Florida Hospital Diagnostic Radiology Residency
Cardiothoracic Radiology Goals and Objectives
Training Location: FRi Princeton

Many of the goals and objectives apply to all rotations and are listed below. Those goals that are more specific to a particular rotation are listed separately.

Cardiothoracic Imaging Curriculum

The educational curriculum in Cardiothoracic Imaging is comprised primarily of the rotations through the Cardiothoracic Imaging Section at FRi Princeton where the Faculty provide direct training and supervision; as well as, a comprehensive series of lectures and conferences in Cardiothoracic Imaging. Correlation is made on a case-by-case basis with other imaging modalities, facilitated by the PACs system. A series of interdepartmental conferences, grand rounds, Journal Clubs, meetings and other venues are expected to enhance the residents’ knowledge of Cardiothoracic Imaging.

Because a full outline of disease entities and conditions is provided under each organ system elsewhere in the Radiology Residency Curriculum, a summarized curriculum for the Cardiothoracic Imaging Section follows:

- A review of the principles of physics and instrumentation/technology.
- A review of the normal anatomy, physiology, pathology and clinical conditions that are evaluated by CT, and MRI.
- The indications, limitations, contraindications and optimal protocols for the various studies, diseases, conditions, as well as, the optimal sequencing of various imaging studies is reviewed.
- The use, delivery systems, timing and dosages of intracavitary and intravenous contrast material is reviewed including any appropriate patient preparation, indications, contraindications, and the physiology and pathophysiology of contrast materials. The recognition and treatment of any allergic, chemotoxic reactions, or other adverse reactions is reviewed. The characteristic appearance of contrast during imaging in various normal and pathologic conditions is reviewed.
- The ACR appropriateness criteria and the economic implications for the health care system and patient of various diagnostic pathways are reviewed as appropriate

Daily Required Reading Minimum

On all rotations, residents are required to read a minimum of cases per day. Please see your preceptor at the beginning of your Chest/Thoracic rotation to discuss the requirements.
Training using the ACGME Six-Core Competencies:

Year 1: Cardiothoracic Radiology

1) Patient Care: At the end of the rotation, the resident should be able to:
   • Gather clinical and radiological data on patients with thoracic disease
   • Develop diagnostic plan based on the clinical presentation and prior imaging
   • Demonstrate basic knowledge of PACS and chest equipment including basic MDCT theory
   • Aid technologist in performing the correct x-ray/CT exam responsibility and safely, assuring that the correct exam is ordered and performed
   • Demonstrate the ability to use the internet as an educational instrument
   • Perform chest fluoroscopy

Milestones include:
   - Using established evidence based guidelines such as ACR appropriateness criteria
   - Appropriately use the electronic health record to obtain relevant clinical information
   - Competently perform basic fluoro studies under indirect supervision
   - Recognize and manage complications of basic procedures

2) Medical Knowledge: At the end of the rotation, the resident should be able to:
   • Demonstrate knowledge of normal chest anatomy and appropriate positions for tubes, catheters and other medical devices on chest image
   • Demonstrate ability to diagnose common conditions (e.g. collapsed lobes) and life threatening conditions (e.g. pneumothorax) on chest radiographs
   • Demonstrate a clinical appropriate diagnostic treatment plan
   • Demonstrate the proper use of radiological equipment such as fluoroscopy equipment and to obtain special radiographic views
   • Understand cardiac and aortic arch great vessel anatomy and the physiological basis for common diseases (e.g. congestive heart failure with pulmonary edema, pulmonary hypertension, pleural effusions with pulmonary collapse, pericardial effusions with tamponade) and understand the plain image findings in common diseases of the heart and great vessels

Work training
   • 1st year should mainly focus primarily on chest x-rays with minimal CT. No cardiac exams.
   • During Cardio (Chest) 2-week rotation – spend a half a day each Friday with a tech, one day on CT, one day on plain films.

