

<b>Rotation:</b> Nuclear Medicine and Molecular Imaging	<b>Rotation Duration:</b> 4 weeks	<b>Month(s):</b> 4 blocks of 4 weeks each; no vacation permitted during these months
<b>Institution:</b> Stanford and VAPAHCS	<b>Call Responsibility:</b> None	<b>Night(s):</b> N/A
<b>Faculty at Stanford:</b> Henry Guo, MD, PhD Andrei Iagaru, MD (Chief) Erik Mittra, MD, PhD Shyam Srinivas, MD, PhD <b>Faculty at VAPAHCS:</b> George Segall, MD (Chief) Minal Vasanaawala, MD <b>Adjunct Clinical Faculty:</b> David Douglas, MD Christine Keeling, MD Jeffrey Tseng, MD		<b>Location:</b> SUH Second Floor, H2200 VA Building 1  <b>Phone Numbers:</b> 8-2414; 8-2415; 4-4180 (Stanford) 6-8870 (VA)
<b>Technologists (Stanford):</b> Mariam Ali, CNMT Paulo Castaneda, CNMT (Radiology Supervisor, South Bay) Cindy Chan, CNMT Elizabeth Farmer, CNMT Christine Fujii, CNMT Matthew Gabriele, CNMT (South Bay) Katherine Giroux, CNMT (Lead Tech) Nora Gurevich, Senior CNMT Tina Huang, CNMT Shawna Kinsella, CNMT (Hoover II PET-MRI) Julie Kulm, CNMT (Lead Administrative Tech) Zachary Leonard, CNMT (Hoover II PET-MRI) Luan Nguyen, CNMT Vinh Nguyen, CNMT Kim Ramos, CNMT Monica Ranger, CNMT, NM Technical Manager Leslee Samoy, CNMT (South Bay)		<b>Training Level:</b> R1, R2, R3 and R4

**Goals & Objectives:**

- 4 blocks of 4 weeks each of clinical training designed to help you become an independent practitioner of Nuclear Medicine
- Training is hands-on clinical Nuclear Medicine working with attending physicians and technologists at Stanford (3 blocks) and VA Palo Alto (1 block)
- Various research opportunities are available in clinical translational oncological, neurological and cardiac projects

Dear 1<sup>st</sup> year Diagnostic Radiology Resident:

Welcome to the Division of Nuclear Medicine and Molecular Imaging at Stanford Hospital!

This is a 4-week rotation. During this rotation, you will work with the Nuclear Medicine resident(s) and fellows, as well as with the attending physicians on service with the expectation to become familiar with all aspects of diagnostic studies and therapies over the course of the 4 rotations during your residency. You will be expected to learn to plan and protocol all studies, interview patients, and follow-up your recommendations with the clinicians under direct supervision from the attending physicians. Your work is done in close collaboration with the technologists. They are a valuable resource, do not hesitate to ask questions.

Remember that you are here to learn and any questions or concerns should be directed to the attending on service who is ultimately responsible for all the studies performed in the clinic.

For 1 week in your first year rotation you will also have a chance to shadow the technologists in order to directly experience and learn the daily and weekly QC for the scanners, the safe receipt of radiopharmaceuticals, dose calibration and preparation, and learn how the scanners are operated.

We hope you will have a great experience with us and welcome any suggestions you may have for us to improve this rotation.

**NUCLEAR MEDICINE CLINIC SERVICE:**

**Clinic Hours:** Monday through Friday, 7:30 AM to 5:00 PM

After 5 PM, the on-call resident or fellow covers all the urgent studies ordered until the following morning. However, studies that started before 5 PM and are expected to be completed by 7 PM should be covered by the resident(s) on service. The on-call resident or fellow will cover all the studies through the weekend until Monday 7:30 AM. A sign-out of any urgent after-hours add-ons is expected to the attending physician on call.

