Resident Core Curriculum  
Non-Invasive Cardiovascular Imaging

**General Goals:** The goals include objectives required for every level of training with graduate levels of supervision and responsibility. All aspects of non-invasive cardiovascular imaging are incorporated into the residency, including cardiac CT and MR, vascular CTA and MRA, and nuclear cardiology. The CV rotation will include imaging of both the heart and the peripheral vascular system. The junior experience will focus on vascular imaging, with transition to a more cardiac focused rotation for the more senior residents. During every rotation, the resident will read the required literature and study the teaching file in non-invasive cardiovascular imaging. Over time, the resident will be progressively more knowledgeable about normal radiographic anatomy, physiology of cardiovascular organs, and the radiological appearances of cardiovascular diseases. In addition, the resident will increasingly understand disease entities, their clinical presentations, and current modes of treatment. Overall the resident will receive training satisfying both ACR guidelines and ACC/AHA Level II guidelines in both Cardiac CT (CCT) and Cardiac MR (CMR). Level II training is the minimal level of training outlined by the ACC/AHA for independent interpretation of cardiac imaging.

**Resident Daily Work Responsibilities (OVERALL BENCHMARKS/OBJECTIVES for Self-Evaluation)**

1. Residents assigned to non-invasive cardiovascular imaging will be available for consultations by technologists, clinicians, and other health care providers, except during conference times, when the attending faculty will cover.
2. Resident questions will be referred to the supervising faculty covering non-invasive cardiovascular imaging.
3. Resident review of cases with the supervising faculty will be conducted as many times in the day as necessary to keep an efficient workflow.
4. All resident examinations will be dictated by the end of every working day.
5. Residents will check and sign his/her reports prior to final verification by supervising faculty.
6. Residents must be familiar with the operation of all imaging equipment.
7. Residents must acquire knowledge of radiation protection and ways to reduce radiation exposure to both patients and hospital personnel. The resident will be supervised to assure that safe practices are followed.
8. Residents will be familiar with divisional CT and MR protocols and refer questions regarding appropriate use of protocols to the supervising faculty.
9. Residents will learn the techniques for performing high quality, state-of-the-art diagnostic examinations. Examinations will be checked before the patient leaves the department if requested to do so by the supervising faculty.
10. Residents must become proficient at detecting abnormalities demonstrated by cross-sectional examinations and be able to generate meaningful differential diagnosis.
11. Residents will become knowledgeable about the use of different radiographic contrast agents (including their indications, contraindications, dosages, and side effects).
12. Residents will acquire an understanding of the proper preparation of patients for examinations and appropriate follow-up afterward. At the start of every working day, the
The resident will be familiar with the patient schedule and anticipate need for any procedures. The resident will check requisitions for the next working day to evaluate for appropriateness of the requested procedure or if additional exams/protocols need to be performed. Absent clinical indication or seemingly inappropriate requests will be clarified and discussed with the referring physician.

13. Residents will do in-depth reading and study, along with a review of teaching file cases, to become knowledgeable about the normal anatomy and physiology of the cardiovascular system and the radiologic appearances of cardiovascular diseases, and gain a general understanding of the disease entities, their clinical presentations, and certain modes of treatment.

14. Residents will serve as a secondary consultant to referring physicians regarding non-invasive cardiovascular imaging. This will strengthen the confidence of the resident in the very important role every radiologist must perform throughout his/her career as a consultant to clinicians.

15. Residents on cardiac focused rotations are expected to be present at the scanner during acquisition, to have reviewed the studies independently, and have prepared a preliminary report prior to interpretation by an attending physician.

16. Residents will keep an independent log of all the cardiac cases which they have reviewed. The log will distinguish which studies the resident individually interpreted and was physically present for the acquisition of images.

17. Residents will become prepared to pass the core examination of the American Board of Radiology.

18. Residents will teach and share knowledge to medical students, radiologic technologist students, and junior residents.

19. Residents will participate in the preparation and presentation of imaging studies at the monthly Interesting Case Conference.

Supervising Faculty Responsibilities:

1. Supervising faculty will be available at all times for any questions or consultations needed by the resident.
2. Supervising faculty will review all cases with the residents before the end of the day.
3. Supervising faculty will provide the resident with constructive feedback in any problem areas encountered during the rotation.
4. Supervising faculty will verify resident-generated reports in a timely manner and inform the resident of any major changes made.

