made available on-line. Note: as with all DR residents, you are expected to attend noon DR conference (even during your NM rotations).

**Research Education:** As part of your nonclinical rotations you will attend four one week special learning modules where you will be introduced to a specific research lab and have self-directed learning. The Radiochemistry Discovery/Radiopharmacy module in the list below is mandatory, and you will choose the remaining 3 modules based on your interests. As a MIM4, you will have this opportunity in the fourth year. As a MIM5 you will do these rotations in your first year.

- 1 Precision Imaging: Quantitative, Molecular, and Image-Guided Technologies (Current Directors: Drs. David Schuster and Baowei Fei)
- 2 Molecular Imaging Biomarker and Probe Development (Current Directors: Drs. Mark Goodman, Hui Mao, and Ephraim Parent)
- 3 Advanced Imaging Sciences (Current Directors: Drs. John Oshinski and Amit Saindane)
- 4 Computational Image Analysis and Guidance (Current Directors: Dr. Ernest Garcia and John Prologo)
- 5 Imaging Implementation Sciences and Integrative Imaging Informatics (Current Directors: Drs. Rich Duszak, Elizabeth Krupinski, Nabile Safdar)
- 6 Surgical Oncology Bio-Imaging Research Unit (Current Director: Dr. Lily Yang)

You will also have a special Research Physics module (flexible scheduling) by the Director of Medical Physics, currently Dr. Jon Nye, and this can further prepare you for research opportunities.

As a MIM4 or MIM5 you will also participate in the Radiology Research Boot Camp in your first 2 years which includes grant writing, biostatistics and other relevant topics. A sample agenda/schedule is provided in Appendix 3. For the MIM5 you will attend weekly Radiology and Imaging Sciences Research in Progress Seminars (RIPS) in your 5<sup>th</sup> year (or T32 year) and time permitting in other years. You are also required to attend Radiology Grand Rounds in which special guest lectures by luminaries from the field of Molecular Imaging often occur.

**Special Cancer Biology Training:** As a MIM5 (or T32) you will audit lectures and seminars held by the Emory Cancer Biology Graduate Program (CBGP)<sup>5</sup> which will consist of twice weekly morning seminars in the fall and spring semesters, Cancer Biology 1 and Cancer Biology 2, to be scheduled in your final year or during your T32 training year.

**Regulatory Education:** You will be required to complete all CITI research education modules to allow you to meet regulatory requirements to conduct research at Emory. We will provide you with details on how to access these modules. In addition as part of the Radiology Research Boot Camp, you will receive instruction by the Office of Research Compliance to familiarize you with IRB, FDA, and other regulatory issues in preparation to carry out clinical trials particular to Emory. As a MIM5 in your first year (or optionally as a MIM4 in your 4th year) you may attend the Division of Animal Resource (DAR) orientation and special training as required for a specific project involving animal studies.

### **Research Opportunities**

Nuclear Medicine and Molecular Imaging resides at the forefront of research. Emory researchers are internationally renowned for their contributions to the field, and you have the opportunity to be a part of this evolving endeavor. There are abundant opportunities for research education and engagement both in the MIM4 and more extensively in the MIM5 track. Optional for MIM4 and mandatory for MIM5, you will have to complete a dedicated mentored major and minor research project that will be explained in further detail and individualized to your skills and interests.

During your orientation at the very beginning of the MIM track, as well in your first nuclear medicine rotation at the VA, you will be given a special overview lecture to introduce you to the exciting projects ongoing in the entire Radiology department. Our Vice Chair for Research, currently Dr. Elizabeth Krupinski, will provide you a special overview during your orientation and you will also meet with the Division Director of Nuclear Medicine and Molecular Imaging, currently Dr. David Schuster, who will further orient you to specific projects within Nuclear Medicine.

As you go through the next 4-5 years you will meet regularly with your mentor and follow a research associate or fellow regularly in your chosen area of interest. If you so choose as a MIM4, you can then participate more fully in specific projects - this will likely involve working some nights and weekends to make sufficient progress in this relatively short time span. As a MIM5, specific research projects are mandatory.