**Duties:**

- Screen the request from ordering physicians and determine appropriateness and urgency
- Arrange with ordering team and nuclear medicine lead technologist for a good time to perform the study
- Protocol the scan using the form provided by the technologist. For protocol guide:
  - Electronic format: go to hospital computer → depts. (N: drive) → NucMed → Procedures
  - Printed “cheat sheet” next to workstation
- Be available throughout the scan for any questions from the technologist, to preview images, request additional views, give medications, etc. Be sure to sign out to the attending or fellow if you are off to conference during the day or to the on-call resident if study is going to be done after hours.
- Review study with attending and dictate the study. If needed, report results to referring clinician and make note in report about their name and day/time call was made.
- Assist with all therapies. Some therapies in NM require admissions. For Stanford, NM is the primary admitting service so you will be required to handle the admission (placing orders, reconciling meds, placing H&P and progress notes, discharging, etc). For LPCH, NM is a consulting service.
- Please save all your interesting (normal and abnormal cases). On Wednesday on your last week of the rotation, we would like you to present 5-10 interesting cases. This is scheduled in the reading room at 7:30 AM.

## Conferences:

You are required to attend all nuclear medicine conferences while on the nuclear medicine rotation. In addition, attendance in the Clinical and Basic Science lectures is required in order to comply with the authorized user eligibility requirements.

Please double check with attending physicians or the administrative associate for cancellations/changes:

Conference Schedule/Format			
Title	Day	Time	Location
Clinical Journal Club	Every Other Monday	12:15 PM	Nuc Med Library
Interesting Cases*	Wednesday	7:30 AM	Nuc Med Reading Room
Clinical NM Lectures	Thursday	7:30 AM	Glazer Conference Room
Basic Science NM Lectures	Friday	7:30 AM	Glazer Conference Room

\* On Wednesday of your last week, you will be up to present 5-10 interesting cases during the Interesting Cases conference. This is for you and the other residents/fellows to reinforce what we've learned, have an opportunity to practice how to describe findings, and practice presenting. No PowerPoint presentations needed, just show the cases at your workstation in the reading room.

**Evaluations:**

Medhub by Nuclear Medicine attending physicians

**Teaching files:**

<https://medwiki-secure.stanford.edu/display/nucmed/Nuclear+Medicine+Case+Tracking>

**Reporting:**

Please use NM and PET templates available in Nuance

**Iodine-131 therapy:**

As part of ABR requirement, you will be required to participate in the treatment of at least 3 patients with less than 33 mCi of  $^{131}\text{I}$  and at least 3 patients with more than 33 mCi of  $^{131}\text{I}$  over 4 years of residency. Please have it signed off for each and keep the records with you!

**Recommended Book Readings:**

- Nuclear Medicine: The Requisites (Thrall)
- Essentials of Nuclear Medicine (Mettler)

**Additional memos:**

*Dress code policy:* When on Nuclear Medicine clinic, please dress professionally when interacting with patients. Scrubs are OK only if you are on-call/post-call.

*Allergies:* Always ask the patient prior to scanning if s/he has any allergies to medicine and document this information on the original requisition. Additionally, confirm allergies on EPIC or LPCH EPIC and document this information in your dictation.