Educational Goals and Objectives (Second Year Residents):

Patient Care:

PCTS1: Consultant

- Demonstrate knowledge of the ACR practice guidelines and technical standards for non-invasive cardiovascular imaging
PCTS2: Competence in Procedures

- Familiarity with the operation of imaging equipment
- Develop a knowledge of the preparation and aftercare required for the common examinations
  - Progress is monitored by:
    - 360° Multi source evaluations
    - Daily performance feedback by faculty
    - Radiation Safety Test
    - Global assessment
    - Review of Case log

Medical Knowledge:
MK1: Protocol Selection and Optimization of Images

- Proficient in the techniques to achieve high-quality diagnostic CT pulmonary angiography, CTA for mesenteric ischemia, CTA for acute dissection and trauma, and peripheral CTA of the upper and lower extremity in order to be prepared for 1590 call.
- Proficient in understanding proper indications, protocling, troubleshooting technical problems with image acquisition, interpretation, appropriateness in high risk patients, such as in pregnancy, renal failure, alternative studies, and dealing with contrast reactions and other complications
- Become knowledgeable about the different contrast agents available and begin to recognize abnormalities that are demonstrated on cross-sectional studies and other imaging modalities
- Demonstrate the ability to recommend additional imaging studies as appropriate to better assess findings on non-invasive cardiovascular imaging studies

MK2: Interpretation of Examination

- Develop a knowledge of normal and abnormal anatomy of the cardiovascular system as demonstrated on contrast studies
- Recognize and develop a knowledge of the differential diagnoses of the more common abnormalities encountered in the cardiovascular system
- Demonstrate the ability to recognize and describe common medical conditions depicted on non-invasive cardiovascular imaging studies
- Familiarity with the basics of MRA interpretation

Educational activities to improve medical knowledge provided during this stage of training are:
  - Review of rotation goals and objectives (at beginning of rotation)
  - One-on one mentoring during the rotation
  - Self-study of materials outlined in the reading list
  - Demonstrate the ability to interpret quality vascular studies on call and whether remediation will be required. If time permits, attend cardiac imaging procedures and readout to begin logging cases
  - Cardiovascular imaging case conferences in AM
  - Cardiovascular imaging didactic noon lectures
  - Monthly Cardiac Imaging noon unknown case conference
  - Annual cardiovascular lecture series.
Journal Clubs
- Interdepartmental conferences (ED, Vascular, HCC, pediatric congenital heart)
- Monthly QA conference

Progress is monitored by:
- 360° Multi source evaluations
- Daily performance feedback by faculty
- Conference Attendance Record
- American College of Radiology in-service exam

System-Based Practice:
SBP1: Quality Improvement (QI)
- The resident will be taught to effectively call on the system resources to provide care of optimal value. Focus will be on the resident to be:
- Able and willing to participate in clinical conferences in which imaging studies are used to guide patient care/evaluations and be able to demonstrate understanding of how imaging relates to the clinical care of the patient

SBP2: Health Care Economics
- Goal is to teach awareness and responsiveness to the larger context and system of health care
- Demonstrate knowledge of ACR appropriateness criteria and cost effective imaging evaluation of common disorders
- Show ability to interact with clinicians regarding cost effective and streamlined evaluation for differing clinical entities
- Self-study of online modules provided by the institution (e.g. Billing, reimbursement)
- Discussion during QA meetings
- Progress is monitored by:
  - 360° Multi source evaluations
  - Performance feedback by faculty
  - Global assessment
  - Annual self-assessment evaluations
  - Semi-annual program director review
  - Attendance monitoring at QA meetings

Practice-Based Learning and Improvement:
PBL11: Patient safety: contrast agents; radiation safety; MR safety; sedation
- Aware of the basic principles of radiation protection in order to reduce as much as possible the radiation dose to the patient and reduce exposure to healthcare providers
- Understand the indications for and contraindications to use of intravenous radiographic contrast, and be able to monitor its administration
- Recognize and treat reactions to intravenous contrast
- Understand the indications and contraindications to the different types of contrast, dosages, side effects, and the differences and relative merits of single and double contrast studies.
- List the risk factors for allergic reaction to intravenous contrast media
- State the proper assessment and treatment for allergic reactions to contrast media
PBL12: Self-Directed Learning

- Develop ability to investigate their own patient care
- Show evidence of independent study using textbooks, learning materials from reading list, and journal articles
- Demonstrate appropriate follow up of interesting cases
- Research interesting cases as directed by faculty
- Identify, rectify, and learn from personal errors
- Incorporate feedback into improved performance
- Efficiently use electronic and print sources to access information
- Appraisal and assimilation of scientific evidence and improvements in patient care

Educational activities to foster self-directed learning provided during this stage of training are:
  - One-on one mentoring during the rotation
  - Self-study of teaching modules provided by the faculty during the rotation
  - Cardiovascular imaging case conferences in AM
  - Cardiovascular imaging didactic noon lectures
  - Monthly Cardiac Imaging noon unknown case conference
  - Annual cardiovascular lecture series.
  - Journal Clubs
  - Monthly QA conference

- Progress is monitored by:
  - 360° Multi source evaluations
  - Annual Self Assessment evaluations

Professionalism:
PROF1: Professional Values and Ethics

- The overriding goal is to teach the resident to practice compassionate, appropriate and effective care for the treatment of disease.
- Goal is to develop an unwavering commitment to
  - Ethical principles
  - Carrying out professional activities
  - Being sensitive to diverse patient populations
- Demonstrate respect for patients, families, and all members of the healthcare team and be able to discuss significant radiology findings
- Explain the impact of the radiology findings on patient care, including what imaging studies may/may not be appropriate
- Respect patient confidentiality at all times
- Present oneself as a professional in appearance and communication
- Demonstrate a responsible work ethic with regard to work assignments
- Patient confidentiality and HIPAA compliance are key concepts.