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<sup>5</sup> [http://www.biomed.emory.edu/PROGRAM\\_SITES/CB/](http://www.biomed.emory.edu/PROGRAM_SITES/CB/)

**Appendix 1:**  
**Sample Schedule for MIM4 and MIM5**

<b>MIM4</b>						4 week rotations	
TY1	R1	R2	R3	R4			
Bonus NM (1)	EUH R1	EUH NM	EUH CARDS	EUH		1	Rotations in the first row highlighted in gray will be scheduled at Emory at the same time to allow a morning lecture series to be given to the whole MIM4 and MIM5 program
Or cut down on flex time in R4	VA R1	Grady	EUH	EUH		2	
	DR rotation	DR rotation	Physics; REAC/TS; Technologist	EUH PET		3	
	DR rotation	DR rotation	DR rotation	EUHM		4	
	DR rotation	DR rotation	DR rotation	EUHM		5	
	DR rotation	DR rotation	DR rotation	VA		6	
	DR rotation	DR rotation	DR rotation	Radiopharmacy plus 3 other selected 1 week Research Education modules		7	Flex months can be filled with desired diagnostic radiology rotations, though if a diagnostic radiology requirement has not been fulfilled the DR program director has discretion on how the flex months are used
	DR rotation	DR rotation	DR rotation	Grady		8	
	DR rotation	DR rotation	DR rotation	Grady		9	
	DR rotation	DR rotation	DR rotation	VA Cards		10	
	DR rotation	DR rotation	DR rotation	Flex		11	
	DR rotation	DR rotation	DR rotation	Flex		12	
	DR rotation	DR rotation	DR rotation	2 weeks: Flex 2 weeks: Mammo in last 6 months		13	
	3 more DR rotations as rotations are 3.25 weeks long in first year						
<b>MIM5</b>							
TY1	R1	R2	R3	R4	R5		
Bonus NM	EUH R1	EUH NM	EUH CARDS	EUH PET	EUH	1	Rotations in the first row highlighted in gray will be scheduled at Emory at the same time to allow a morning lecture series to be given to the whole MIM4 and MIM5 program
	VA R1	Grady	EUHM	Physics; REAC/TS; Technologist	EUH	2	
	Radiopharmacy plus 3 other selected 1 week Research Education modules	Research	Research	Research	EUH	3	Flex months can be filled with desired diagnostic radiology rotations, though if a diagnostic radiology requirement has not been fulfilled the DR program director has discretion on how the flex months are used
	Research	Flex/Research	Flex	Research	EUH PET	4	
	Research	DR rotation	DR rotation	Flex	EUHM	5	
	DR rotation	DR rotation	DR rotation	DR rotation	VA	6	
	DR rotation	DR rotation	DR rotation	DR rotation	Grady	7	
	DR rotation	DR rotation	DR rotation	DR rotation	VA Cards	8	
	DR rotation	DR rotation	DR rotation	DR rotation	Research	9	
	DR rotation	DR rotation	DR rotation	DR rotation	Research	10	
	DR rotation	DR rotation	DR rotation	DR rotation	Research	11	
	DR rotation	DR rotation	DR rotation	DR rotation	Flex	12	
	DR rotation	DR rotation	DR rotation	DR rotation	2 weeks: Flex 2 weeks: Mammo in last 6 months	13	
	3 more DR rotations as rotations are 3.25 weeks long in first year						