**First year rotation (General Nuclear Medicine at Stanford)**

- Introduction to the instruments used for imaging in Nuclear Medicine
- Education in the safe handling of radioactive materials (Health Physics)
- The resident will understand the concept of ALARA as it applies to Nuclear Medicine
- The resident will learn the indications for common Nuclear Medicine procedures, including bone scans, V/Q lung scans, myocardial perfusion imaging
- The resident will learn the importance of avoiding misadministrations by interviewing the patient, writing prescriptions for administration of radiopharmaceuticals and ensuring the dose and radiopharmaceutical are appropriate
- The use of PACS and the importance of correlative imaging and laboratory findings in establishing a differential diagnosis
- The role of therapy using radionuclides is introduced with attention to meeting the training requirements for the American Board of Radiology (
- The role of Nuclear Medicine studies in Pediatrics will be introduced
- The resident will observe interpretation of PET/CT scans
- The resident will be observed for quality of interaction with patients, medical colleagues, technologists and ancillary staff, and referring physicians
- One week of the rotation will be a hands-on experience with the technologist in-charge of the daily operations. These activities include, but are not limited to: dose calibrator constancy/accuracy/linearity tests; survey meter check calibration; gamma camera quality control (intrinsic/extrinsic flood, center of rotation, uniformity); dose calibration; management of radioactive spills; surveying for contamination; the use of the  $^{99m}\text{Tc}$  generator; preparation of  $^{99m}\text{Tc}$  labeled MAA, MDP and  $^{111}\text{In}$  labeled WBCs.
- The residents who opt in for Authorized User status will be required to attend the basic science lectures held every Friday in the Nuclear Medicine conference room (7:30-8:30)

**Checklist for 1<sup>st</sup> year rotation:**

There will be 1-on-1 teaching sessions during read out and a formal assessment at the end of the year. You are expected to augment with independent studying from the Requisites and Essentials textbooks. Essentials is available as PDF for download from Lane Library. Additional self-directed learning online and through PubMed is also important.

This checklist below will ensure a standard learning experience, despite differences in resident schedules and attending assignments. For each checklist item, please ask a nuclear medicine attending to spend 5-10 minutes with you to review these topics and then have them sign off. You are encouraged to work with any of them depending on availability. Go at your own pace and in any order. But please aim to complete the checklist by end of week 3.

Initials:

- \_\_\_\_\_ Review this Nuclear Medicine Curriculum Handbook
- \_\_\_\_\_ Tour (patient vs staff bathrooms, injection rooms, break room, radiochemistry lab)
- \_\_\_\_\_ Have training with Health Physics (arranged by the administrative associate)
- \_\_\_\_\_ Shadow an attending or NM fellow/resident while they interview patients
- \_\_\_\_\_ Learn how to protocol (resources, who/where to ask if you have questions)
- \_\_\_\_\_ Learn what to look for when asked to clear the study at completion of exam
- \_\_\_\_\_ Learn the basics of bone scintigraphy and review 10 bone scans
- \_\_\_\_\_ Learn the basics of pulmonary V/Q scintigraphy and review 10 V/Q scans
- \_\_\_\_\_ Learn the basics of biliary scan for acute/chronic cholecystitis and review 5 scans
- \_\_\_\_\_ Learn the basics of GI bleeding scintigraphy and review 5 scans
- \_\_\_\_\_ Learn the basics of cerebral perfusion scans and review 1 normal and 1 abnormal
- \_\_\_\_\_ Learn the basics of thyroid scans and therapy for cancer and hyperthyroidism
- \_\_\_\_\_ Perform at least 1 scans and therapy each for cancer and hyperthyroidism
- \_\_\_\_\_ Learn the basics of imaging and therapy for neuroendocrine tumors
- \_\_\_\_\_ Learn the basics of infection imaging and review 1 <sup>111</sup>In-WBC and 1 <sup>99m</sup>Tc WBC
- \_\_\_\_\_ Learn the basics of gastric emptying scans and review minimum 5 cases
- \_\_\_\_\_ Learn the basics of sentinel lymph node scintigraphy for breast cancer and melanoma
- \_\_\_\_\_ Learn the basics of renal scintigraphy
- \_\_\_\_\_ Learn basic approach to pediatric studies and review minimum of 10 cases
- \_\_\_\_\_ Read the basics of PET imaging