Educational activities to foster professionalism and etiquette provided during this stage of training are:
  - One-on one mentoring during the rotation,
  - Self-study of online modules provided by the institution
Discussion during resident meetings
- Conference attendance

Progress is monitored by:
  - 360° Multi source evaluations
  - Conference attendance record
  - Performance feedback by faculty

Interpersonal and Communication Skills:
ICS1: Effective Communication with Patients, Families, and Care Givers
- Effective information exchange between patients, their families and other health care professionals is taught and enforced during every step of NICV training.
- Communicate with the patient and family members before during and after the examination to ensure that patient remains comfortable and informed about progress.
- Adequately explain each examination to the patient in order to ensure that the patient feels comfortable and to provide patient care that is compassionate, appropriate, and effective

ICS2: Effective Communication with Members of the Health Care Team
- Communicate effectively with all members of the health care team (technologists, medical students, fellows, residents, allied health providers, support staff, and attending physicians/radiologists)
- Call results to the referring physicians and show ability to interact with referring physicians
- Interact with clinicians when reviewing cases involving radiographs and non-invasive cardiovascular imaging studies and show ability to provide preliminary readings, follow up with attending radiologists, formulate a diagnostic plan for complex cases, and communicate any changes to referring clinicians
- Use the PACS, voice recognition systems, and hospital information systems to become proficient in dictating reports of significant radiographic findings in a concise and clear manner

Progress is monitored by:
  - 360° Multi source evaluations
  - American Board of Radiology oral exam
  - Performance feedback by faculty

Monitoring and Assessment of Resident Performance

The resident’s progress will be monitored by the attending radiologists on the service on a daily basis and immediate feedback will be given. At the end of each rotation, the resident will receive a consensus evaluation of performance from faculty on service. Deficiencies or substandard performance will be discussed personally and privately with the resident and will be brought to the attention of the Residency Program Director by the attending radiologist if deemed necessary. Resident performance is also evaluated through direct observation, case logs,
multi-source professional evaluations, structured case discussion, review of patient outcomes, and other performance evaluation methods as outlined in detail above.

Reading List:

1. Valji K. Vascular and Interventional Radiology, 2nd edition, Saunders, 2006 (relevant chapters for this rotation only)(Book in radiology library available)


Educational Goals and Objectives (Third Year Residents):

The objectives above as well as the following:

Patient Care:
PCTS1: Consultant

- Familiarity with available and relevant medical records and how to access them for the purposes of patient care
- Interact with clinicians when reviewing cases involving radiographs and non-invasive cardiovascular imaging studies and show ability to provide preliminary readings, follow up with attending radiologists, formulate a diagnostic plan for complex cases, and communicate any changes to referring clinicians

PCTS2: Competence in Procedures

- Develop a knowledge of the preparation and aftercare required for more complex procedures
- Continue to improve skills for performing non-invasive cardiovascular examinations, and tailor examinations to answer all questions being asked by the clinician; anticipate those questions that should have been asked but were not

Educational activities to foster development of a compassionate, appropriate and effective approach to patient care provided during this stage of training are:

- One-on one mentoring during the rotation,
- Interdepartmental conferences (ED, Vascular, HCC, nuclear cardiology, pediatric congenital heart)
- Self-study of materials outlined in the reading list
- Cardiovascular imaging case conferences in AM
- Cardiovascular imaging didactic noon lectures
- Monthly Cardiac Imaging noon unknown case conference
- Annual cardiovascular lecture series.
- Journal Clubs
- Monthly QA conference

- Progress is monitored by :
  - 360° Multi source evaluations
  - Daily performance feedback by faculty
  - Radiation Safety Test
  - Global assessment
  - Review of Case log

Medical Knowledge:

