# *Welcome to…*

## Thoracic Imaging

During your time at BCH, you will spend about one week in the Thoracic imaging rotation, which covers not only chest imaging, but also cardiac and vascular imaging. Given the relatively short amount of time that you will be spending in the thoracic imaging service and the large amount of educational materials that you will need to master, every day on the rotation is valuable. If you have any absences during your Thoracic rotation you will have to make them up during your elective time.

During your thoracic rotation, the majority of the studies you read will be plain radiographs of the chest and abdomen from inpatient service, outpatient service and the emergency room. You will also read cross-sectional imaging studies such as CT and MRI studies to evaluate for thoracic congenital and acquired disorders involving lungs, airways, mediastinum, heart, vessels, chest wall and diaphragm.

### *THE WORK DAY:*

The work day begins at **7:30 AM** and ends when all radiographs and cross sectional imaging studies performed at or before **5:00 PM** are reviewed and dictated. Usually, all the work in the thoracic imaging section can be completed by **6:00 PM.** However, occasionally, it can be later if complicated cross sectional imaging studies are completed just before 5:00 PM or review and dictation of chest and abdomen radiographs are being delayed. It is essential that you do not make personal plans (including traveling or moonlighting arrangement plans) before **7:00 PM** during your rotation in the thoracic section.

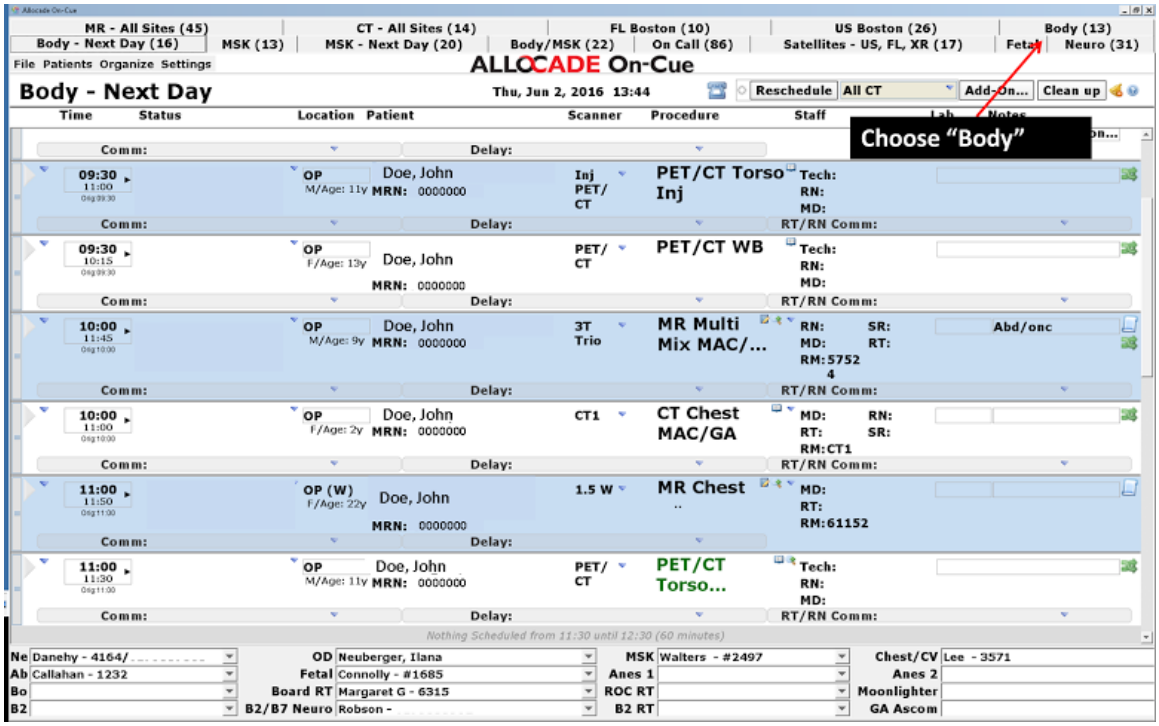
On Monday when there is a weekly GU conference from 5:00 PM to 6:00 PM, the residents are expected to attend GU conference and immediately return to thoracic section service to complete the daily work if all work has not been completed by that time.