## Second year rotation (2 weeks of general Nuclear Medicine and 2 weeks of PET at Stanford)

- The resident will be educated further about the common and less commonly ordered diagnostic tests and will learn about dynamic studies of the urinary and gastro-intestinal tract
- The role of  $^{111}\text{In}$  and  $^{99\text{m}}\text{Tc}$  white blood cell scan and  $^{67}\text{Ga}$  Gallium in patients with infection or abscess will be learned
- The resident will be involved in the interpretation and reporting of PET/CT and learn normal variations and potential causes of false positive results
- The resident will be actively involved in the treatment of patients with hyperthyroidism using less than 33 mCi of  $^{131}\text{I}$
- The resident will be expected to be involved in the interpretation of several diagnostic studies daily, presenting the patient history, indications and results of the study to the attending physician. The resident will be responsible for dictating and editing the report.
- The resident will learn how radiopharmaceuticals are ordered, delivered and logged into the division
- The resident will be observed for quality of interaction with patients, medical colleagues, technologists and ancillary staff and referring physicians.

## Checklist for 2<sup>nd</sup> year rotation:

Initials:

- \_\_\_\_\_ Get familiar with most protocols used for Nuclear Medicine studies
- \_\_\_\_\_ Learn when to use SPECT/CT in addition to planar imaging
- \_\_\_\_\_ Learn the pharmacokinetics and physical properties of the radiopharmaceuticals
- \_\_\_\_\_ Learn the radiation exposure for Nuclear Medicine studies
- \_\_\_\_\_ Learn what radiopharmaceuticals require stopping breast feeding
- \_\_\_\_\_ Learn how to manage contamination
- \_\_\_\_\_ Learn the basic pearls and pitfalls of PET imaging
- \_\_\_\_\_ Learn how to protocol PET scans

### Third year (PET at the VAPAHCS)

- The resident will be responsible for the interpretation and reporting of PET/CT and learn the most common indications for PET/CT, as well as Neurology and Cardiology applications
- The resident will continue to be observed for quality of interaction with patients, medical colleagues, technologists and ancillary staff and referring physicians

#### Expectations:

- 1) Recognition of normal and abnormal patterns in cross-sectional anatomy
- 2) Understanding the biodistribution of radiopharmaceuticals: FDG, NaF, Rb etc.
- 3) Image interpretation in context of clinical care
- 4) Accurate, timely, and professional communication with technologists, consulting physicians, and patients
- 5) Follow-up on interesting or difficult cases without prompting and share this information with faculty

### Checklist for 3<sup>rd</sup> year rotation:

Please see the Chief Technologist at the beginning of your rotation for scheduling training times. Training will be scheduled over the course of your 4-week rotation period. Competencies for items marked with an asterisk (\*) ***must be demonstrated***.

DATE METHOD INIT

#### TECHNICAL AND RADIATION SAFETY COMPETENCIES:

##### ***Radioactive shipping and receiving***

\_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ DOT Requirements (I, II, III labeling)  
 \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \*Surface/1 meter surveying – *may also be done during the day with the General or*

Float tech

\_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \*Wipes for contamination – *may also be done during the day with the General or*  
 Float tech

\_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ Logging of doses

##### ***Quality Control***

\_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \*Daily Constancy  
 \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ Quarterly Linearity

_____	_____	_____	Annual Accuracy
_____	_____	_____	Geometry
_____	_____	_____	*Survey meter QC (battery check, source check)
_____	_____	_____	*Daily QC for PETCT:
			Warm up
			Fast Calibration
			PET QC – Normalization
			CT phantom
			<b><i>Dose Calibrator – Operation</i></b>
_____	_____	_____	*Proper selection of channels – <i>may be done throughout day with any tech</i>
_____	_____	_____	*Measuring activity – <i>may be done throughout day with any tech</i>
_____	_____	_____	*Measuring residuals – <i>may be done throughout day with any tech</i>
_____	_____	_____	*Survey meter operation (various scales) – <i>may be done throughout day with any tech</i>
			<b><i>Proper handling of radioactivity</i></b>
_____	_____	_____	ALARA
_____	_____	_____	*Personal protective equipment (gloves, lab coat) – <i>may be done throughout day with any tech</i>
_____	_____	_____	*Proper use of personal dosimetry (ring & body) – <i>may be done throughout day with any tech</i>
_____	_____	_____	*Proper use of syringe shields (size and type) – <i>may be done throughout day with any tech</i>
_____	_____	_____	*Knowledge and use of administrative controls in preventing a medical event (proper patient identification and written directive) – <i>may be done throughout day with any tech</i>
_____	_____	_____	*Proper administration of radioisotopes to patients or human research subjects <i>May be done throughout day with any tech</i>
			<b><i>Surveys for contamination</i></b>
_____	_____	_____	*Proper monitoring of areas/spills
_____	_____	_____	*Demonstrate competency in decontamination and management of radioactive spills
_____	_____	_____	*Proper documentation of surveys/spills
			<b><i>Waste management</i></b>

