

**BRIDGEPORT HOSPITAL  
PULMONARY DISEASE FELLOWSHIP  
CURRICULUM**

Updated: December, 2009

## **OVERVIEW**

Bridgeport Hospital's Pulmonary Disease Fellowship Program is a two-year training program. The curriculum will enable internal medicine-trained physicians to master the intellectual and procedural skills of Pulmonary Medicine. Graduates of the program will have acquired the skills and experience required to sit for the American Board of Internal Medicine Examination in Pulmonary Medicine.

### **TRAINING SITES**

Bridgeport Hospital is the primary training site at which fellows spend >85% of their training. Other training sites have included Yale New Haven Hospital (YNHH) and the Hospital for Special Care (HSC). Trainees also have performed electives in the private offices of Pulmonary and Internal Medicine Associates.

### **FACULTY**

Full-time, hospital-based faculty:

David Kaufman, MD, Section Chief of Pulmonary Medicine. ABIM certified in Internal Medicine, Pulmonary Disease and Critical Care Medicine.

Constantine Manthous, MD, Chief of Medical Intensive Care Section, Program Director Internal Medicine Training Program, and Associate Clinical Professor at Yale. ABIM certified in Internal Medicine and Critical Care Medicine.

Armand Wolff, MD, Director Pulmonary Medicine Fellowship. Medical Director Sleep Center. ABIM certified in Internal Medicine, Pulmonary Medicine, and Critical Care Medicine. AASM certified in Sleep Medicine.

Jeffrey Kwon, MD, Assistant Medical Director Sleep Center. ABIM certified in Internal Medicine, Pulmonary Medicine, and Critical Care Medicine.

Private practice faculty:

Arthur Turetsky, MD, Senior Attending. ABIM certified in Internal Medicine and Pulmonary Medicine, and AASM certified in Sleep Medicine.

Daniel Rudolph, MD, Senior Attending ABIM certified Internal Medicine, Pulmonary Disease, and Critical Care Medicine.

Adil Salam, MD, Junior Attending. ABIM certified Internal Medicine and Pulmonary Disease., and AASM certified in Sleep Medicine.

John Ayala, MD, Junior Attending. ABIM certified in Internal Medicine, Pulmonary Medicine, and Critical Care Medicine.

Part-time faculty

Arthur Kotch, MD, Senior Attending, ABIM certified in Internal Medicine and Pulmonary Medicine, and AASM certified in Sleep Medicine.

## ***EDUCATIONAL OBJECTIVES – FORMAL CURRICULUM***

At the beginning of training, fellows receive a hardcopy of the entire 2-year curriculum. Prior to each rotation, fellows are given a copy of the specific educational objectives of each rotation (including a summary of their responsibilities and schedule). After reviewing the objectives, they attest to having done so by signing the objectives. These are kept in the personal file of each trainee. The overall curriculum and objectives of each rotation are reviewed periodically in Section meetings.

Certain educational experiences (i.e. outpatient pulmonary medicine, allergy-immunology) are achieved through longitudinal sessions conducted throughout the fellowship. Likewise instruction in Sleep Medicine is provided longitudinally, with the fellows assisting in Sleep Laboratory activities throughout the fellowship. Other educational objectives (e.g. RRC essentials) are covered systematically by emphasis during discussions, review, and formal reading assignments associated with each rotation. Consultations on patients with disease processes emphasized during a particular block will be used as points of departure to emphasize teaching points in the formal reviews and readings. Additionally, trainees are exposed to other pulmonary diseases in the course of patient care/consultations.

The included curriculum is an outline of subjects covered formally and serves as a guide for self-study and structured discussions of pathophysiology topics during rounds. The curriculum includes all aspects required for pulmonary training as outlined in the Residency Review Committee's Essentials.

### ***Structure/Schedule of Training (in 4 week-blocks)***

|     |                                      |            |
|-----|--------------------------------------|------------|
| F1: | Pulmonary Consultation Service (PCS) | 7 months   |
|     | Critical Care (CCM)                  | 3.5 months |
|     | Ambulatory/Research/Elective         | 1.5 months |
| F2: | Pulmonary Consultation Service       | 5.5 months |
|     | Critical Care                        | 2.5 months |
|     | Pulmonary Rehabilitation/HSC         | 1 month    |
|     | Ambulatory/Research/Elective         | 3 months   |

## ***LINES OF RESPONSIBILITY AND SUPERVISION***

### **Pulmonary Consultation Service**

The fellow will respond within 24 hours to provide consultations requested of the Pulmonary Consultation Service. The fellow will perform a history and physical examination, formulate a differential diagnosis and develop a plan for further evaluation and management.