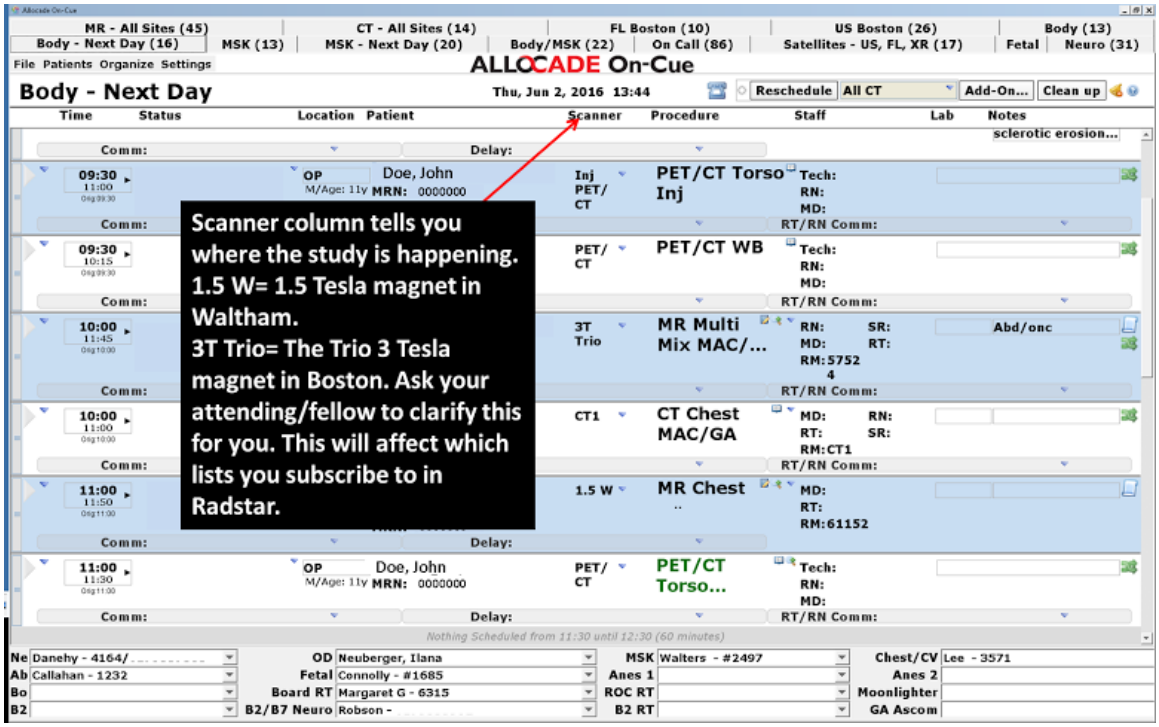
On Friday when there is educational conference by the NERRS (New England Roentgenray Society), you will work in the reading room from 7:30 until it is time to leave for the conference at 3:30, not attending any other conferences that day. When you are allowed to leave for the NERRS conference**, you are expected to attend the entire session** until the end. Otherwise, you are expected to stay in the clinical service as usual.

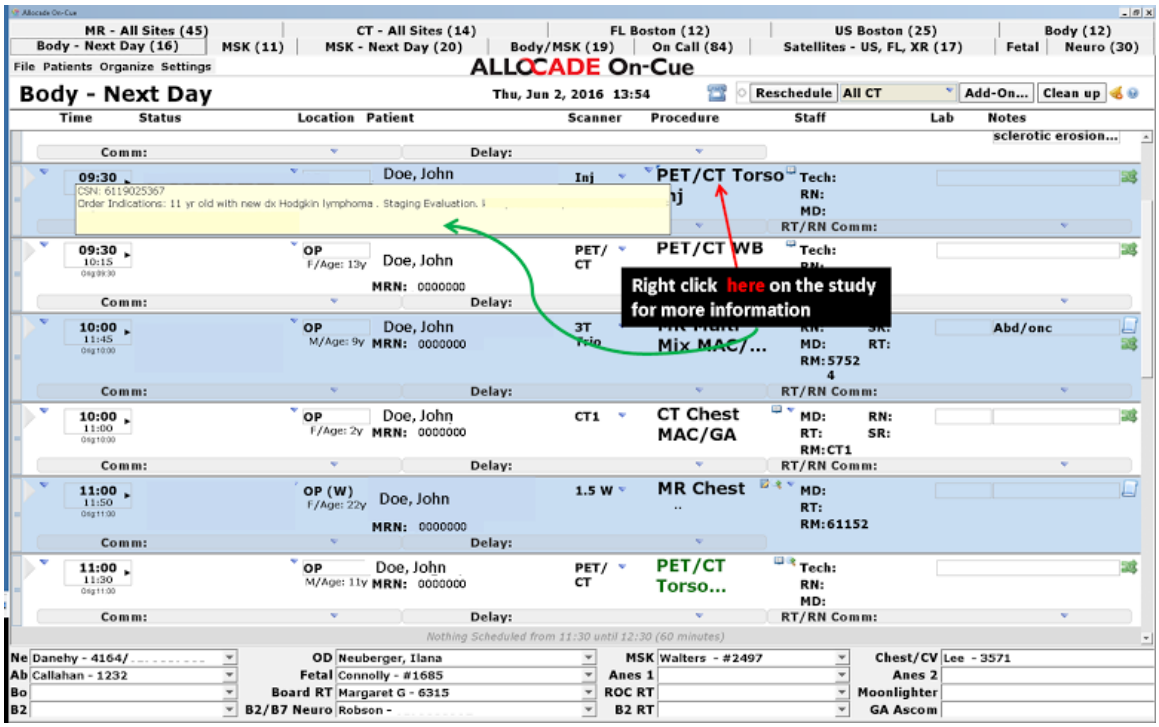
Detailed daily workflow and your responsibilities are listed below.

