The Nuclear Medicine/CT angiography rotation is based at the Palo Alto VA Medical Center and gives the cardiology fellow experience with various imaging techniques to achieve Level 2 proficiency as well as learning various modalities of stress testing, often in conjunction with imaging tests.

**The objectives of this 2-month rotation include:**

1. Understand the indications for exercise treadmill testing and specific nuclear cardiology tests, safe use of radionuclide’s, and basics of instrumentation and image processing
2. Chose the optimal stress test for a given patient and learn the importance of physical and pharmacologic stress in nuclear cardiology
3. Interpret radionuclide myocardial perfusion imaging studies, including SPECT, MUGA, and PET studies
4. Interpret CT angiography studies.
5. Safely conduct exercise tests and interpret exercise electrocardiograms
6. Develop Level 2 proficiency in performing and interpreting cardiac nuclear imaging tests.

**Progression of responsibility**

As the fellow develops more experience in the performance of treadmill tests and nuclear imaging studies, he/she is given more autonomy in the performance of tests, selection of radioisotope and dose, and imaging parameters.

**MEDICAL KNOWLEDGE**

**GOAL:** Demonstrate knowledge of established and evolving biomedical, clinical, epidemiologic and social-behavioral sciences, as well as application of this knowledge to patient care.

Emphasis on the rotation is for the cardiology fellow to:

- Understand the principles of myocardial perfusion and blood flow, factors determining flow, coronary flow regulation, vasoreactivity, coronary flow reserve, regional flow differences, and flow variability.
- Understand the principles of radioactivity, radioactive decay, radionuclide production, radionuclide generators, photon interactions with matter, and spectrum radiating detectors.
- Have a basic understanding of the instrumentation, techniques, and principles involved in nuclear imaging, including collimation, resolution, contrast, localization, noise, ECT, SPECT, PET, image reconstitution methods, and attenuation and scatter correction.
- Know the various methods of stress testing (treadmill, upright and reclining bicycle, pharmacologic), including indications, contra-indications, safety, and technique.
- Understand the advantages, disadvantages, and differences between various protocols for image acquisition.
- Know the differences between the various radioisotopes used in nuclear cardiology, including their energy, half lives, and organs of elimination.
- Know the value of perfusion imaging in the diagnosis, prognosis, and management of patients with coronary artery disease.
PATIENT CARE

Fellows must able to provide patient care which is compassionate, appropriate and effective for the treatment of health problems and the promotion of health. Fellows are expected to demonstrate:

**Competency:**
1. Gather essential and accurate information about their patients.
2. Use information technology to support patient care decisions and patient education.

**Objective**
1. Chose the optimal stress test for a given patient given their symptoms and co-morbidities.
2. Information about a patient’s medical history, medications and co-morbidities are obtained from the VA electronic medical record and are key elements in the decisions about testing modalities.

INTERPERSONAL AND COMMUNICATION SKILLS

Fellows must demonstrate a commitment to carrying out professional responsibilities and an adherence to ethical principles.

**Competency:**
1. Work effectively as a member or leader of a health care team or other professional group

**Objective:**
1. Demonstrate on-going communication during stress testing, which involves the team conducting the study with continuous monitoring of the patient’s condition.
2. Be able to communicate when an emergent condition arises and coordinate the team to provide care expeditiously.

PROFESSIONALISM

Fellows must demonstrate a commitment to carrying out professional responsibilities and an adherence to ethical principals.

**Competency:**
1. Demonstrate a commitment to ethical principles pertaining to confidentiality of patient information, informed consent and business practices.

**Objective:**
1. Demonstrate understanding of HIPPA regulations, particularly as they relate to patients in a testing environment.
2. Be able to obtain informed consent from patients with appropriate information about the risks and benefits of the procedure relevant to that particular patient.
PRACTICE-BASED LEARNING AND IMPROVEMENT

Fellows must demonstrate the ability to investigate and evaluate their care of patients, to appraise and assimilate scientific evidence, and to continuously improve patient care based on constant self-evaluation and life-long learning.

**Competency:**
1. Analyze practice experience and perform practice-based improvement activities using a systematic methodology.
2. Apply knowledge of study designs and statistical methods to the appraisal of clinical studies and other information on diagnostic and therapeutic effectiveness.

**Objective:**
1. During the two months of the rotation, fellows develop the ability to independently perform and analyze stress tests and nuclear imaging studies.
2. Recommendations on how to apply the information from imaging studies and stress testing are based on knowledge of current literature and guidelines.

SYSTEMS BASED PRACTICE

Demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care.

**Competency:**
1. Provide health care which is cost-effective without compromising quality of patient care.

**Objective:**
1. Fellows assess patients referred for stress testing and/or imaging studies and based on their evaluation, perform the test most appropriate for the clinical questions which need to be addressed as well the patient’s clinical condition, co-morbidities and medications. Thus, the patient gets the study more appropriate for the clinical issues, which minimizes unnecessary or inappropriate testing.
### Level of Supervision

- When learning new procedures, fellows receive direct supervision from attendings or experienced technicians.
- Test results are reviewed with the fellow directly and immediate feedback is provided.

### Rotation Directors

- Nuclear Medicine: George Siegel, M.D.
- ETT: Victor Froelicher, M.D.

### EDUCATIONAL METHODS

1. Review of ETT results with the supervising physician and other members of the exercise physiology group.
2. Daily reading sessions with the attending in nuclear medicine and other residents (radiology, nuclear medicine)
3. Monthly case presentation at the Nuclear Cath Correlation Conference.
4. Individual reading including resources provided by the Cardiology Section and the Nuclear Medicine Service.
5. ACC/AHA guidelines
6. Internet resources: Lane Library, Up to date, etc

### Required Readings

Fellows are expected to read the Nuclear Cardiology chapter of the Adult Clinical Cardiology Self-Assessment Program (ACCSAP). A copy is provided to each fellow at the beginning of the rotation.

Other recommended educational resources during the rotation include:


### FEEDBACK MECHANISM

The nuclear medicine and exercise testing faculty will provide verbal and written feedback (via MedHub) at the end of each month's rotation. The written evaluation will be in the format utilized by the American Board of Internal Medicine which stresses the six competencies of the ACGME.

Assessment methods include, but are not limited, to the following:

- **Clinical performance rating** at the end of the rotation, focusing on patient care, medical knowledge, practice-based learning and improvement, professionalism, systems-based practice, and interpersonal and communication skills.

- **Narrative evaluation** of the fellow's performance (based upon the above core competencies) by the faculty at bi-annual evaluation meetings.
- **Focused observation and evaluation** of the fellow’s ability to interpret exercise treadmill studies and nuclear perfusion scans.
- **Fellow project report**: evaluation of the fellow’s ability to summarize and discuss pertinent cases during the monthly nuclear cardiology-coronary angiography correlation conference.

Fellows will also provide oral and written evaluations of the rotation and faculty (360°). The oral evaluations are generally done as a group at a bi-annual formal meeting between the fellowship program director and fellows. These evaluations are transcribed into written format by the fellowship coordinator and verified by the fellowship program director. Written evaluations of the rotation are done via MedHub.