This evaluation will be discussed with the supervising pulmonary specialist. Formal recommendations will be communicated via a consultation note and, if appropriate, by direct discussion with the referring physicians. The patient will also be informed of the attending pulmonologist's clinical impression and recommendations. The fellow is expected to establish the urgency and priority the patients' problems and respond accordingly. The role of the attending is to verify the historical facts and physical findings related by the fellow, review laboratory tests and imaging studies, critique the presentation, and further discuss the findings and recommendations. The attending will personally evaluate all new consultation patients in a timely fashion.

When an Internal Medicine resident or medical student is on the consult service they will be supervised by the fellow and/or the attending. They will have the opportunity to evaluate the patients and write preliminary consultation notes. They will see their patients in follow up as needed, and discuss their findings with the fellow and attending.

Should the patient require diagnostic or therapeutic procedures it is the fellow's responsibility to optimize the patient's condition in preparation for that procedure, inform the patient of the rationale for the procedure as well as the associated risks and benefits, and obtain appropriate written informed consent. The fellow will order appropriate premedication and discuss conscious sedation with the attending physician. The fellow will follow up on the results and ascertain the patient's clinical stability post procedure. All procedures are to be supervised by an attending except in cases of emergency.

During their rotation on the Pulmonary Consultation Service, the trainee will interpret all pulmonary function studies and discuss them with the attending. The Pulmonary Consult and PIMA fellows are expected to attend all scheduled conferences. They will also attend the longitudinal outpatient clinics as assigned. The ICU fellow is excused from the didactic sessions (but should attend if at all possible) and from the weekly clinic.

### **Critical Care Medicine**

Fellows in the MICU work closely with the assigned pulmonologist/intensivist in the MICU alongside the patients' primary care physicians to provide comprehensive care. The fellow is directly responsible to the critical care attending. They will also for oversee residents and students in evaluation, resuscitation, and management of the patients.

### **Policy on non-teaching service patients**

The fellow has no responsibility to take part in the care of non-teaching service patients. As there are no non-teaching patients on the Team Care Consult Service or in the Medical Intensive Care Unit, this will not be encountered. On the Private (PIMA) Consult Service, there may at times be patients without pulmonary disease issues, and the fellows shall not be expected to be involved in their care. This is a requirement of the ACGME and is the official policy of the Section of Pulmonary, Critical Care, and Sleep Medicine. Fellows are expected to assist with and actively participate in the care of patients in severe distress and with life-threatening emergencies anywhere in the hospital if such assistance is requested by anyone at anytime.

***In-patient Pulmonary Consultation Service (PCS)***

|                           | Monday  | Tuesday  | Wednesday  | Thursday   | Friday   |
|---------------------------|---|--|--|--|--|
| 7 - 8                     |   | SLEEP TOPICS:<br>PSG INTERPS,<br>LECTURES,<br>BOARD<br>REVIEW<br>QUESTIONS<br>(OPTIONAL)                               |  | PULMONARY<br>BOARD REVIEW<br>SERIES<br>(OPTIONAL)  |  |
| 8 - 12                    | 8 - 11<br>PULMONARY<br>ROUNDS<br><br>11 - 12<br>MEDICAL<br>MORNING<br>REPORT  | 8-11<br>PULMONARY<br>ROUNDS<br><br>11 -12<br>MEDICAL<br>MORNING<br>REPORT  | 8 - 12<br>PULMONARY<br>ROUNDS  | 8 - 11<br>PULMONARY<br>ROUNDS<br><br>11 -12<br>MEDICAL<br>MORNING<br>REPORT  | 8:30 - NOON<br>PULMONARY<br>CONTINUITY<br>CLINC  |
| Noon<br>Lecture<br>Series | DEPT INT MED<br>RESEARCH<br>CONFERENCE<br>1 <sup>ST</sup> MONDAY<br><br>RESEARCH<br>UPDATE AND<br>JOURNAL CLUB<br>OTHER MONDAYS | PULMONARY<br>PATHO-<br>PHYSIOLOGY<br>CONFERENCE  | 1 <sup>ST</sup> WEEK<br>PULMONARY<br>PATHOLOGY-<br>RADIOLOGY<br>SERIES<br><br>2 <sup>nd</sup> WEEK<br>PATHOLOGY<br>REVIEW WITH<br>PATHOLOGIST<br><br>OTHER WEEKS<br>CASE<br>PRESENTATION<br>LECTURE SERIES | MEDICINE<br>GRAND<br>ROUNDS  |  |
| 1-5                       | DICTATED BY<br>FELLOWS'<br>ASSIGNMENT<br><br>DEVOTED TO<br>RESEARCH<br>ACTIVITY UNLESS<br>OTHER<br>DUTIES<br>SUPERCEDE          | DICTATED BY<br>FELLOWS'<br>ASSIGNMENT<br><br>DEVOTED TO<br>RESEARCH<br>ACTIVITY<br>UNLESS OTHER<br>DUTIES<br>SUPERCEDE | 2:30 - 5:00<br>YALE STATE<br>CHEST<br>CONFERENCE   | DICTATED BY<br>FELLOWS'<br>ASSIGNMENT<br><br>DEVOTED TO<br>RESEARCH<br>ACTIVITY<br>UNLESS OTHER<br>DUTIES<br>SUPERCEDE | 1:00 - 2:00<br>CLINIC WRAP UP<br>DISCUSSION OF<br>INTERESTING OR<br>CHALLENGING<br>CASES FROM THE<br>CLINIC<br>FOLLOWED BY<br>INFORMAL<br>MEETING WITH<br>PROGRAM<br>DIRECTOR AS<br>REQUIRED |