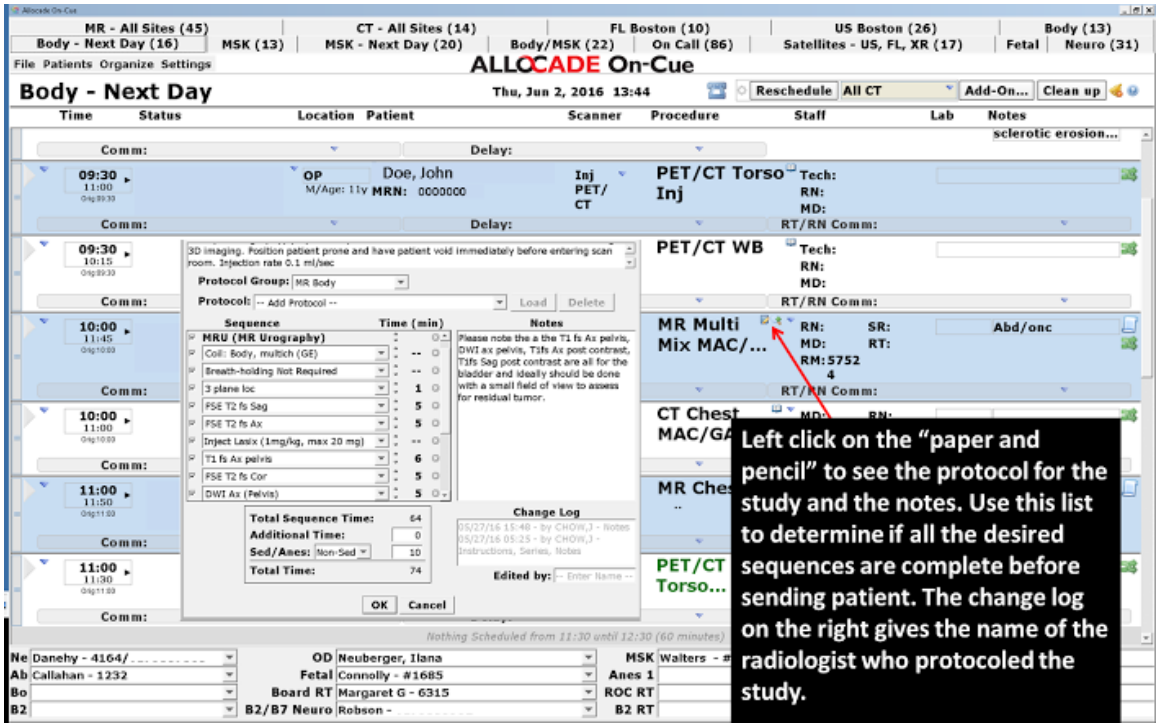
**7:30 AM (Beginning of work day):**

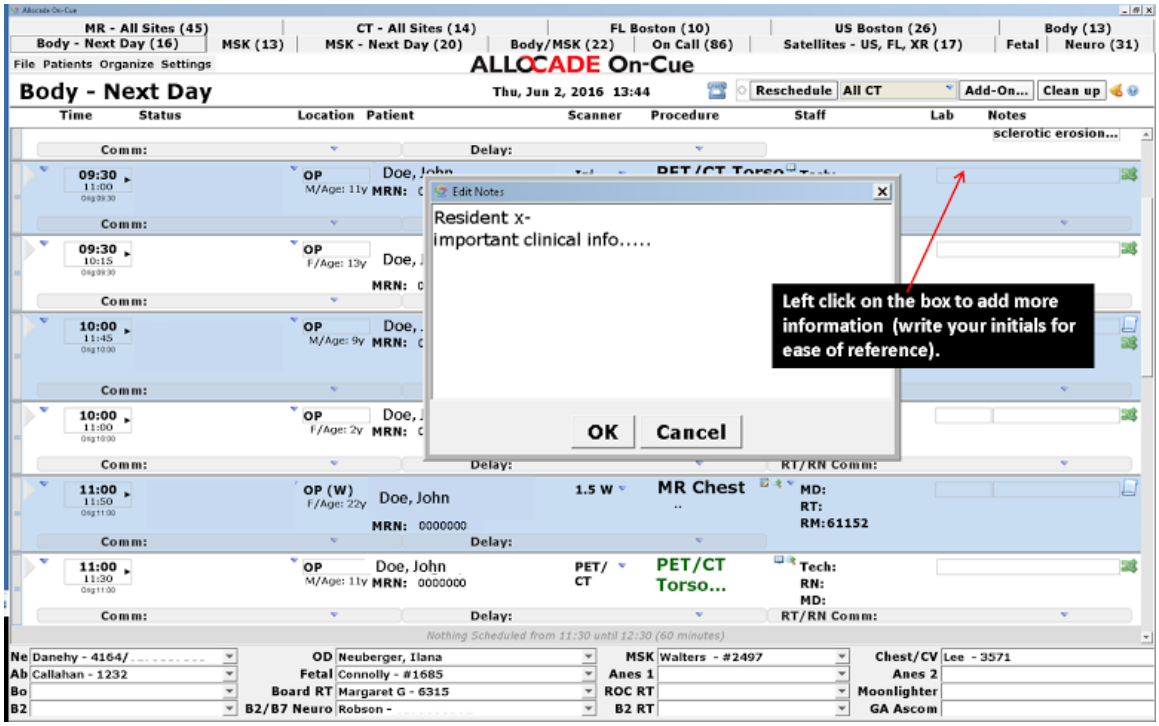
You are expected to show up on time. Preparation for the scheduled cross sectional imaging studies ahead of time is essential for the smooth workflow throughout the day. Either the day before the service or early in the morning, use Allocade (see below picture) to identify which cross sectional studies belong to the thoracic imaging section. This often involves the review of prior imaging, surgical and clinical notes.