MK1: Protocol Selection and Optimization of Images

- Recommend the appropriate study based on the clinical scenario and understand the relative strengths of each modality (eg. CT versus MRI versus ultrasound versus angiography)
• Detect abnormalities while the procedures are in progress, such as 1) disease recognition skills will continue to increase on plain radiographs and contrast studies, and 2) begin to develop meaningful differential diagnoses for the pathology that is found
• Understand the physics of cardiac CT and MR with respect to image optimization
• Familiarity with image post-processing of CTA and MRA data including MPR, MIPs, volume rendering, vessel tracking and analysis
• Understand the physics of radiation protection and how to apply it to routine studies
• Demonstrate knowledge of indications for the examinations requested (when the reason for the examination is not clear, the resident will effectively communicate with the patient and referring physician until clarified)
• Protocol cases, in consultation with the attending, to assure that the examination is appropriate and of sufficient quality to address the clinical concerns of the patient and referring physician
• Understand protocoling, MR sequence selection, imaging acquisition troubleshooting and contrast media injection protocols

MK2: Interpretation of Examinations
• Familiarity with the anatomy and pathology of the organs examined in every case
• Familiarity with imaging findings of common and uncommon acute and chronic cardiovascular diseases, the basics of a variety of therapies, and indications including stent grafting and bypass surgery
• Identify pathology in order to interpret routine non-invasive cardiovascular studies with accuracy, appropriate to the level of training when presenting to the attending
• Distinguish between normal and abnormal cardiovascular anatomy to level of training when presenting to the attending
• Focus on advanced vascular imaging with CT and MR and basics of cardiac CT and MR
• Interpret advanced vascular CT and MR exams of the thoracic and abdominal vessels as well as run-off vessels for vascular disease
• Review all studies with the supervisor faculty attending
• Demonstrate the ability to interpret quality vascular studies on call and whether remediation will be required. If time permits, attend cardiac imaging procedures and readout to begin logging cases

Educational activities to improve medical knowledge provided during this stage of training are:
  o Review of rotation goals and objectives (at beginning of rotation)
  o One-on one mentoring during the rotation,
  o Self-study of materials outlined in the reading list
  o Cardiovascular imaging case conferences in AM
  o Cardiovascular imaging didactic noon lectures
  o Monthly Cardiac Imaging noon unknown case conference
  o Annual cardiovascular lecture series.
  o Journal Clubs
    o Interdepartmental conferences (ED, Vascular, HCC, pediatric congenital heart)
    o Monthly QA conference
• Progress is monitored by:
Systems-Based Practice:

SBP1: Quality Improvement (QI)
- Goal is to further teach and enhance awareness and responsiveness to the larger context and system of health care
- The resident will be taught to effectively call on the system resources to provide care of optimal value.
- Familiarity with departmental procedures, contrast safety, and sedation required in the performance of examinations
- Make suggestions to improve methods and systems utilized in radiology whenever appropriate
- Able and willing to participate in clinical conferences in which imaging studies are used to guide patient care/evaluations and be able to demonstrate understanding of how imaging relates to the clinical care of the patient
- Demonstrate knowledge of the ACR practice guidelines and technical standards for non-invasive cardiovascular imaging

SBP2: Health Care Economics
- Show ability to interact with clinicians regarding cost effective and streamlined evaluation for differing clinical entities
- Explain the impact of the radiology findings on patient care, including what imaging studies may/may not be appropriate
- Demonstrate knowledge of ACR appropriateness criteria and cost effective imaging evaluation of common disorders

Educational activities to enhance systems-based practice provided during this stage of training are:
- One-on one mentoring during the rotation,
- Self-study of online modules provided by the institution (e.g. Billing, reimbursement)
- Discussion during resident meetings
- Discussion during QA meetings

Progress is monitored by:
- 360° Multi source evaluations
- Performance feedback by faculty
- Global assessment
- Annual self-assessment evaluations
- Semi-annual program director review
- Attendance monitoring at QA meetings
Practice-Based Learning and Improvement

PBL12: Self-Directed Learning
- Goal is to further develop ability to investigate their own patient care
- Demonstrate appropriate follow up of interesting cases
- Research interesting cases as directed by faculty
- Identify, rectify, and learn from personal errors
- Incorporate feedback into improved performance
- Efficiently use electronic and print sources to access information
- Appraisal and assimilation of scientific evidence and improvements in patient care
- Demonstrate evidence of independent reading and learning through use of printed and electronic resources
- Follow up on abnormal or interesting cases through personal communication with the referring physician or patient medical records
- Log cardiac cases, be present for the acquisition of as many cases and cardiac readouts as possible
- Able and willing to participate in multi-disciplinary clinical conferences in which imaging studies are used to guide patient care/evaluations and be able to demonstrate understanding of how imaging relates to the clinical care of the patient

Educational activities to foster learning practice-based learning provided during this stage of training are:
- One-on one mentoring during the rotation,
- Self-study of teaching modules provided by the faculty during the rotation,
- Cardiovascular imaging case conferences in AM
- Cardiovascular imaging didactic noon lectures
- Monthly Cardiac Imaging noon unknown case conference
- Annual cardiovascular lecture series.
- Journal Clubs
- Monthly QA conference
- Attendance of interdepartmental conferences (Vascular, ED, Hepatoma, Nuclear Cardiology, Cardiac Imaging)

