Rotation 1:

1. Knowledge Based Objectives
   At the end of the rotation the resident should be able to:
   - Demonstrate knowledge of the principals of iodinated contrast administration, basic MRI safety, basic time resolved MR angiography, basic nuclear cardiology including fundamentals of cardiac PET, basic image reformatting.
   - Demonstrate knowledge of ECG gating.
   - Demonstrate knowledge of vascular CT and MR fundamentals.
   - Demonstrate knowledge of all aspects of cardiac gating, including considerations of exam time and (for CT) patient dosimetry.

   Assessment:
   Faculty Observation
   Cases Reviewed by/with Faculty Radiologist

2. Technical Skills
   At the end of the rotation the resident should be able to:
   - Obtain a complete patient history for the safe administration of iodinated contrast material and the safe utilization of MRI.
   - Obtain a complete history and physical exam for safe administration of beta-blockade and nitroglycerin.
   - Demonstrate knowledge of image acquisition and interpret the following protocols for MRA: runoff (for peripheral vascular disease), aneurysm, dissection and vasculitis of the aorta, renal, mesenteric, pulmonary arteries (for pulmonary embolism) and pulmonary veins (for mapping atrial fibrillation) commensurate with competency and individual experience.
   - Demonstrate knowledge of image acquisition and interpret the following protocols for MRV: peripheral (for planning venous access) and central including: thoracic, abdominal, pelvic (for DVT), and thoracic duct commensurate with competency and individual experience.
   - Demonstrate knowledge of image acquisition and interpret the peripheral (for planning venous access) protocols for CTV commensurate with competency and individual experience.
   - Operate state-of-the-art vascular MR and CT scanners.
   - Build a vascular MR protocol at the MR scanner
   - Identify the interplay between parameters such as FOV, bandwidth, matrix size, etc. when using the MR scanner.
   - Scan patients using the CT scanner and identify the effects of cardiac gating (when applicable) the effects of CT parameters such as mAs, kV, and gantry rotation time.
   - Adhere to dictation format and templates.

   Assessment:
   Faculty Observation
3. Decision-Marking & Value Judgment Skills
At the end of the rotation, the resident should be able to:

- Understand and summarize patient cardiovascular history, including interpreting lab values.
- Integrate cardiac CT findings into overall patient management, emphasizing cardiac gating and its role in all of cardiac imaging commensurate with experience and individual competency.
- Demonstrate sufficient knowledge of CV medicine to interpret radiological studies and generate meaningful differential diagnoses commensurate with experience and individual competency.
- Provide compassionate, appropriate and effective patient care commensurate with experience and individual competency.
- Insure the patient’s dignity and privacy and not discriminate against any patient based on religion, ethnic, sexual or educational differences.
- Communicate effectively and use appropriate nomenclature with healthcare professionals, including faculty, technologists, and support staff.
- Communicate with referring physicians about all significant or unexpected radiological findings.
- Recognize limits in personal skill and knowledge, especially when assisting with imaging interpretation and patient management. Obtain help from supervisory faculty when appropriate.

- Demonstrate a professional work ethic including:
  - Altruism.
  - Punctuality.
  - Adherence to all relevant policies and procedures.
  - Proper preparation for rotation, including recommended reading assignments completed.
  - Treat all faculty, technologists, and support staff with respect, understanding, and professionalism.

Assessment:
Faculty Observation
Global rating by faculty
Cases reviewed with/by Faculty Radiologist

Rotation 2:

1. Knowledge Based Objectives
At the end of the rotation the resident should be able to:

- Demonstrate review and/or retention of knowledge requirements set forth for the first rotation.
- Apply cardiovascular history to proper imaging triage and selection of imaging tests.
- Demonstrate knowledge of cardiac stress safety in nuclear cardiology.
- Demonstrate knowledge of CT image reformatting, including MPR (straight and curved) and selective MIPS.
- Demonstrate knowledge of all aspects of cardiac CT, including coronary calcium scoring, evaluation of noncoronary cardiac calcification, coronary CT angiography, bypass graft analysis, cardiac masses, and cardiac function.
- Demonstrate knowledge of research design and implementation principals.
- Demonstrate knowledge of the interface between cardiac imaging and cardiology and the principles of ECG interpretation and the administration of drugs commonly used in cardiac CT (metoprolol PO/IV, nitroglycerine SL).
- Reconstruct CT data at different phases of the cardiac cycle and gain explicit understanding of cardiac gating.

**Assessment:**
Faculty Observation
Cases Reviewed by/with Faculty Radiologist

2. **Technical Skills**
At the end of the rotation the resident should be able to:
- Demonstrate retention of the technical skills listed in the first rotation.
- Perform ECG gated CTs adhering to protocol.
- Perform protocol time resolved MR angiography.
- Recognize the side effects of routinely used CV medications before administering pharmacologic agents.
- Perform, coronary CTA, emphasizing imaging parameters (mAs, kV, gantry rotation time) and contrast media (concentration, volume, rate).
- Demonstrate knowledge of image acquisition and interpret the following protocols for CTA: runoff (for peripheral vascular disease), aneurysm, dissection and vasculitis of the aorta, mesenteric, pulmonary veins (for mapping atrial fibrillation) and transplant commensurate with competency and individual experience.