Required Reading List:
   • Fundamentals of Diagnostic Radiology (Brant & Helms) Cardiovascular and pulmonary chapters
   • High Resolution CT of the Lung (Webb, Muller, Naidich) – Chapters 1-3 (Basic technique, normal anatomy and overview of HRCT descriptors)
   • Cardiac Imaging – Case Review Series
   • Cardiac Imaging – The Requisites
Chest Radiology: Plain Film Patterns and Differential Diagnosis

Milestones include:
- Selecting appropriate protocol and contrast agent/dose for basic flouro and CT procedures
- Makes core observations
- Formulate differential diagnoses
- Recognize critical findings
- Differentiate normal from abnormal

3) Practice-Based Learning and Improvement: At the end of the rotation, the resident should be able to:
- Review all cases and dictate a preliminary report. Then review your interpretation with faculty and then correct report as needed before sending it to the faculty members report queue
- Share good learning cases and missed diagnosis with others in the department through conferences

Milestones include:
- Recognizes and manages contrast reactions
- Describes the mechanism of radiation injury and the ALARA concept
- Documents training in critical thinking skills and research design

4) Interpersonal and Communication Skills: At the end of the rotation, the resident should be able to:
- Provide a concise report to include observations, description of findings and differential diagnoses based on clinical data
- Provide direct communication to referring physicians or their appropriate representative, and document communication in the report for emergent or important unexpected findings
- Demonstrate the verbal and non-verbal skills necessary for face-to-face listening and speaking to physicians, families, and support personnel

Milestones include:
- Communicating information about imaging and examination results in routine, uncomplicated cases
- Obtains informed consent
- Adhere to transfer of care policies
- Generates accurate reports with appropriate elements for coding
- Communicates urgent and unexpected findings per RSF policy

5) Professionalism: At the end of the rotation, the resident should be able to:
- Demonstrate altruism
- Demonstrate compassion (be understanding and respectful of patient, their families, and medical colleagues, technologists, nurses, IT, clerical staff)
- Demonstrate excellence: perform responsibilities at the highest level and continue active learning throughout one’s career
- Demonstrate honesty with patients and staff
• Demonstrate honor and integrity: avoid conflict of interests when accepting gifts from patients and vendors
• Demonstrate sensitivity without prejudice on the basis of religious, ethnic, sexual or educational differences, and without employing sexual or other types of harassment
• Demonstrate knowledge of issues of impairment
• Demonstrate positive work habits, including punctuality and professional appearance
• Demonstrate the broad principles of biomedical ethics
• Demonstrate principles of confidentiality with all information transmitted during a patient encounter
• Teaching of medical students

Milestones include:
- Recognizing the importance and priority of patient care and advocates for patient interests
- Fulfills work related responsibilities
- Recognizes personal limitations and seeks help when appropriate
- Responds appropriately to constructive criticism
- Maintains patient confidentiality
- Attends required meetings

6) Systems-Based Practice: At the end of the rotation, the resident should be able to:
• Demonstrate ability to design cost-effective care plans via a case example
• Demonstrate knowledge of the regulatory environment

Milestones include:
- Describes departmental QI initiatives
- Describes the departmental QA system