_____	_____	_____	Sharps vs non-sharps waste
_____	_____	_____	What constitutes short-lived vs long-lived waste (storage/decay); proper segregation
_____	_____	_____	Disposal of radioactive blood/urine
_____	_____	_____	Hot sink disposal (what can go and daily limits of each)
_____	_____	_____	Weekly wipes
 <b><i>*Generator Elution (Note: we will use a Mo-Tc generator to demonstrate these principles)</i></b>			
_____	_____	_____	Elute generator system for preparation of radiopharmaceuticals
_____	_____	_____	Elution frequency and expected yield
_____	_____	_____	Measure/test the eluate for radionuclidic purity, radiochemical purity and chemical purity
_____	_____	_____	Process the eluate with reagent kits to prepare labeled radioactive drugs
_____	_____	_____	Measure and test the compounded reagent kit for radiochemical purity
 <b>CLINICAL COMPETENCIES</b>			
_____	_____	_____	<b>Appropriateness criteria for oncologic and non-oncologic PET imaging</b>
 <b>Patient Preparation:</b>			
_____	_____	_____	A. Dietary restrictions
_____	_____	_____	B. Medication restrictions
_____	_____	_____	C. Fingerstick blood glucose measurement
_____	_____	_____	D. Physical activity
_____	_____	_____	 <b>Protocols used for PET studies</b>
<b>Non-radioactive adjuncts</b>			
_____	_____	_____	A. management of claustrophobia, anxiety, pain
_____	_____	_____	B. Furosemide
_____	_____	_____	C. Insulin
_____	_____	_____	D. Fingerstick blood glucose measurement
 <b><i>* Acquisition and Processing of PET/CT scans</i></b>			
_____	_____	_____	Patient positioning
_____	_____	_____	Electrode positioning (if gated)



**Fourth year (General Nuclear Medicine at Stanford and PET at Stanford or the VA)**

- The resident will be actively involved with more of the diagnostic scans seen in the first and second months and should become increasingly confident and competent in interpretation of all standard Nuclear Medicine diagnostic studies
- The resident will learn the regulations for release of patients treated with radionuclides including doses larger than 33 mCi of  $^{131}\text{I}$
- The trainee will learn how to interpret whole body scans with  $^{123}\text{I}$  and  $^{131}\text{I}$
- The role of Nuclear Medicine studies in Pediatrics will be expanded so the resident should be exposed to the majority of procedures they will encounter in practice
- More advanced PET/CT and PET/MRI training, including participation at tumor boards
- The resident should have received all necessary training to practice Nuclear Medicine in their future role as a consultant in Radiology

**Checklist for 4<sup>th</sup> year rotation:**

Initials:

- \_\_\_\_\_ Get familiar with protocols used for Nuclear Medicine therapies
- \_\_\_\_\_ Learn the basics of peptide receptor radionuclide therapy (PRRT) for neuroendocrine tumors and therapies for bone metastases
- \_\_\_\_\_ Learn all major indications for PET/CT and PET/MRI
- \_\_\_\_\_ Learn the basics of PET imaging with specific radiopharmaceuticals for neuroendocrine tumors and prostate cancer
- \_\_\_\_\_ Learn all major indications for pediatric Nuclear Medicine studies