- Progress is monitored by:
  - 360° Multi source evaluations
  - Annual Self-Assessment evaluations

Professionalism:
PROFI: Professional Values and Ethics
- Goal is to enhance and further develop an unwavering commitment to
  - Ethical principles
  - Carrying out professional activities
  - Being sensitive to diverse patient populations
- Demonstrate respect for patients, families, and all members of the healthcare team and be able to discuss significant radiology findings
- Respect patient confidentiality at all times
- Present oneself as a professional in appearance and communication
- Demonstrate a responsible work ethic with regard to work assignments
- Patient confidentiality and HIPAA compliance are key concepts.

Educational activities to foster professionalism and etiquette provided during this stage of training are:
  - One-on-one mentoring during the rotation,
  - Self-study of online modules provided by the institution
  - Discussion during resident meetings
  - Conference attendance

- Progress is monitored by:
  - 360° Multi source evaluations
  - Conference attendance record
  - Performance feedback by faculty

**Interpersonal and Communication Skills:**

**ICS1: Effective Communication with Patients, Families, and Care Givers**
- Obtain consent for more complex procedures and answer all questions the patient may have
- Improve effective information exchange between patients, their families and other health care professionals is taught and enforced during every step of NICV training
- Communicate with the patient and family members before during and after the examination to ensure that patient remains comfortable and informed about progress

**ICS2: Effective Communication with Members of the Health Care Team**
- Call results to the referring physicians and show ability to interact with referring physicians
- Communicate effectively with all members of the health care team (technologists, medical students, fellows, residents, allied health providers, support staff, and attending physicians/radiologists)
- Use appropriate language in communicating to clinicians through reports or consultations so proper management decisions can be made
- Competent in using PACS, voice recognition systems, and the hospital patient information systems in the daily accomplishment of the workload and instruct others in their use
- Produce concise reports that include all relevant information
- Communicate effectively the results of studies to referring clinicians whenever needed (for emergent studies, this will be accomplished in a timely manner)
- Effectively convey the findings of examinations through accurate dictation of reports
- Provide preliminary reports to all referring clinicians if needed before the final review of cases (when there is a significant discrepancy between the preliminary reading and final reading, the resident will notify the referring clinician immediately)
- Dictate and correct reports in a timely fashion to avoid delay in patient disposition
- Thorough dictations will be made with indications, techniques, findings, and conclusions
Educational activities to foster learning practice-based learning provided during this stage of training are:

- One-on-one mentoring during the rotation,
- Self-study of teaching modules provided by the institution (Patient confidentiality/HIPAA)
- Discussion during resident meetings

- Progress is monitored by:
  - 360° Multi source evaluations
  - American Board of Radiology oral exam
  - Performance feedback by faculty

**Monitoring and Assessment of Resident Performance**

The resident’s progress will be monitored by the attending radiologists on the service on a daily basis and immediate feedback will be given. At the end of each rotation, the resident will receive a consensus evaluation of performance from faculty on service. Deficiencies or substandard performance will be discussed personally and privately with the resident and will be brought to the attention of the Residency Program Director by the attending radiologist if deemed necessary. Resident performance is also evaluated through direct observation, case logs, multi-source professional evaluations, structured case discussion, review of patient outcomes, and other performance evaluation methods as outlined in detail above.

**Reading List:**


Educational Goals and Objectives (Fourth Year Residents):

The above objectives as well as the following:

Patient Care:
PCTS1: Consultant
- Demonstrate knowledge of the ACR practice guidelines and technical standards for non-invasive cardiovascular imaging
- Familiarity with available medical records and how to access them for the purposes of patient care
- Explain the impact of the radiology findings on patient care, including what imaging studies may/may not be appropriate
- Act as a consultant in non-invasive cardiovascular radiology to the clinical services

PCTS2: Competence in Procedures
- Perfect diagnostic examination techniques and be very skilled and efficient in performing and interpreting all diagnostic procedures performed
- Know the proper preparation of patients for diagnostic procedures and the appropriate follow-up afterwards

Educational activities to foster development of a compassionate, appropriate and effective approach to patient care provided during this stage of training are:
- One-on-one mentoring during the rotation,
- Interdepartmental conferences (Nuclear Cardiology, Cardiac Catheterization, Echocardiography, pediatric congenital heart)
- Self-study of materials outlined in the reading list
- Cardiovascular imaging case conferences in AM
- Cardiovascular imaging didactic noon lectures
- Monthly Cardiac Imaging noon unknown case conference
- Annual cardiovascular lecture series.
- Journal Clubs
- Monthly QA conference