**Year 2: Cardiothoracic Radiology**

1) Patient Care: At the end of the rotation, the resident should be able to:
• Correlate physical findings by other clinicians with radiographic findings
• Based on your radiographic findings and the clinical setting, guide clinicians in the appropriate use of thoracic imaging techniques such as high resolution CT, MR of cardiac and great vessels and nuclear procedures such as PET-CT
• Refine interpretive skills with complex pathology
• Better perform the Cardiothoracic studies listed in the first rotation now to include the interpretation of HRCT and thoracic CTA studies
• Identify the abnormality at fluoroscopy and modify the technique or change the patient’s position or obtain special views or perform special maneuvers to obtain diagnostic fluoroscopic spot films
• Decreasing fluoroscopic time needed to perform a study without compromising diagnostic accuracy
• Demonstrate competence when evaluating and integrating data from other studies (CT, MRI, sonography and nuclear medicine) and make appropriate recommendations to the referring physician about more appropriate or additional diagnostic studies needed for evaluation of the patient’s abnormality
• Be able to direct the choice of imaging modality and protocol emergent studies
• Understand when referral or other imaging modalities are necessary
• Understand the basic physics of MR including TR, TE, T1W, Spin echo, Gradient Recall Echo imaging. Steady State Free Precession and Inversion Recovery techniques
• Understand the basic physics of MDCT and appropriate dose reduction techniques
• Learn the basic principles of contrast distribution, particularly as applied to arterial and venous phase scanning
• Learn to recognize and treat contrast reactions
• Develop skills in interpretation of basic cardiac pathology
• Learn the appropriate format for dictation of cardiac reports

Milestones include:
- Recommends appropriate imaging of common conditions independently
- Competently performs intermediate procedures (HSG, thyroid biopsy, etc)
- Recognizes and manages complications of intermediate procedures

2) Medical Knowledge: At the end of the rotation, the resident should be able to:
• Demonstrate understanding of the principles of research project design and implementation and consider starting a scholarly project in thoracic radiology such as a case report or research project with the faculty and, if appropriate, interested medical student
• Understand the proper use of radiological equipment such as chest sonography and demonstrate its use while on the ultrasound rotation
• Monitor and interpret CTA for pulmonary embolism, aortic dissection and CTA for coronary artery disease
• Monitor and interpret HRCT studies for the evaluation of the common diseases of the pulmonary parenchyma
• Understand the anatomy and physiology of common, acquired, and congenital heart disease and basic radiographic findings in these conditions
• Reviewed the entire core curriculum for Cardiac imaging at the end of this document.
• Learn the radiographic appearance of specific cardiac diseases
• Develop skills in interpretation of basic cardiac pathology
• Learn the appropriate format for dictation of cardiac reports

Required Reading List:
• Cardiac CT, PET, MR
• Cardiac Imaging Cases
• High Resolution CT of the Lung (Webb, Muller, Naidich)
• Expertdx: Chest
• Thoracic Imaging: Case Review Series
• Thoracic Radiology: The Requisites

Milestones include:
- Selects appropriate protocols and contrast agent/dose for intermediate imaging like basic abdominal MRI
- Makes secondary observations
- Narrows differential diagnosis
- Describes management options

3) **Practice-Based Learning and Improvement**: At the end of the rotation, the resident should be able to:

- Demonstrate knowledge of and apply the principles of evidence based medicine in practice
- Demonstrate critical assessment of the scientific literature
- Shows evidence of independent study using textbooks from expected reading list.
- Demonstrates appropriate follow up of interesting cases.
- Prepares teaching file of interesting cases.
- Is able and willing to make detailed presentations of Cardiac studies at both intra and interdepartmental conferences.
- Upon request, participates in educational courses for clinicians, medical students, and fellow residents.

Milestones include:

- Re-demonstrates recognition and management of contrast reactions, now to include precautions related to the use of Gadolinium agents.
- Accesses resources to determine exam specific average radiation dose info
- Accesses resources to determine safety of implanted devices and retained metal
- Works with faculty mentors to identify potential scholarly projects

4) **Interpersonal and Communication Skills**: At the end of the rotation, the resident should be able to:

- Interact with x-ray technologists, medical students, fellow residents, and attending radiologists.
- Interact with clinicians when reviewing cases involving cardiac studies.
- Participate in administrative and scholarly committees when asked.