## Appendix 2: Concentrated Lecture Schedule and Assigned Readings

	Cycle 1			Assigned Reading	
Week 1	Monday	Labor Day			
	Tuesday	Biliary scintigraphy		Hepatobiliary Scintigraphy in Acute Cholecystitis Sincalide-stimulated cholescintigraphy: a multicenter investigation to determine optimal infusion methodology and gallbladder ejection fraction normal values.	Semin Nucl Med. 2012 Mar;42(2):84-100 J Nucl Med. 2010 Feb;51(2):277-81.
	Wednesday	Radiology Grand Rounds			
	Thursday	VQ Scintigraphy I: Clinical Aspects and Technique		PIOPED I	JAMA. 1990 May 23-30;263(20):2753-9
	Friday	VQ Scintigraphy II: Interpretation Systems		SPECT/CT and pulmonary embolism	Eur J Nucl Med Mol Imaging. 2014; 41(Suppl 1): 81-90
Week 2	Monday	Benign thyroid disease			
	Tuesday	Malignant thyroid disease		Radioiodine therapy for thyroid cancer in the era of risk stratification and alternative targeted therapies.	J Nucl Med 2014; 55:1485-1491.
	Wednesday	Radiology Grand Rounds	After Grand Rounds 30 minute VQ case Conference		
	Thursday	Thyroid Therapy Dosimetry			
	Friday	Lymphoscintigraphy and sentinel lymph node biopsy		Lymphoscintigraphy and Sentinel nodes	J Nucl Med. 2015 Jun;56(6):901-7.
Week 3	Monday	Bone Scintigraphy		Evaluation of Osseous Metastasis in Bone Scintigraphy	Semin Nucl Med. 2015;45(1):3-15.
	Tuesday	Multiple Myeloma			
	Wednesday	Radiology Grand Rounds	After Grand Rounds 30 minute Thyroid case Conference		
	Thursday	Infection Imaging: The basics		Radionuclide Imaging of Osteomyelitis	Semin Nucl Med. 2015;45(1):32-46.
	Friday	FDG PET Physiology and Protocols		Determination of accuracy and precision of lesion uptake measurements in human subjects with time-of-flight PET	J Nucl Med 2014; 55:602-607
Week 4	Monday	Neuroendocrine pathophysiology and imaging			
	Tuesday	Neuroendocrine therapy and theranostics		Modern nuclear imaging for paragangliomas: Beyond SPECT.	J Nucl Med 2012; 53:264-274
	Wednesday	Radiology Grand Rounds	After Grand Rounds 30 minute Neuroendocrine case Conference		
	Thursday	Prostate Cancer Imaging		New Clinical Indications for 18F/11C-choline	Eur Urol. 2016 Feb 2. pii: S0302-2838(16)00131-7
	Friday	Research PET tracers			
	Cycle 2				
Week 1	Monday	Labor Day			
	Tuesday	Gastric Emptying		Consensus recommendations for gastric emptying scintigraphy: A joint report of the american neurogastrology and motility society and the society of nuclear medicine.	J Nucl Med Technol 2008; 36:44-54.
	Wednesday	Radiology Grand Rounds			
	Thursday	Renal scintigraphy: Diurectic renography		Radionuclides in Nephrourology, Part 2: Pitfalls and Diagnostic Applications.	J Nucl Med 2014; 55:786-798.
	Friday	Renal scintigraphy: ACE renography; transplant kidneys			
Week 2	Monday	Gynecologic PET			
	Tuesday	Breast Cancer and PET		A molecular approach to breast imaging	J Nucl Med 2014; 55:177-180
	Wednesday	Radiology Grand Rounds	After Grand Rounds 30 minute Renal case Conference		
	Thursday	Brain Imaging: Seizures		The role of radionuclide imaging in epilepsy, part 1: Sporadic temporal and extratemporal lobe epilepsy.	J Nucl Med 2013; 54: 1775-1781.
	Friday	Brain Imaging: Tumors and Dementia		Effectiveness and safety of 18F-FDG PET in the evaluation of dementia: A review of the recent literature.	J Nucl Med 2012; 53: 59-71
Week 3	Monday	Myocardial Perfusion Imaging: Physiology and Protocol		Understanding appropriate use criteria in nuclear medicine.	J Nucl Med Technol 2012; 40:81-86.
	Tuesday	Myocardial Perfusion Imaging: Imaging and interpretation		Compared performance of high-sensitivity cameras dedicated to myocardial perfusion SPECT: A comprehensive analysis of phantom and human images.	J Nucl Med 2012; 53:1897-1903
	Wednesday	Radiology Grand Rounds	After Grand Rounds 30 minute Brain case Conference		
	Thursday	Head and Neck Malignancy			
	Friday	Lymphoma		Recommendations for Initial Evaluation, Staging, and Response Assessment of Hodgkin and Non-Hodgkin Lymphoma: The Lugano Classification.	J Clin Oncol 32:3059-3067
Week 4	Monday	Y-90 Liver SIRT			
	Tuesday	Other Nuclear Cardiac Imaging		Radionuclide Imaging of Myocardial Metabolism	Circ Cardiovasc Imaging 2010; 3:211-222
	Wednesday	Radiology Grand Rounds	After Grand Rounds 30 minute MPI case Conference		
	Thursday	Parathyroid Imaging		Parathyroid scintigraphy in patients with primary hyperparathyroidism: 99mTc sestamibi SPECT and SPECT/CT.	Radiographics. 2008; 28:1461-1476.
	Friday	Advanced applied infection imaging			



### Appendix 3:

## FINAL PROGRAM COURSE: INTRODUCTION TO RESEARCH IN RADIOLOGY

### Day One

- 1:30 Introduction/Housekeeping
- 1:45 Motivation for Research in Radiology
- 2:30 Principles of Diagnostic Testing
- 3:15 **Break**
- 3:30 Study Design, Analysis, Reporting and Bias
- 4:15 Research Ethics
- 5:00 How to Write a Research Proposal
- 5:45 **Adjourn**

### Day Two

- 8:00 Technology Assessment/Outcome & Cost-Effectiveness Analysis
- 9:00 Why Research for Residents
- 9:45 **Break**
- 10:00 Decision Trees & Bayes Theorem: Aids in Decision Making
- 10:45 Clinical Trial Statistics
- 11:30 Abstract Writing & Oral Presentations
- 12:15 **Lunch**
- 1:15 Radiology Residents Involvement in Research
- 2:00 Manuscript Preparation
- 2:45 **Break**
- 3:00 Evaluating Diagnostic Test Performance: ROC
- 3:45 IRB Approval Process
- 4:30 **Course Evaluations**
- 4:45 **Adjourn**