**Assessment:**
Faculty Observation

3. **Decision-Making & Value Judgment Skill**
At the end of the rotation, the resident should be able to:
- Demonstrate retention of decision-making & value judgment skills listed in the first rotation.
- Provide compassionate, appropriate and effective patient care commensurate with experience and individual competency.
- Insure the patient’s dignity and privacy and not discriminate against any patient based on religion, ethnic, sexual or educational differences.
- Communicate effectively and use appropriate nomenclature with healthcare professionals, including faculty, technologists, and support staff.
- Communicate with referring physicians about all significant or unexpected radiological findings.
- Recognize limits in personal skill and knowledge, especially when assisting with imaging interpretation and patient management. Obtain help from supervisory faculty when appropriate.
- Demonstrate a professional work ethic including:
  - Altruism.
  - Punctuality.
  - Adherence to all relevant policies and procedures.
  - Proper preparation for rotation, including recommended reading assignments completed.
  - Treat all faculty, technologists, and support staff with respect, understanding, and professionalism.

**Assessment:**
Faculty Observation
Global Rating by Faculty
Cases Reviewed with/by Faculty Radiologist
Rotation 3:

1. **Knowledge Based Objectives**  
   At the end of the rotation the resident should be able to:  
   • Demonstrate retention of knowledge requirements listed in previous rotations.  

   **Assessment:**  
   Faculty Observation  
   Cases reviewed with/by Faculty Radiologist  

2. **Technical Skills**  
   At the end of the rotation the resident should be able to:  
   • Demonstrate retention of the technical skills listed in previous rotations.  
   • Perform and post-process static and time resolved CT and MR angiography commensurate with experience and individual competency.  
   • Perform sophisticated image post-processing to make cardiac diagnoses.  

   **Assessment:**  
   Faculty Observation  

3. **Decision-Making & Value Judgment Skills**  
   At the end of the rotation, the resident should be able to:  
   • Demonstrate retention of decision-making & value judgment skills listed in previous rotations.  
   • Provide compassionate, appropriate and effective patient care commensurate with experience and individual competency.  
   • Insure the patient’s dignity and privacy and not discriminate against any patient based on religion, ethnic, sexual or educational differences.  
   • Communicate effectively and use appropriate nomenclature with healthcare professionals, including faculty, technologists, and support staff.  
   • Communicate with referring physicians about all significant or unexpected radiological findings.  
   • Recognize limits in personal skill and knowledge, especially when assisting with imaging interpretation and patient management. Obtain help from supervisory faculty when appropriate.  
   • Demonstrate a professional work ethic including:  
     o Altruism.  
     o Punctuality.  
     o Adherence to all relevant policies and procedures.  
     o Proper preparation for rotation, including recommended reading assignments completed.  
     o Treat all faculty, technologists, and support staff with respect, understanding, and professionalism.  

   **Assessment:**  
   Faculty Observation  
   Cases reviewed with/by Faculty Radiologist  
   Global Rating by Faculty
Mini-Fellowship (Optional):
At the end of the rotation, the resident should be able to:

- Complete 4 electives (3 months) including cardiac CT, cardiac MR, cardiac PET/CT and cardiovascular image post-processing.
- Achieve level 2 competence (as defined by the ACC and the ACR) in cardiac CT and MR.

Assessment:
Faculty Observation
Cases Reviewed with/by Faculty Radiologist

Senior Elective

- Cardiac MRI - Dr. Kwong
- Coronary CTA, including post-processing - Dr. Steigner
- MRA Techniques and Practical Applications at the Scanner - Dr. Ersoy
Cardiac MRI: Goals and Expectations for Residents

Knowledge Based Objectives: At the end of the rotation the resident should be able to:

1. Apply the basic principles of coronary physiology, cardiac function, and metabolism in the practice of cardiac MRI.

   Rotation: _____________
   Mastery measured by (circle one of the following): Observation OSCE
   Global rating by faculty Written Exam, ACR in-service, ABR
   Cases reviewed by/with attending Report Signed by attending

2. Have a basic understanding of all common applications of MRI technology as a diagnostic tool in cardiovascular diseases.

   Rotation: ______________
   Mastery measured by (circle one of the following): Observation OSCE
   Global rating by faculty Written Exam, ACR in-service, ABR
   Cases reviewed by/with attending Report Signed by attending

3. Have a rudimentary understanding of the concepts of Bayesian analysis, sensitivity, specificity and test accuracy pertinent to non-invasive evaluation of a wide spectrum of cardiovascular diseases.

   Mastery measured by (circle one of the following): Observation OSCE
   Global rating by faculty Written Exam, ACR in-service, ABR
   Cases reviewed by/with attending Report Signed by attending

4. Have an understanding of current applications of cardiac MRI in myocardial viability and ischemia, valvular dysfunction, non-ischemic cardiomyopathy, and pericardial diseases.