Milestones include:

- Communicates under direct supervision in challenging circumstances
- Communicates under direct supervision difficult information such as errors, complications, adverse events, and bad news
- Efficiently generates clear and concise reports that do not require substantive faculty member correction on routine cases
- Communicates findings and recommendations clearly and concisely

5) **Professionalism**: At the end of the rotation, the resident should be able to:

- Help in the teaching of junior radiology residents and house staff from other departments

Milestones include:

- Becomes an effective health care team member
- Continues to demonstrates professional behaviors described under year 1

6) **Systems-Based Practice**: At the end of the rotation, the resident should be able to:

- Demonstrate knowledge of funding sources
- Demonstrate knowledge of reimbursement methods
- Shows ability to interact with clinicians regarding cost effective and streamlined patient evaluation for differing clinical entities.
- Able and willing to participate in clinical conferences in which imaging studies used to guide patient care/evaluation.
- Is able and willing to organize and present case conferences/didactic sessions as directed and supervised by radiology staff

Milestones include:
- Incorporating QI into clinical practice
- Participates in the QA department process
- States relative cost of common procedures

**Years 3 and 4: Cardiothoracic Radiology**

1) **Patient Care:** At the end of the rotation, the resident should be able to:
   - Understand and be able to monitor, supervise and interpret specialized thoracic procedures such as a high resolution CT, thoracic CTA, coronary CTA, thoracic MRA and basic cardiac MRI studies
   - Continue to expand the knowledge of CT anatomy and pathology begun in the first two rotations, now to include advanced cardiac and coronary CTA.
   - Refine MRI interpretive skills with complex pathology.
   - Provide emergent provisional interpretation as needed.
   - Be able to direct the choice of imaging modality and protocol emergent studies to include medically managing coronary CTA examinations in conjunction with the radiology nursing staff.
   - Understand when referral or other imaging modalities is necessary.
   - Become a more autonomous consultant and teacher.

Milestones include:
- Recommends appropriate imaging of uncommon conditions independently
- Integrates current research and literature with guidelines, taking into consideration cost effectiveness and risk benefit analysis, to recommend imaging
- Competently performs advanced procedures
- Recognizes and manages complications of advanced procedures
- Independently performs fluoro studies and image guided body procedures

2) **Medical Knowledge:** At the end of the rotation, the resident should be able to:
   - Understand the common radiographic findings in the major cardiac congenital abnormalities and be able to offer a reasonable differential diagnosis based on the radiographic findings
   - Consider starting or continuing a scholarly project in thoracic radiology such as a case report or research project with the faculty and, if appropriate, interested medical student
   - Master the knowledge of congenital heart disease including the radiographic findings and physiology
   - Assist in preparation and presentation of interdepartmental case conferences.
• Independently monitor and triage Coronary CTA studies

**Required Reading List:**

- Cardiovascular Magnetic Resonance
- Cardiovascular MRI: Physical Principles to Protocols (*Vivian Lee*)
- High Resolution CT of the Lung
- High Resolution CT of the Chest: Complete Atlas
- Thoracic Imaging: Pulmonary & Cardiovascular
- Thyroid Cancer in Clinical Practice

Milestones include:

- Selects appropriate protocols and contrast agent/dose for advanced imaging
- Demonstrates knowledge of physical principles to optimize imaging quality
- Independently modifies protocols as determined by clinical circumstances
- Provides accurate, focused, and efficient interpretations
- Prioritizes differential diagnoses and recommends management

- **Recommends ancillary imaging when appropriate**
- Makes subtle observations
- Suggests a single diagnosis when appropriate
- Integrates current research and literature with guidelines to guide management

3) **Practice-Based Learning and Improvement:** At the end of the rotation, the resident should be able to:

- Analyze and develop improvement plans in the clinical practice, including knowledge, observation, and procedural skills
- Shows evidence of independent study using textbooks from expected reading list.
- Demonstrates appropriate follow up of interesting cases.
- Prepares teaching file of interesting cases.
- Is able and willing to make detailed presentations of cardiac studies at both intra and interdepartmental conferences.
- Upon request, participates in educational courses for clinicians, medical students, and fellow residents.
- Upon request, participates in educational activities at the local/national level.