- Progress is monitored by:
  - 360° Multi source evaluations
  - Daily performance feedback by faculty
  - Radiation Safety Test
  - Global assessment
  - Review of Case log

Medical Knowledge:
MK1: Protocol Selection and Optimization of Images
- Be present at the CT and MR scanner for all cardiac studies with regards to ECG gating, protocol selection, MR sequence selection and parameter manipulation (e.g. TE, TR, TI, FOV, etc), pharmaceutical administration, contrast media injection protocols, and general image optimization including artifact troubleshooting
• Development of advance image post-processing including cardiac volumetric and functional calculations, analysis of velocity encoded imaging, and coronary vessel tracking and analysis
• Protocol cases, in consultation with the attending, to assure that the non-invasive cardiovascular examination is appropriate and of sufficient quality to address the clinical concerns of the patient and referring physician
• Become proficient in detecting abnormalities on plain radiographs and contrast studies while in progress
• Observe the acquisition and processing of nuclear cardiology studies
• Demonstrate knowledge of indications for the examinations requested (when the reason for the examination is not clear, the resident will effectively communicate with the patient or referring physician until clarified)

MK2: Interpretation of Examination
• Develop a thorough knowledge of the differential diagnosis of abnormalities encountered in non-invasive cardiovascular studies
• Relate the imaging findings to the clinical condition and its pathology
• Understand the clinical management of the conditions encountered
• Familiarity with the anatomy of the organs examined in every case
• Familiarity with imaging findings of common acute and chronic non-invasive cardiovascular diseases
• Identify pathology in order to interpret non-invasive cardiovascular imaging studies with accuracy appropriateness to the level of training when presenting to the attending
• Distinguish between normal and abnormal cardiovascular anatomy with excellent accuracy according to the level of training when presenting to the attending and demonstrate improvement compared to the prior rotation
• Development of appropriate differential diagnostic lists will be well advanced
• Obtain a broad understanding of cardiovascular diseases, their clinical features, radiographic manifestations, and current modes of treatment
• Demonstrate the ability to interpret quality vascular studies on call and whether remediation will be required. If time permits, attend cardiac imaging procedures and readout to begin logging cases
• Complete a minimum of 50 exams each of CCT and CMR performed and primarily interpreted and a minimum of 150 cases each of CCT and CMR reviewed with mentor
• Complete 40 hrs each of CME for CCT and CMR with some of the time covered by current lectures in the radiology curriculum including: physics, anatomy, physiology, and pathology and independent study if accreditation as ACC/SCMR Level II reader is desired by resident and elective cardiac rotation time is chosen.
• Focus on cardiac imaging, including cardiac CT and MR as well as nuclear cardiology. Residents must attend nuclear cardiology checkout at the scheduled time Monday through Friday
• Review all studies with the supervising faculty attending
• Assist in covering vascular imaging studies as needed per clinical workload

Educational activities to improve medical knowledge provided during this stage of training are:
Review of rotation goals and objectives (at beginning of rotation)
- One-on-one mentoring during the rotation
- Attendance of daily nuclear cardiology readouts
- Self-study of materials outlined in the reading list and literature list in addendum
- Cardiovascular imaging case conferences in AM
- Cardiovascular imaging didactic noon lectures
- Monthly Cardiac Imaging noon unknown case conference
- Annual cardiovascular lecture series.
- Journal Clubs
- Interdepartmental conferences (Nuclear Cardiology, Cardiac Catheterization, Echocardiography, pediatric congenital heart)
- Monthly QA conference

Progress is monitored by:
- 360° Multi-source evaluations
- Daily performance feedback by faculty
- Conference Attendance Record
- American College of Radiology in-service exam

Systems-Based Practice:
**SBP1: Quality Improvement (QI)**
- Familiarity with departmental procedures, contrast safety, and sedation required in the performance of examinations

**SBP2: Health Care Economics**
- Teach and enhance awareness and responsiveness to the larger context and system of health care
- The resident will be taught to effectively call on the system resources to provide care of optimal value
- Able and willing to participate in clinical conferences in which imaging studies are used to guide patient care/evaluations and be able to demonstrate understanding of how imaging relates to the clinical care of the patient
- Demonstrate knowledge of ACR appropriateness criteria and cost-effective imaging evaluation of common disorders
- Show ability to interact with clinicians regarding cost-effective and streamlined evaluation for differing clinical entities
- Make suggestions to improve methods and systems utilized in radiology whenever appropriate
- Able and willing to participate in multi-disciplinary clinical conferences in which imaging studies are used to guide patient care/evaluations and be able to demonstrate understanding of how imaging relates to the clinical care of the patient