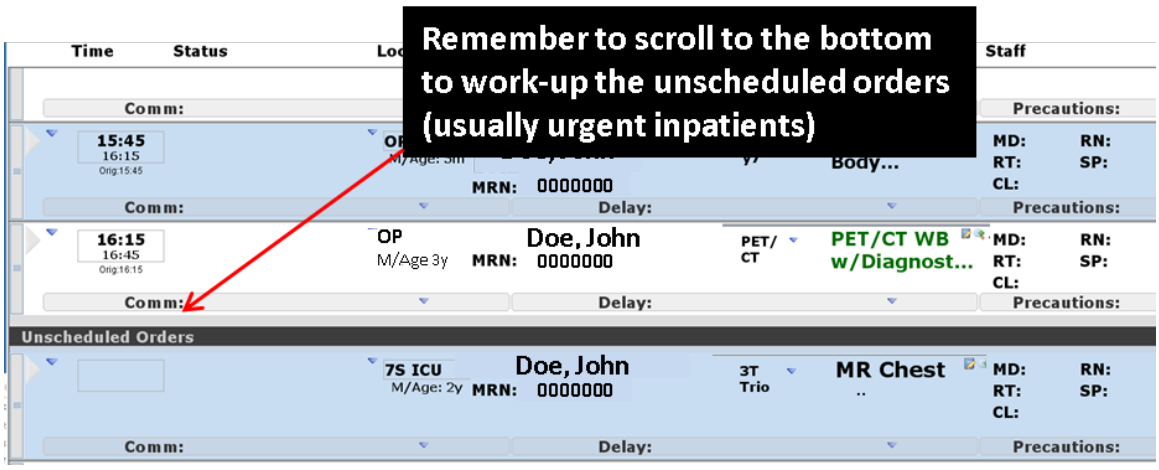



Scanner column tells you where the study is happening.
1.5 W= 1.5 Tesla magnet in Waltham.
3T Trio= The Trio 3 Tesla magnet in Boston. Ask your attending/fellow to clarify this for you. This will affect which lists you subscribe to in Radstar.


Right click here on the study for more information


Left click on the "paper and pencil" to see the protocol for the study and the notes. Use this list to determine if all the desired sequences are complete before sending patient. The change log on the right gives the name of the radiologist who protocoled the study.


Edit Notes
Resident x-
important clinical info.....
OK
Cancel
Left click on the box to add more information (write your initials for ease of reference).




**7:45 AM (Morning round):**

You will be expected to present scheduled cross-sectional imaging studies including information related to the relevant prior clinical and imaging studies, clinical indication for the current imaging studies, and plans for the imaging. The attending radiologist covering the thoracic imaging section will assign cross sectional imaging studies to the resident and fellow so that you are aware of the cases that you are responsible for.

**7:45 AM – 11:50 PM (Morning work): If there is morning conference, attend morning conference from 7:45 AM to 8:30 AM, then immediately report back to Thoracic Imaging service at 8:30 AM. If there is no morning conference, morning work starts immediately after morning rounds.**

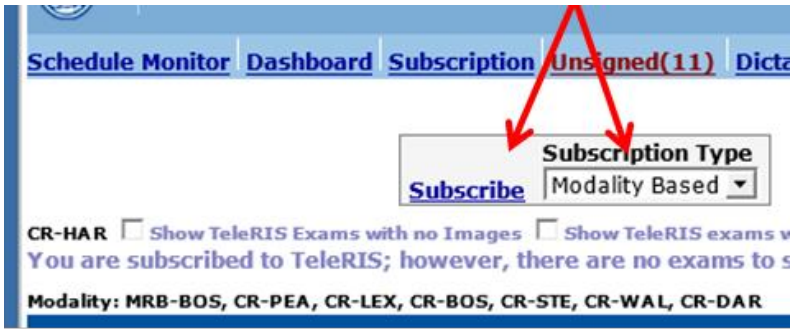
During this time, all chest and abdomen radiographs performed and on the unread worklist should be reviewed and dictated.

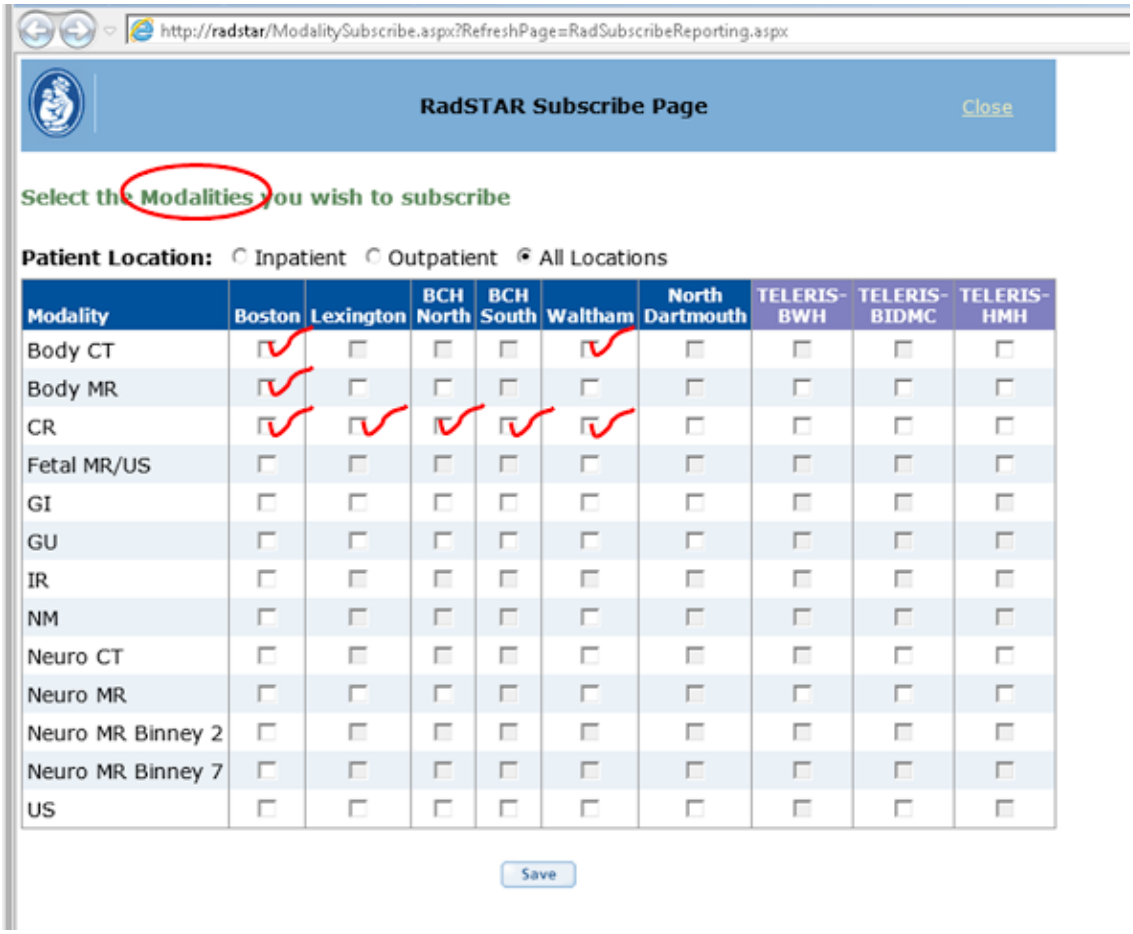
On Radstar, you are expected to subscribe to:

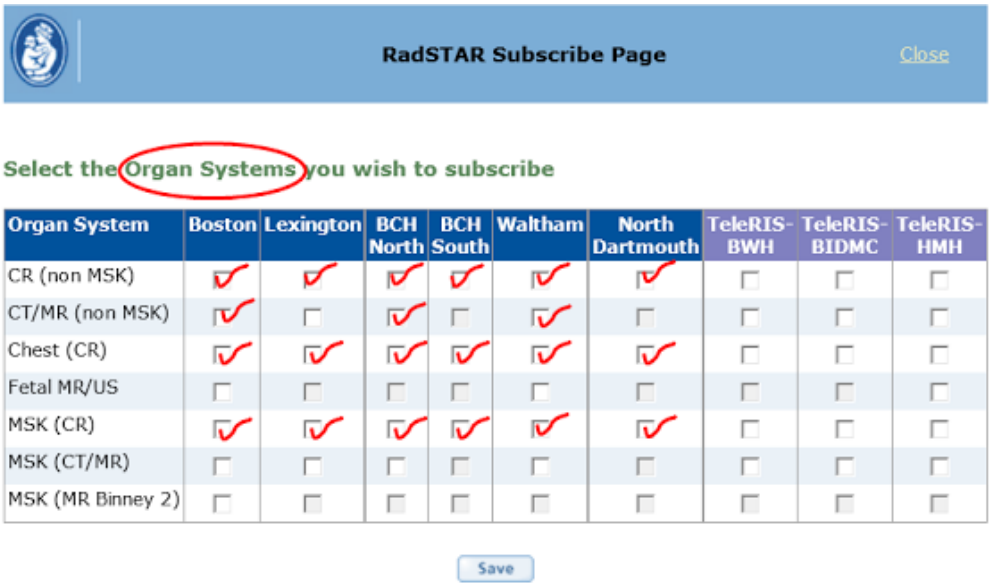
1) **ALL** radiographs. You should focus on the chest and abdomen radiographs performed in Boston, which should be read chronologically and treated equally (do not prioritize chest radiographs when you are on the thoracic imaging rotation). You should consecutively read all unread chest and abdomen radiographs on the Boston unread list. Once all of the chest and abdomen radiographs have been read, you should next read the MSK radiographs in Boston, then the radiographs performed at the satellite locations (Lexington, Peabody, Waltham)

2) Body CT and Body MR appropriate for the studies you have been assigned for that day. During the morning rounds, the attending radiologist covering thoracic imaging service will assign you to the cross sectional imaging studies that you will be responsible for.

There are two ways to accomplish this, Modality versus Organ System






**11:50 AM – 1:00 PM (Noon Conference) if there is one noon conference. 11:50 AM to 1:30 or 1:45 PM if there are two noon conferences. Of note, if there are two noon conferences, usually there is no morning conference.**

**1:00 PM - ~6:00 PM (Afternoon work):**

During this time, all chest and abdomen radiographs as well as cross sectional imaging studies performed by 5:00 PM and on the unread worklist should be reviewed and dictated.