Milestones include:

- Re demonstrates recognition and management of contrast reactions
- Communicates the relative risk of exam specific radiation exposure to patients and practitioners. Applies principles of *Image Gently and Image Wisely*
- Communicates MR safety of common implants and retained foreign bodies to patients and practitioners
- Selects appropriate sedation agent and dose of conscious sedation

4) **Interpersonal and Communication Skills:** At the end of the rotation, the resident should be able to:

- Interact with x-ray technologists, medical students, fellow residents, and attending radiologists.
• Interact with clinicians when reviewing cases involving cardiac imaging studies.
• Can participate in administrative and scholarly committees when asked.
• Can serve as a liaison between our department with both other radiology departments and other specialty groups in our institution.

Milestones include:
- Communicates without supervision in challenging circumstances
- Efficiently generates clear and concise reports that do not require substantive faculty member correction on all cases
- Communicates appropriately under stressful situations

5) **Professionalism:** At the end of the rotation, the resident should be able to:
• Participate in teaching of faculty, residents and medical students on rounds
• Residents must demonstrate ability to interact with patient/patient’s family/clinician when discussing significance of x-ray findings and their impact on patient care including what imaging studies may or may not be appropriate.
• Can participate in activities relative to the role of cardiac imaging both to the medical community and the general public.
• Is perceived as a role model for radiology from both within and outside the department.

Milestones include
- Is an effective team leader promoting patient welfare, patient autonomy, and social justice
- Serves as a role model for professional behavior

6) **Systems-Based Practice:** At the end of the rotation, the resident should be able to:
• Demonstrate knowledge of basic management principles such as budgeting, record keeping, medical records, and the recruitment, hiring, supervision and management of staff
• Shows ability to interact with clinicians regarding cost effective and streamlined patient evaluation for differing clinical entities.
• Able and willing to participate in clinical conferences in which imaging studies used to guide patient care/evaluation.
• Is able and willing to organize and present case conferences/didactic sessions as directed and supervised by radiology staff.
• Is able and willing to participate in activities at the local/national level under staff supervision.

Milestones include:
- Identifying and completing a systems based practice project

**Assessment tools for all Cardiothoracic Rotations:**
• Reviewing rotation curriculum, goals and objectives, as a benchmark for progress of resident, and success of faculty in educating the resident. Discussion regarding the specifics of the document is encouraged to promote improvement of the resident’s learning and the program’s teaching. Positive points and deficiencies and unfulfilled goals and objectives should be discussed by the residents and faculty
• Global ratings by faculty including rotation evaluation sheet
• Resident’s performance discussing unknown cases in conference (one of the metrics on Global Evaluation sheet is particularly important)
• Placing cases in teaching file (one of the metrics on Global Evaluation)
• Conference attendance logs
• In-service examination
• 360 degree evaluations – supervisory technologists in radiology core
• Fluoroscopy time log submitted by physicist to Program Director
• Self assessment based on Rad Primer quizzes
• Future plans: evaluation of teaching by medical students

**Cardiothoracic Procedure Logs:**
- Coronary CTA studies for CCTA proficiency examinations
Cardiovascular Imaging Curriculum based off the ABR Core Exam

1) Basics of imaging: radiography, CT, and MR
   a) Indications and limitations of the modalities and comparison to
echocardiography, angiography and cardiac catheterization,
SPECT, and PET.
   b) Physics behind image creation and potential artifacts on radiography, CT, and MR
      i) X-ray physics
      ii) CT physics
         (1) Multidetector CT artifacts relevant to cardiac imaging
         (2) Tradeoffs between noise, dose and image quality
         (3) Spatial resolution, contrast resolution, and imaging reconstruction
             algorithms
         (4) Temporal resolution, half scan, and multi-segment reconstruction
         (5) Contrast injection—principles, protocols, bolus geometry, iodine flux
      iii) MR physics
         (1) MR artifacts relevant to cardiac and vascular imaging
         (2) Trade-off between spatial resolution, temporal resolution, contrast resolution, and acquisition time
         (3) Principles of black blood, edema, and scar imaging
         (4) Steady-state free precession cine imaging
         (5) Velocity-encoded cine (phase contrast) imaging—principles, applications, and limitations
   c) Three-dimensional imaging and post-processing
      i) Multiplanar reconstruction (MPR)
      ii) Maximum intensity projection (MIP)
      iii) Volume rendering (VR)
   d) Patient safety
      i) Radiation exposure and how technical modifications may modify dose
      ii) Drugs and contrast agents used for cardiac imaging
      iii) Cardiac devices and the effect of the magnetic field of the MR unit