Educational activities to enhance systems-based practice provided during this stage of training are:
- One-on-one mentoring during the rotation,
- Self-study of online modules provided by the institution (e.g. Billing, reimbursement)
Discussion during resident meetings
Discussion during QA meetings

- Progress is monitored by:
  - 360° Multi source evaluations
  - Performance feedback by faculty
  - Global assessment
  - Annual self-assessment evaluations
  - Semi-annual program director review
  - Attendance monitoring at QA meetings

Practice-Based Learning and Improvement:

**PBL12: Self-Directed Learning**

Goal is to further develop ability to investigate their own patient care

- Demonstrate appropriate follow up of interesting cases
- Research interesting cases as directed by faculty
- Identify, rectify, and learn from personal errors
- Incorporate feedback into improved performance
- Efficiently use electronic and print sources to access information
- Appraisal and assimilation of scientific evidence and improvements in patient care
- Demonstrate evidence of independent reading and learning through use of printed and electronic resources
- Follow up on abnormal or interesting cases through personal communication with the referring physician or patient medical records
- Log cardiac cases, be present for the acquisition of as many cases and cardiac readouts as possible
- Attend nuclear cardiology daily checkout and supplement didactic and view box teaching with background reading as outlined in the nuclear cardiology curriculum.

Educational activities to foster learning practice-based learning provided during this stage of training are:

- One-on one mentoring during the rotation,
- Self-study of teaching modules provided by the faculty during the rotation,
- Cardiovascular imaging case conferences in AM
- Cardiovascular imaging didactic noon lectures
- Monthly Cardiac Imaging noon unknown case conference
- Annual cardiovascular lecture series.
- Journal Clubs
- Monthly QA conference
- Attendance of interdepartmental conferences (Vascular, ED, Hepatoma, Nuclear Cardiology, Cardiac Imaging)

- Progress is monitored by:
  - 360° Multi source evaluations
  - Annual self-assessment evaluations
Professionalism:

PROF1: Professional Values and Ethics
Goal is to enhance and further develop an unwavering commitment to
- Ethical principles
- Carrying out professional activities
- Being sensitive to diverse patient populations
- Demonstrate respect for patients, families, and all members of the healthcare team and be able to discuss significant radiology findings
- Respect patient confidentiality at all times
- Present oneself as a professional in appearance and communication
- Demonstrate a responsible work ethic with regard to work assignments
- Patient confidentiality and HIPAA compliance are key concepts.

Educational activities to foster professionalism and etiquette provided during this stage of training are:
- One-on-one mentoring during the rotation,
- Self-study of online modules provided by the institution
- Discussion during resident meetings
- Conference attendance
- Progress is monitored by:
  - 360° Multi source evaluations
  - Conference attendance record
  - Performance feedback by faculty

Interpersonal Skills:

ICS1: Effective Communication with Patients, Families, and Care Givers
Goal is to further improve effective information exchange between patients, their families and other health care professionals is taught and enforced during every step of NICV training.
- Appropriately obtain informed consent
- Communicate with the patient and family members before during and after the examination to ensure that patient remains comfortable and informed about progress.

ICS2: Effective Communication with Members of the Health Care Team
- Communicate effectively with all members of the health care team (technologists, medical students, fellows, residents, allied health providers, support staff, and attending physicians/radiologists)
- Call results to the referring physicians and show ability to interact with referring physicians
- Use appropriate language in communicating to clinicians through reports or consultations so proper management decisions can be made
- Thorough dictations will be made with indications, techniques, findings, and conclusions
- Dictate and correct reports in a timely fashion to avoid delay in patient disposition
- Competent in using PACS, voice recognition systems, and the hospital patient information systems in the daily accomplishment of the workload and instruct others in their use
- Produce concise reports that include all relevant information
• Communicate effectively with all members of the healthcare team
• Communicate effectively the results of studies to referring clinicians whenever needed (for emergent studies, this will be accomplished in a timely manner)
• Effectively convey the findings of examinations through accurate dictation of reports
• Provide preliminary reports to all referring clinicians if needed before the final review of cases (when there is a significant discrepancy between the preliminary reading and final reading, the resident will notify the referring clinician immediately)
• Interact with clinicians when reviewing cases involving radiographs and non-invasive cardiovascular imaging studies and show ability to provide preliminary readings, follow up with attending radiologists, formulate a diagnostic plan for complex cases, and communicate any changes to referring clinicians
• Assist with supervision and teaching of medical and radiology technologist students

Educational activities to foster learning practice-based learning provided during this stage of training are:
  o One-on-one mentoring during the rotation,
  o Self-study of teaching modules provided by the institution (Patient confidentiality/HIPAA)
  o Discussion during resident meetings
• Progress is monitored by:
  o 360° Multi-source evaluations
  o American Board of Radiology oral exam
  o Performance feedback by faculty

Monitoring and Assessment of Resident Performance

The resident’s progress will be monitored by the attending radiologists on the service on a daily basis and immediate feedback will be given. At the end of each rotation, the resident will receive a consensus evaluation of performance from faculty on service. Deficiencies or substandard performance will be discussed personally and privately with the resident and will be brought to the attention of the Residency Program Director by the attending radiologist if deemed necessary. Resident performance is also evaluated through direct observation, case logs, multi-source professional evaluations, structured case discussion, review of patient outcomes, and other performance evaluation methods as outlined in detail above.