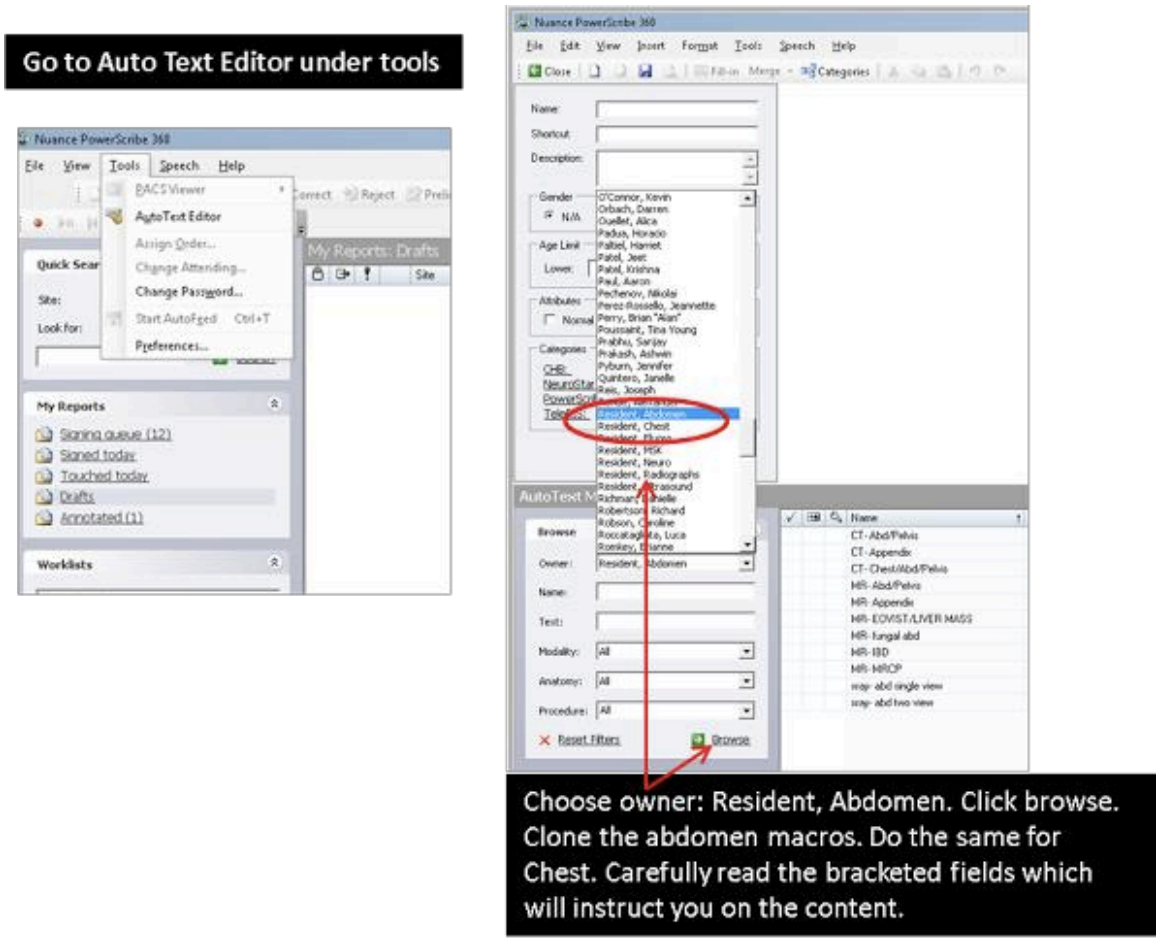
**~6:00 PM (End of day round):**

Discuss with an attending radiologist in thoracic imaging service regarding whether all of assigned day's work have been completed. If needed, prepare for the morning round for the next day by reviewing relevant history of prior studies for the scheduled cross sectional imaging studies. You can find which cases are scheduled for the next day on Allocade.

## *THE REPORTS:*

Go to the "Auto Text Editor" tab and copy the macros from "**Resident, Chest**" and "**Resident, Abdomen**", since there will be some cross-over between the two during your rotation. Whenever possible use these macros for your reports unless specifically told not to do so by the attending of the day. If you are doing an

uncommon exam with no appropriate macro available, try to structure your report in a similar manner.




## *GOALS:*

**1) Cleveland Clinic Modules**

By midweek at the latest, you should complete the following Cleveland Clinic Modules, and submit the transcripts to Abby:

Bronchopulmonary Foregut Malformations
Mediastinal Masses
Pulmonary Edema
Esophageal Atresia

In addition there are some very useful cardiac modules. You may not have time to complete them during your week of Thoracic, but you should complete them before the end your BCH rotation.

Acyanotic Congenital Heart Disease
Coarctation of the Aorta and Hypoplastic Left Heart
Cyanotic Congenital Heart Disease

**2)** Below is ABR topic list for pediatric thoracic imaging. In preparation for boards, you are expected to be familiar with the imaging of these diagnoses. Although you will not encounter all of these pediatric thoracic disorders during your week on the Thoracic service, you should make every attempt to see as many of these kinds of cases as possible and performed focus reading to increase your fund of knowledge on these topics.

## Chest and Airway

### Upper Airway

- Congenital
  - tracheomalacia/bronchomalacia/laryngomalacia
  - laryngeal stenosis, web, cleft
  - choanal atresia
  - masses (eg hemangioma)
  - pyriform aperature stenosis
- Inflammatory
  - tonsillar enlargement/adenoidal hypertrophy
  - croup
  - epiglottitis
  - tracheitis
  - retropharyngeal plegmon/abscess
- Neoplasm
  - juvenile angiofibroma
  - subglottic hemangioma
  - laryngeal papilloma
- Trauma
  - foreign body
  - acquired subglottic stenosis

### Chest: mediastinum, lung, pleura, chest wall, diaphragm

- Congenital
  - agenesis/hypoplasia
  - venolobar syndrome
  - bronchial atresia
  - bronchopulmonary foregut malformations
    - sequestration
    - bronchogenic cyst

- congenital pulmonary airway malformation (CPAM)/cystic adenomatoid malformation (CCAM)
- congenital lobar emphysema
- hybrid lesions
- tracheal bronchus other congenital bronchial anomalies
- tracheoesophageal fistula
- lymphangiectasia
- neuroendocrine cell hyperplasia (NEHI)
- Pectus deformity (carinatum and excavatum)

- Inflammatory
  - infections
    - bacterial pneumonia (including Streptococcus, Staphylococcus, pertussis, Chlamydia, Mycoplasma, H. influenza) especially round pneumonia, abscess, and complications (necrosis, abscess, fistulae, empyema, pneumatocele)
    - viral pneumonia (including RSV, varicella, measles)
    - tuberculosis
    - fungal infections
    - plasma cell granuloma/inflammatory pseudotumor, mylofibroblastic inflammatory tumor
    - bronchiolitis/organizing pneumonia