2) Normal anatomy, including variants, encountered on radiography, CT, and MR
   a) Heart, including chambers, valves, pericardium, and coronary arteries
   b) Aorta and pulmonary arteries
   c) Venae cavae and pulmonary veins

3) Physiological aspects of cardiac imaging as assessed with radiography, CT, and MR
   a) Normal cardiac cycle
   b) Physiological anatomy of cardiac muscle
   c) Mechanics of cardiac contraction
   d) Physical basis for blood flow, pressure, and resistance
      i) Ventricular volume and pressure relationship
      ii) Functional cardiac measurements
         (1) Ejection fraction
         (2) Stroke volume
(3) Left ventricular mass
(4) Flow \( (Q=V\times A) \)
(5) Pressure gradient (modified Bernoulli equation, \( \Delta P = 4v^2 \))
(6) Pulmonary-to-systemic flow (Qp/Qs) ratio
(7) Regurgitant volume and regurgitant fraction
(8) Diastolic heart function

iii) Normal cardiac and pulmonary pressures
iv) Vascular regions supplied by the coronary arteries

4) Ischemic heart disease

a) Risk factors, primary prevention, and screening
b) Roles of echocardiography, angiography, SPECT, PET, CT, and MR in the evaluation of a patient with suspected ischemic heart disease, including the advantages and limitations of each modality
c) Inducible myocardial ischemia
d) Acute MI
e) Chronic MI
f) Post-MI complications
   i) Cardiac rupture
   ii) Left ventricular aneurysm and pseudoaneurysm
   iii) Papillary muscle rupture
   iv) Congestive heart failure
   v) Dressler syndrome
g) Myocardial perfusion and viability
   i) Stunned myocardium
   ii) Hibernating myocardium
h) Role of myocardial delayed-enhancement imaging in guiding management of left ventricular dysfunction
i) Coronary artery stenosis and aneurysm
j) Role of coronary CT angiography in guiding management of chest pain
k) Therapeutic and interventional options

5) Cardiomyopathy

a) Hypertrophic
b) Dilated
c) Restrictive
   i) Distinguish restrictive cardiomyopathy from constrictive pericarditis
d) Arrhythmogenic right ventricular dysplasia
e) Therapeutic and interventional options

6) Cardiac masses

a) Thrombus
   i) Distinguish thrombus from tumor
b) Primary benign tumors
   i) Myxoma
   ii) Lipoma
   iii) Rhabdomyoma
   iv) Fibroma
v) Lipomatous hypertrophy of the interatrial septum

c) Primary malignant tumors
   i) Angiosarcoma
   ii) Lymphoma

d) Metastasis
e) Therapeutic and interventional options

7) **Valvular disease**
   a) Myxomatous degeneration
   b) Rheumatic heart disease
   c) Infective endocarditis
   d) Congenital valve disease
   e) Specific lesions
      i) Aortic stenosis
      ii) Aortic regurgitation
      iii) Mitral stenosis
      iv) Mitral regurgitation
      v) Mitral annular calcification
      vi) Tricuspid regurgitation
      vii) Pulmonary stenosis
      viii) Pulmonary regurgitation
   f) Therapeutic and interventional options