Reading List:


6. Cardiac MR Article List (see addendum)

Other Requirements/Expectations
CTA/MRA Call

The on-call Vascular Imaging attending can be paged at 9886 (RADIOLOGY NICV ATTEND OC). If for any reason you are unable to reach the on-call attending by paging, please call their cell phone or home phone (can be obtained from the hospital operator).

1232 Call:
The 1232 call resident (Senior resident) will interpret and dictate CTA and MRA studies performed from 5p - 8p during the weekdays (M-F). The 1232 resident will send the dictations to the cue of the on call Vascular Imaging attending. The on call Vascular Imaging attending is the vascular attending covering the following day (in dark blue on NCV schedule). The 1232 resident will protocol all CTA and MRA presented to them during their shift. If the 1232 has a concern or question regarding a protocol or the interpretation of study, they are to contact the on call attending.

On weekends, the 1232 resident will continue to protocol, interpret and dictate CTA studies from 8a - 9p Sat and Sun. They will also be responsible for interpretation of MRA studies performed during the weekend hours. The 1232 call resident should send studies to the on call attending covering Vascular Imaging for the entire weekend (in dark blue on attached schedule). If there is a question regarding a study during this time, the resident should contact the on call attending covering Vascular imaging for the weekend.

1590 Call:
The 1590 call resident will continue to interpret and dictate CTA studies performed from 8p - 8a during weekday and weekends. The 1590 resident will send the dictations to the cue of the Vascular Imaging attending covering the following day (in dark blue on attached schedule). If there are any questions with a study, they should contact the on call attending.

Additionally, the 1590 resident will protocol vascular MRA. The resident will give preliminary reads on these studies when asked by the clinical team, similar to MR for other divisions. If the resident feels uncomfortable with the prelim, then the on-call attending (attending on vascular imaging the next day) should be contacted. They must dictate the preliminary interpretation and send it to the on call attending’s cue. Alternatively, they may dictate the full study and send it to the attending’s cue.
Please send dictations to the attending's cue rather than using the dummy cue. Remember to NOT include the attending's name when in the preliminary state. The attending will add his name at the time of final signing. The call schedule will be posted in the NCV reading room. It will also be available on QGenda.

Vacation Policy
Residents may request vacation up to two weeks prior to the beginning of the rotation. The primary resident on the rotation requires coverage at all times. If there are multiple residents on the service for a given rotation, the need for coverage will be at the discretion of the division. As per residency policy, residents are not allowed more than 1 week total away from the rotation over the course of their residency. Additionally, residents are highly discouraged from taking vacation during their first rotation as preparation for 1590 call is paramount.

Core Knowledge Presentation Topics

Overview
The CV rotation will include imaging of both the heart and the peripheral vascular system. The focus of the rotation will vary depending on the resident's level of training and type of rotation (required, elective, focus time) as outlined below. The junior experience will focus on vascular imaging, with transition to a more cardiac focused rotation for the more senior residents. A joint read out with cardiology will continue for both cardiac CT and cardiac MR. This will occur at a predetermined time each day. Residents on rotations with a cardiac focus are expected to be present at the scanner during acquisition and to have reviewed the studies independently and have prepared a preliminary report prior to interpretation by an attending physician. All residents will keep an independent log of all the cardiac cases which they have reviewed. This log should also distinguish which studies the resident individually interpreted and was physically present for the acquisition of images.

Residents who wish to qualify for accreditation by the ACC/SCMR as a level II cardiac CT and MR reader will have to choose cardiac imaging as an elective or focus time during the 4th year and will need to meet the following requirements:

Cardiac CT and MR Education
- Minimum of 50 exams each of CCT and CMR performed and primarily interpreted
- Minimum of 150 cases each of CCT and CMR reviewed with mentor
- 40 hrs each of CME for CCT and CMR. Some of this time will be covered by current lectures in the radiology curriculum.
  - Lectures
    - Physics
    - Anatomy
    - Physiology
    - Pathology
  - Independent study
    - Teaching file
    - Web-based
- Case Review books
- DVD
- Required reading
  - Written and oral assessment of knowledge base and skill set
Addendum:

The following Cardiac MR Reading List is available to all residents wishing to gain more knowledge in cardiac MRI:

**CMR Article List  *=10 most important**


Updated 4/1/2015