Rotation: Imaging 2

Imaging 2 provides addition nuclear cardiology experience and COCATS Level 1 cardiac MRI experience. Fellows administer, process, and read VHVI cardiac nuclear studies with cardiology faculty on Mondays, Wednesdays, alternating Thursdays, and Fridays. During times when fellow presence is not required in the nuclear laboratory, fellows will administer, process, and interpret cardiac MRI studies under the supervision of cardiac MRI technologists and faculty.

Fellows on this rotation are expected to attend nuclear conferences and multimodality imaging conference.

Nuclear Cardiology (in Imaging 1 and 2)
Learning Objectives

Patient Care	
Objective	**Teaching Methods**
Obtain pertinent medical histories by review of patient medical records. Screen patients for suitability for stress testing, including the performance of focused physical examinations to aid in screening and establish safety of stress testing, plus to detect contraindications to stress testing, either by exercise or pharmacologic methods.	Clinical Teaching, Clinical Experiences, Performance Feedback
Learn methods for interpretation of tests and risk stratification. Produce high quality reports that adhere to American Heart Association and American Society of Nuclear Cardiology standards, and suitable for inclusion in the Vanderbilt electronic medical record. Be able to integrate test results in the context of patient management.	Clinical Teaching, Clinical Experiences, Performance Feedback

Medical Knowledge	
Objective	**Teaching Methods**
Preceding this rotation, the fellow or resident should be qualified in advanced cardiac life support.
Understand indications, methods, risks and benefits of stress testing, using both exercise and pharmacological methods.
Understand basic principles of radiation, radiation dosimetry, radiation protection. Know the basic properties of the commonly used radioisotopes, Tc-99m and Tl-201.
Understand the basic principles of gamma cameras, image acquisition and image processing of myocardial perfusion scans and radionuclide ventriculography (equilibrium gated radionuclide angiography).
Understand pathophysiology of myocardial ischemia and infarction, plus the elements of how to evaluate ventricular performance, both regional and global.
Understand the basic image characteristics of myocardial ischemia and	Clinical Teaching, Clinical Experiences, Didactics Text reading

infarction, and their effects on perfusion imaging.
Recognize common imaging artifacts and become facile in their detection.
Understand methods of attenuation correction, strengths and weaknesses.
Become expert in performing both exercise and pharmacologic stress testing, including arrhythmia interpretation and ECG stress test interpretation. Understand how to integrate myocardial perfusion scan results with clinical and ECG parts of stress testing.

Professionalism	
Objective	**Teaching Methods**
Maintain patient privacy Be accessible to colleagues Be personally responsible for actions.	Clinical Teaching, Clinical Experiences, Role Models
Demonstrate compassion and respect for others, including patients from a diverse cultural, social, and religious backgrounds	Clinical Teaching, Clinical Experiences, Role Models

Interpersonal and Communication Skills	
Objective	**Teaching Methods**
Communicate effectively with patients, families, and members of the health care team, including findings and diagnoses when appropriate to both patients and consulting physicians. Communicate abnormal results to ordering physicaians timely.	Clinical Teaching, Clinical Experiences, Role Models
Maintain timely and comprehensive medical records, including the prompt generation of standard nuclear and ECG stress test reports that will be available same day in the electronic medical record.	Clinical Teaching, Clinical Experiences, Role Models, Performance Feedback

Practice Based Learning and Improvement	
Objective	**Teaching Methods**
Identify both strengths and gaps in knowledge and expertise and set appropriate learning goals	Clinical Teaching, Performance Feedback, Role Models
Utilize information technology to effectively locate, appraise, and utilize evidence based medicine in current literature to answer clinical and technical questions Respond appropriately to feedback and accept constructive criticism	Clinical Teaching, Performance Feedback, Role Models
Utilize quality improvement methods to implement changes within the	Clinical Teaching,

practice environment	Performance Feedback, Role Models

Systems Based Practice	
Objective	**Teaching Methods**
Work effectively as a member of the health care team	Clinical Teaching, Clinical Experiences, Performance Feedback Role Models
Demonstrate understanding of cost-effectiveness and risk-benefit analysis	
Advocate for and work towards patient safety and improved quality of care	
Identify system errors and implement systems solutions	

Cardiac MRI

Learning Objectives

Patient Care	
Objective	**Teaching Methods**
1. Review the patient's medical history and prior imaging studies, understand the indication and clinical question to be addressed by CMR, determine appropriateness of CMR examination, and prescribe a tailored yet complete CMR examination.	Clinical Teaching, Clinical Experience
2. Recognize hazards and understand safe practices for working in the CMR environment, and properly screen patients for contraindications for CMR examination.	Didactic (DVD), Clinical Experience
3. Ensure that CMR examinations are performed to maintain patient comfort, privacy, and safety.	Clinical Experience
4. Recognize and manage complications associated with CMR examinations, including stress testing, contrast agents, sedation, and power injections.	Clinical Teaching, Clinical Experience, Didactic (classroom)
5. Complete accurate reports of the CMR examination including summary of findings, procedure description, management of complications, and notification of attending physician regarding results when appropriate.	Clinical Teaching, Clinical Experience, Performance Feedback