8) **Pericardial disease**
   a) Acute pericarditis
   b) Constrictive pericarditis
      i) Distinguish restrictive cardiomyopathy from constrictive pericarditis
   c) Pericardial effusion
      i) Hemopericardium
      ii) Tamponade
   d) Pericardial cyst
   e) Pericardial defect
   f) Pneumopericardium
   g) Therapeutic and interventional options

9) **Congenital heart disease**
   a) Left-to-right shunts
      i) Atrial septal defect
      ii) Ventricular septal defect
      iii) Partial anomalous pulmonary venous connection (1) Scimitar syndrome
      iv) Patent ductus arteriosus
   b) Eisenmenger syndrome
   c) Admixture lesions (bidirectional shunts)
      i) Transposition of the great arteries
      ii) Truncus arteriosus
iii) Total anomalous pulmonary venous connection
d) Right-to-left shunts
   i) Tetralogy of Fallot and pulmonary atresia with ventricular septal defect
   ii) Ebstein anomaly
e) Great vessel anomalies
   i) Coarctation of the aorta
      (1) Distinguish from pseudocoarctation
   ii) Double aortic arch
   iii) Right aortic arch
      (1) Mirror image
      (2) Non-mirror image
   iv) Pulmonary sling
   v) Persistent left superior vena cava
f) Coronary artery anomalies
   i) Retroaortic course
   ii) Interarterial course
g) Miscellaneous anomalies
   i) Cardiac malposition, including situs abnormalities
   ii) Congenitally corrected transposition of the great arteries
h) Therapeutic and interventional options

10) Acquired disease of the thoracic aorta and great vessels
a) Aneurysms
   i) Atherosclerotic
   ii) Marfan syndrome
      iii) Ehlers-Danlos syndrome
b) Pseudoaneurysms
   i) Mycotic
   ii) Post-traumatic and post-surgical
c) Dissection
   i) Intramural hematoma
d) Aortitis and arteritis
e) Atherosclerosis
   i) Plaque
   ii) Ulcerated plaque
      iii) Penetrating ulcer
f) Thromboembolism
   i) Acute pulmonary embolism
   ii) Chronic pulmonary embolism
g) Pulmonary hypertension
h) Pulmonary arteriovenous malformation
i) Compression
   i) Superior vena cava syndrome
j) Pulmonary vein complications after radiofrequency ablation
k) Therapeutic and interventional options
11) Devices and postoperative appearance
   a) Monitoring and support devices
      i) Intra-aortic balloon pump
      ii) Pacemaker generator and pacemaker leads
      iii) Implantable cardiac defibrillator
      iv) Left ventricular assist device
      v) Pericardial drain
   b) Postoperative chest
      i) Coronary artery bypass graft surgery
      ii) Cardiac valve replacement
      iii) Transluminal septal closure
      iv) Aortic graft and aortic stent
      v) Heart transplant
12) **Requirements for Cardiac CTA Certification (via SCCT Exam)**

a) **Level 1**
   
   vi) Mentored interpretative experience of 50 cases

b) **Level 2**
   
   vi) Evaluation of 50 non-contrast studies
   
   vii) Evaluation of 150 contrast studies, which 50 are live cases
   
   viii) 20 hours of lectures related to CT or CCT
         Evaluation of 50 contrast studies per year
         20 hours of Category 1 every 36 months of CCT

c) **Level 3**
   
   ix) Evaluation of 100 non-contrast studies
   
   x) Evaluation of 300 contrast studies, which 100 are live cases
   
   xi) 40 hours of lectures related to CT or CCT
        Evaluation of 50 contrast studies per year
        40 hours of Category 1 every 36 months of CCT
By signing this document you are confirming that you have received and reviewed, with your preceptor, the Cardiothoracic radiology goals and objectives for this academic year.

This receipt will be kept in your personal file.

Resident Name (please print)_____________________________________________________

Resident Signature __________________________

by signing this – you confirm that you have reviewed the G&O with your preceptor

Date________________________________________

Preceptor Signature __________________________

by signing this – you confirm that you have reviewed the G&O with the resident

Date________________________________________