**Small airways disease**

- reactive airways disease
- viral pneumonia/bronchiolitis

**Bronchiectasis:**

- cystic fibrosis
- Primary ciliary dyskinesia or immotile cilia syndrome
- chronic infection (ie primary immune disorders)
- foreign body
- aspiration
-

**Neoplasms /mass like lesions**

- mediastinal masses
  - Anterior mediastinum:
    - lymphoma/leukemia
    - germ cell tumors
    - thymoma/carcinoma
    - other masses: thymic cysts, bronchogenic cysts
    - vascular malformations
    - normal prominent thymus and thymic rebound
  - Middle mediastinum:
    - Adenopathy (lymphoma/metastatic disease)
    - congenital masses: bronchogenic cysts, esophageal duplication cyst, neurenteric cyst
    - neurogenic tumors
    - vascular malformations
    - Castleman Disease

- Posterior mediastinum:
  - Neurogenic tumors
  - Other masses: bronchogenic cyst, infection, hematoma, adenopathy (eg Castleman Disease)
- Primary lung tumors
  - Adenoma/carcinoid tumor
  - hamartoma
  - hemangioma
  - mesenchymal sarcoma (and its association with developmental cystic lesions of lung)
  - Pleuropulmonary blastoma
- Other Tumors:
  - Lymphoma
  - Metastases
  - Post transplant lymphoproliferative disorder
- Chest wall neoplasms/masses
  - Ewing sarcoma family (including Askin tumor)
  - Rhabdomyosarcoma
  - benign rib and spine neoplasms
  - vascular malformations
  - infection

- Trauma
  - contusion
  - airleak
    - pneumothorax
    - pneumomediastinum
    - bronchopleural fistula
  - fracture of tracheobronchial tree
  - airway foreign body
  - post-traumatic bronchial stenosis
  - post-traumatic diaphragmatic hernia
  -
- Vascular
  - pulmonary thromboembolic disease
  - other venous thrombosis or occlusion, anomalous vessels
  - AV malformations
  - Vasculitis (eg Wegener's, Goodpasture)
  - Acute chest syndrome (sickle cell disease)
  - Central venous catheter complications
  - Bronchial artery embolization
- Unique chest problems in neonate
  - hyaline membrane disease/ surfactant deficiency disease
  - transient tachypnea of newborn
  - neonatal pneumonia
  - congenital diaphragmatic hernia
  - chronic lung disease of infancy (bronchopulmonary dysplasia)
  - meconium aspiration syndrome
  - persistent fetal circulation
  - ECMO therapy and its complications
  - Abnormal support apparatus positions
  - airleak in the neonate
    - pulmonary interstitial emphysema
    - Pneumothorax
    - pneumomediastinum
- Miscellaneous:

        - includes chest manifestations of systemic disorders
        - interstitial lung disease/other
            - idiopathic pulmonary hemosiderosis
            - alveolar proteinosis
            - collagen vascular diseases
            - cardiogenic and noncardiogenic pulmonary edema
            - histiocytosis
    - Breast masses/disorders (including physiologic gynecomastia in pubertal males
- Diaphragm
    - Paralysis
    - Eventration
    - Hernias
        - Post traumatic
        - Congential (Morgagni and Bochdalek hernias)

- **Cardiovascular: Cardiac**
    - Congenital Heart Disease
        - Segmental approach to imaging of congenital heart disease
            - Normal segmental anatomy
            - Anomalies of visceroatrial situs
                - Asplenia
                - Polysplenia
                - Situs inversus
        - Left to right shunts
            - Ventricular septal defect
            - Patent ductus arteriosus
            - Atrial septal defect
            - Endocardial cushion defect
            - Aortopulmonary window
            - Partial anomalous pulmonary venous return
        - Intermixing (admixture) states with increased pulmonary blood flow
            - Total anomalous pulmonary venous connection (TAPVC) without obstruction
            - D-transposition of the great arteries
            - Truncus arteriosus
            - Single ventricle
        - Intermixing (admixture) states with decreased pulmonary blood flow
            - Tetralogy of Fallot
            - Pulmonary atresia with VSD
            - Single ventricle with RVOT obstruction
        - Left-sided obstruction
            - Coarctation
            - Add critical aortic stenosis
            - Hypoplastic left heart syndrome
            - Cortriatriatum
            - Obstructed TAPVC
        - Other congenital heart disease
            - Pulmonary valve stenosis
            - L-transposition of great arteries
            - Pulmonary atresia with intact ventricular septum
            - Ebstein anomaly

        - Congenital absence of the pericardium
    - Vascular rings and slings
        - Right aortic arch with aberrant left subclavian artery
            - alone (mirror image branching)
            - with aberrant left subclavian artery
        - Double aortic arch and variants
        - Circumflex aortic arch
        - Pulmonary sling
    - Anomalous coronary artery origins
        - Anomalous right coronary artery from the left sinus of Valsalva
        - Anomalous left coronary artery from the right sinus of Valsalva
        - Anomalous left coronary artery from the pulmonary artery
    - Systemic venous variants
        - Left SVC
        - Interrupted IVC with azygos continuation
    - Late or adult presentations of CHD
        - Bicuspid aortic valve, aortic valve stenosis and aortic root dilatation
- Cardiac masses
    - Rhabdomyoma, fibroma
    - Thrombus
- Trauma
    - hemopericardium
    - Other cardiac trauma
- Syndromes with congenital heart disease or vascular disease
    - Marfan syndrome
    - Loeys Dietz syndrome
    - Ehlers-Danlos syndrome
    - Williams syndrome
    - Alagille syndrome
    - Neurofibromatosis 1
    - Down syndrome
    - Holt Oram syndrome
    - Turner syndrome
    - PHACE syndrome
- Acquired Cardiac Disease
    - Infectious/inflammatory
        - pericarditis
        - myocarditis
        - Kawasaki disease
    - Cardiomyopathies
        - Hypertrophic
        - Dilated
        - Restrictive
        - ARVD
- Cardiac Operations
    - Post-operative cross sectional imaging assessment of the following procedures:
        - Atrial switch for transposition of great arteries (Senning and Mustard procedures)
        - Arterial switch for transposition of great arteries (Jatene arterial switch)
        - Single ventricle repair: Norwood 1 and Damus Kaye Stansel anastomosis