*The lecture series and the State Chest Conference at Yale become the Pulmonology Core Lecture Series July-September.*

## ***OVERVIEW OF THE PULMONARY MEDICINE CURRICULUM***

No curriculum can illuminate ALL of the content that a Pulmonary fellow must learn in order to become a proficient and compassionate clinician. The Pulmonary Consultation Service rotations are the center of the clinical fellowship; through them the fellows are exposed to most diseases in Pulmonary Medicine over the course of their 2 years of training during:

- a. PCS consultations (in which diseases/pathophysiology are discussed case-by-case and recorded in the Fellow's case log-book),
- b. Discussions of pulmonary cases in Morning Report and Pulmonary conferences,
- c. Didactics,
- d. Formal, systematic review of the PCS and cardiopulmonary critical care curricula.

Rare diseases/syndromes may not be encountered during clinical rotations. These will be discussed through literature reviews and didactic lecture series. They may also be encountered through outpatient exposure.

Pulmonary physiology topics will be discussed during conferences and informal discussions. A more practical exposure will be derived through interaction with the pulmonary function testing (PFT) laboratory and with the respiratory therapy staff.

Exposure to Sleep Medicine topics will occur during didactic sessions as well as consultative services in both the inpatient and outpatient settings. Practical knowledge will be obtained through interaction with the Sleep Center staff. The fellow will also participate in Sleep Center outpatient activities while on the ambulatory block.

The systematic review of Pulmonary Medicine topics is taken directly from the RRC list of essentials. Although the clinical cases encountered over the course of the fellows' PCS rotations will vary, each rotation will "focus" on broad areas of the curriculum.

Fellows will be required to review and present state-of-the-art articles on topics from the curriculum. This will occur during the course of daily rounds as well as Journal Club and other conferences. These articles are listed as "essential readings" in the curriculum. They are NOT meant to be the only self-study the fellow does. Rather, they will serve as points of departure for additional reading in the various areas of Pulmonary Medicine.

Fellows will be exposed to a variety of clinical problems as they see new consultations. In addition to the systematic "areas of emphasis" for each rotation, fellows are expected to read on the problems/diseases of patients as they perform consultations (and document the exposures in their case log-books).

## ***PULMONARY MEDICINE CURRICULUM: OTHER GENERAL CONSIDERATIONS***

### **Chest Radiology**

Radiology studies will be interpreted as part of the daily care of patients. An excellent on-line resource is <http://mypacs.net>. Also helpful, [radiologyeducation.com](http://radiologyeducation.com) offers an array of multiple sites with free resources to complement self-study. Fraser and Pare's, *Disease of the Chest* is also a valuable resource of differential chest radiography. Other specific Radiology textbooks are available as a source in the Pulmonary Fellow Library.

Furthermore, Radiology topics will be reviewed during the course of formal didactics as well as during rounds. A monthly combined Pathology/Radiology/Pulmonary conference also will provide a venue for review of chest radiography. Also, it may be possible for fellows to spend time individually in the radiology department.

### **Pulmonary Pathology**

Each month there is a combined Pathology/Radiology/Pulmonary case conference as a focused pulmonary pathology slide review with a staff Pathologist. On a more informal basis review of pulmonary pathology specimens will be undertaken with a staff pathologist as practicable.