Medical Knowledge	
Objective	**Teaching Methods**
1. Learn the standard views and techniques for CMR examinations for studying cardiac structure, tissue characterization, function, and blood flow, including: a. Tomographic still-frame CMR for morphology. b. Cine CMR for assessment of ventricular function. c. Delayed contrast-enhanced CMR imaging for myocardial infarction, scar, intraventricular thrombus and microvascular obstruction (associated with MI) and viability assessment and visualization of other causes of abnormal myocardial interstitium. d. First-pass CMR imaging (with vasodilator infusion) or cine CMR imaging with stress (with inotropic agent) for myocardial perfusion evaluation and ischemia detection. e. Phase-contrast velocity mapping for blood flow quantification for shunt sizing and determination of valvular regurgitation and stenosis. f. MR angiography. g. Myocardial tagging. h. MR angiography of the native coronary arteries.	Clinical Teaching, Clinical Experience, Didactics (DVD), Didactic (classroom), Computer Modules
2. Master the *core concepts* of CMR including: a. Image formation and pulse sequence selection using "bright" and/ or "dark blood" methods with and/or without contrast agents. b. Flow, motion, and phase imaging (velocity-encoded) techniques. c. Hardware components of CMR system, and MRI-compatible equipment (power injectors, infusion pumps, and hemodynamic monitor). d. ECG, pulse, and respiratory gating and triggering schemes. e. Sources of artifacts and their effects on CMR images.	Clinical Teaching, Clinical Experience, Didactics (DVD), Didactic (classroom), Computer Modules
3. Master *image analysis* and *post-processing skills*, including: a. standard dimension measurements for the heart and great vessels	Clinical Teaching, Clinical Experience, Didactic

b. volumetric imaging of mass, biventricular volumes, and ejection fraction. c. velocity-encoded flow analysis. d. MIP, MPR, and 3D-VR manipulation of MRA data sets.	(classroom)
4. Master *interpretive skills* for diagnosing and reporting: a. ischemic heart disease, including myocardial ischemia, acute myocardial infarction, chronic ischemic heart disease, and viability b. acquired and non-ischemic cardiomyopathies b. valvular abnormalities c. congenital heart disease, both native appearance and post-surgical monitoring. d. aortic, pulmonary arterial, caval, and pulmonary venous diseases e. pericardial diseases f. Intra- and pericardiac masses, including thrombi	Clinical Teaching, Clinical Experience, Didactics (DVD), Didactic (classroom), Computer Modules, Performance Feedback

Professionalism	
Objective	**Teaching Methods**
Demonstrate accountability and professional behavior towards patients, family members, and members of the health care team and adherence to ethical principles	Clinical Experience, Role Models
Demonstrate compassion and respect for others, including patients from a diverse cultural, social, and religious backgrounds	Clinical Experience, Role Models

Interpersonal and Communication Skills	
Objective	**Teaching Methods**
Communicate effectively with patients, families, and members of the health care team, including findings and diagnoses to referring physicians, and when appropriate, to patients.	Clinical Experience, Role Models
Provide timely and comprehensive reports of CMR examinations, including notification of significant results to referring physician when appropriate.	Clinical Teaching, Clinical Experience

Practice Based Learning and Improvement	
Objective	**Teaching Methods**
Identify both strengths and gaps in knowledge and expertise and set appropriate learning goals	Independent study, Clinical Experience, Performance Feedback
Utilize information technology to effectively locate, appraise, and utilize evidence based medicine with in current literature to improve patient care	Independent study, Computer Modules
Utilize quality improvement methods to implement changes within the practice environment	Clinical Experience

Systems Based Practice	
Objective	**Teaching Methods**
Work effectively as a member of the health care team, by providing CMR services, coordination of patient care and reporting of results.	Clinical Experience
Understand the complexities of and work with the multidisciplinary resources necessary to appropriately directed patients to alternative (either superior or complementary to CMR) imaging studies.	Clinical Experience
Demonstrate understanding of cost-effectiveness and risk-benefit analysis and incorporate these into patient care	Clinical Experience, Didactic (classroom)
Advocate for and work towards patient safety and improved quality of care	Clinical Experience, Role Models
Identify system errors and implement systems solutions	Clinical Experience