        - Superior cavopulmonary connection: including the bidirectional Glenn procedure
        - Total cavopulmonary connection: Fontan procedure
        - Pulmonary blood flow augmentation as initial palliation for CHD including Blalock-Taussig, Waterston, and Pott's shunts
- **Cardiovascular: Vascular**
    - Congenital
        - Vascular malformations
        - Variants: Caval anomalies (e.g. left SVC, absent hepatic IVC)
    - Trauma
        - Acute traumatic aortic injury
        - Arterial contrast extravasation
        - Pseudoaneurysm
        - AV fistulae
        - Hypoperfusion complex
        - post operative (eg post organ transplant) complications (e.g., stenosis, thrombosis, aneurysm/pseudoaneurysm)
    - Inflammatory/infectious
        - Aortitis
        - Vasculitides
            - Takayasu's, Kawasaki's,
    - Syndromic/Systemic vascular diseases
        - Syndromes (Ehler Danlos, Marfan, NF—and other causes of mid aortic syndrome—, Williams)
        - Other cardiovascular syndromes
    - Idiopathic
        - Fibromuscular dysplasia
        - Mid aortic syndrome
        - Other idiopathic cardiovascular
    - Thrombotic
        - Deep venous thrombosis
        - Catheter related thrombosis and evaluation
        - IVC filters

**3.** While you will not be able to see a small fraction of the studies listed above during your week of Chest/CT, you should make every attempt to seek out the 5 cases listed on the card below. These cases are not a "requirement" since you are at the mercy of the clinical schedule for the week.

## Chest/CV cases

MRN/ACC#

- ❑ Neonatal medical and surgical lung diseases _____
- ❑ Congenital lung malformations _____
- ❑ Large airway malformations _____
- ❑ Mediastinal vascular and non-vascular lesions _____
- ❑ Congenital heart disease _____

# EDUCATIONAL MATERIALS

## Books

Imaging in Pediatric Pulmonology, Cleveland RH, Langston C, Colin AA, Lee EY. Springer, 2012

Rotations in Pediatric Radiology, Reid JR, Paladin A, Davros W, Lee EY. Oxford, 2014

## Reference Articles


1. Tsai J, Lee EY, Restrepo R, Eisenberg RL. Focal large airway anomalies and abnormalities in pediatric patients. AJR 2013
2. Baez JC, Lee EY, Restrepo R, Eisenberg RL. Chest wall lesions in children. AJR 2013
3. Wasilewsaka E, Lee EY, Eisenberg RL. Unilateral hyperlucent lung in children. AJR 2012
4. Ranganath SH, Lee EY, Restrepo R, Eisenberg RL. Mediastinal masses in children. AJR 2012
5. Son JK, Lee EY, Eisenberg RL. Focal nonvascular thoracic masses in children. AJR 2011
6. Lee EY, Restrepo R, Dillman JR, Ridge CA, Hammer MR. Boiselle PM. Imaging evaluation of pediatric trachea and bronchi: systematic review and updates. Semin Roentgenol. 2012
7. Lee EY, Greenberg SB, Boiselle PM. Multidetector computed tomography of pediatric large airway diseases: state-of-the-art. Radiol Clin North Am. 2011

8. Lee EY, Boiselle PM, Cleveland RH. Multidetector CT evaluation of congenital lung anomalies. Radiology. 2008
9. Lee EY. Interstitial lung disease in infants: new classification system, imaging technique, clinical presentation and imaging findings. Pediatr Radiol. 2013
10. Laya BF, Lee EY. Congenital causes of upper airway obstruction in pediatric patients: updated techniques and review of imaging findings. Semin Roentgenol 2012

# *MISSING DAY NOTIFICATION PROCEDURE*

If you cannot come to work for any reasons, you should immediately notify **all of following individuals**:

1. Edward Y. Lee, MD (Chief, Thoracic Imaging Division) – Email or phone call
2. Delma Jarrett, MD (Director of Resident Education) – Email or phone call
3. Abigail Polkinghorn, MD (Resident Education Coordinator) – Email or phone call
4. Attending radiologist in thoracic imaging service – Email or phone call

Information regarding the number and reason behind the missing day in thoracic imaging service will be reported to your residency director at your institution.

Again, given the limited time that you will be spending in thoracic imaging section and large amount of educational materials that you will need to be master, **your full attention and attendance is needed during your rotation in thoracic imaging section.**

We hope that you have a fun and educational time during your thoracic imaging rotation, and if you have any questions or concerns, don't hesitate to ask me.

Sincerely,

Edward Y. Lee, MD, MPH
Chief, Thoracic Imaging Division
Associate Professor of Radiology
Boston Children's Hospital and Harvad Medical School