   Rotation: ______________
   Mastery measured by (circle one of the following): Observation OSCE
   Global rating by faculty Written Exam, ACR in-service, ABR
   Cases reviewed by/with attending Report Signed by attending

5. Know the practical aspects of MRI safety associated with performing resting or stress cardiac MRI studies.

   Rotation: ____________
   Mastery measured by (circle one of the following): Observation OSCE
   Global rating by faculty Written Exam, ACR in-service, ABR
   Cases reviewed by/with attending Report Signed by attending
Technical Skills: At the end of the rotation the resident should be able to:

1. Assist in performance of all aspects of cardiac MRI studies under supervision by MRI technologists and attending cardiologists or radiologists.

   Rotation: ____________

   Mastery measured by (circle one of the following): Observation  OSCE

   Global rating by faculty  Written Exam, ACR in-service, ABR

   Cases reviewed by/with attending  Report Signed by attending

2. Assist in the performance of several/all aspects of stress tests, including consent, administration of pharmacologic stress agents, assessment of vital signs and EKG’s, determination of the adequacy of the study and its endpoint and monitoring the patient during recovery.

   Rotation: ______________________

   Mastery measured by (circle one of the following): Observation  OSCE

   Global rating by faculty  Written Exam, ACR in-service, ABR

   Cases reviewed by/with attending  Report Signed by attending

2. Gain experience in various aspects of MRI pulse sequence preparation and contrast administration.

   How much:_____________

   Rotation: ____________

   Mastery measured by (circle one of the following): Observation  OSCE

   Global rating by faculty  Written Exam, ACR in-service, ABR

   Cases reviewed by/with attending  Report Signed by attending

4. Review data and discuss high-risk findings with the attending cardiologist or radiologist.

   Rotation: __________

5. Perform first hand qualitative and quantitative analysis of the MRI imaging data for all clinical cases covering a broad range of clinical diagnostic problems.

   Rotation: __________

   Mastery measured by (circle one of the following): Observation  OSCE

   Global rating by faculty  Written Exam, ACR in-service, ABR

   Cases reviewed by/with attending  Report Signed by attending

6. Present and discuss MRI imaging data findings directly with the attending cardiologist or radiologist.

   Rotation: _________________

5. Be involved under supervision in the daily protocoling and interpretation of a full range of cardiac MRI examinations including cardiac MR imaging for the evaluation of: adult congenital heart disease and indications of adult acquired heart disease, including pericardial disease, ischemic and dilated cardiomyopathies, assessment of myocardial viability, the measurement of infarct size and microvascular obstruction, myocardial perfusion at rest and stress, ventricular morphology, global and regional function at rest and stress, valvular morphology and function, functional evaluation of pre- and post-operative heart disease.
Decision-Marking & Value Judgment Skills: At the end of the rotation, the resident should be able to:

1. Works in a well-coordinated manner with the MRI technologists and nurses in cases involving stress cardiac MR imaging in order to maintain patient throughput and safety.

Mastery measured by (circle one of the following): Observation OSCE
Global rating by faculty Written Exam, ACR in-service, ABR
Cases reviewed by/with attending Report Signed by attending

2. Effectively exchange information with patients, patient family members, medical students, other residents, supervising faculty, referring CV physicians, technologists, nurses, and other members of the health care team.

Mastery measured by (circle one of the following): Observation OSCE
Global rating by faculty Written Exam, ACR in-service, ABR
Cases reviewed by/with attending Report Signed by attending

3. Provide direct communication to the referring physician or appropriate clinical personnel when interpretation reveals an urgent or unexpected finding and document this communication in the radiologic report.

Mastery measured by (circle one of the following): Observation OSCE
Global rating by faculty Written Exam, ACR in-service, ABR
Cases reviewed by/with attending Report Signed by attending

4. Produce a clear and informative written radiologic report, including a precise diagnosis whenever possible, a differential diagnosis when appropriate, and recommended follow-up or additional studies when appropriate.

Mastery measured by (circle one of the following): Observation OSCE
Global rating by faculty Written Exam, ACR in-service, ABR
Cases reviewed by/with attending Report Signed by attending

5. Provide direct communication to the referring physician or appropriate clinical personnel when interpretation reveals an urgent or unexpected finding and document this communication in the radiologic report.

Mastery measured by (circle one of the following): Observation OSCE
Global rating by faculty Written Exam, ACR in-service, ABR
Cases reviewed by/with attending Report Signed by attending
Mastery measured by (circle one of the following): Observation OSCE

Global rating by faculty Written Exam, ACR in-service, ABR

Cases reviewed by/with attending Report Signed by attending

6. Demonstrate skills in obtaining informed consent, including effective communication to patients about procedures, their alternatives, and possible complications.

Rotation: ____________

Mastery measured by (circle one of the following): Observation OSCE

Global rating by faculty Written Exam, ACR in-service, ABR

Cases reviewed by/with attending Report Signed by attending