**Procedures** (in general, all procedures should be supervised by an attending)

1. Fiberoptic bronchoscopy (FOB) - Minimum of 4 hours performing FOB with the artificial lung, using the atlas of anatomy. Observe 2-3 FOB and then perform 20 under direct attending supervision, documenting experience in a procedure logbook. This includes procedures such as bronchoalveolar lavage, endo- and trans-bronchial biopsy, and transtracheal needle aspiration of lymph nodes. Performance of a minimum of 20 FOB (and sub-procedures) and certification of proficiency by Program Director are required to perform independently.
2. Thoracentesis – For those entering the program already ABIM certified in thoracentesis, performance of 3 procedures observed by Pulmonary Section faculty is required to obtain certification of proficiency by the Program Director. For those fellows who are not already ABIM certified, a minimum of 5 directly observed thoracenteses will be required.
3. Central venous lines and pulmonary artery catheters – For those entering the program already certified, a minimum of 3 procedures directly supervised by the Pulmonary Section faculty will be required before they can be performed independently. Pulmonary artery catheterization will always require supervision by the faculty.
4. Chest tube thoracostomy, endotracheal intubation, pulmonary artery catheterization and pleural biopsy will only be performed under direct supervision of an attending physician.

As the fellow progresses through training, more independence will be afforded them. However, **ALL PROCEDURES MUST BE DISCUSSED WITH THE ATTENDING STAFF PRIOR TO PERFORMANCE, EVEN IF THE FELLOW IS CERTIFIED TO PERFORM THEM INDEPENDENTLY.** The fellows will be responsible for instructing the residents in performing procedures as directed by the attending staff.

## ***OVERVIEW OF THE PULMONARY MEDICINE CURRICULUM***

Although the Curriculum is broken down into rotations with specific topics of study and areas of emphasis, there are commonalities found during each rotation/activity pertaining to the six ACGME core competencies:

**Medical Knowledge** - Expand on the medical knowledge obtained during residency to include more specifics relating to Pulmonary Medicine. This will include topics within Critical Care Medicine as they relate to the pulmonary and cardiovascular systems. Fellows will be expected to read independently the literature pertaining to the disease states encountered while providing consultative services as well as the general Pulmonary Medicine textbooks and literature. Knowledge will be demonstrated during rounds, formal didactic sessions, as well as informal discussions. With progress through the program, fellows will be expected to develop a deeper understanding of pulmonary pathophysiology and to show “higher level” processing of information. Also, the fellows will be responsible for teaching their co-fellows as well as residents and students in both formal and informal environments. Many of the didactic conferences are fellow driven with input from the attending staff.

**Patient care** – Arrive at 6-7 AM (as required by patient load), pre-round on established patients and begin evaluation of new consultations. Coordinate residents and students on the service to assist. Using pre-rounds as an opportunity to teach residents (both on and off the service) about patients’ problems. Perform initial assessments and develop plans as appropriate with residents and students prior to discussing with attending staff. In general, attending rounds will be held between 9-11 AM, as dictated by the needs of the service. Attending rounds will provide an opportunity for education as well as refining the assessments and care-plans established during pre-rounds. As the fellow progresses through training, higher levels of processing and increasing responsibility for patient care and teaching will be expected.

**Interpersonal communication skills** – Continue to develop skills required for therapeutic relationships with patients and their families. During the early phase of training, fellows should be observed by the attending staff (i.e. CEX) at least 2-3 times while performing the history and physical exam. This provides an opportunity to refine bedside skills with direct feedback. The fellow will initially observe the attending conduct discussions with family members; as they progress in their training, the fellow will take more of an active role in leading these discussions (initially under the supervision of the attending staff and ultimately without supervision).

**Professionalism** – The fellow will act as a “junior attending” by coordinating the team’s activities. They will provide timely updates, as appropriate and required, to the attending staff. Begin asserting surrogate leadership in “all areas Pulmonary” in the absence of the attending, especially with the residents and students. The level of leadership expected will increase as the fellow progresses through training. The fellow will, at all times, be expected to present themselves professionally as a member of the section of Pulmonary, Critical Care, and Sleep Medicine. This will include interactions with patients, their family members, and their primary physicians, as well as the hospital’s physician and non-physician staff members.



**Practice-based learning and improvement** – The fellow will be expected to show a dedication to self-improvement as well as continuing medical education. Throughout their training, fellows will be provided with both formal and informal feedback and constructive criticism; they will be expected to incorporate this into their daily practice. The fellows will attend all conferences offered by the section, will attend the Joint Resident conferences on Scientific Methods, Medical Statistics and Critical Appraisal of the Medical Literature, and will be encouraged to attend Medical Morning Report, Grand Rounds, and other departmental conferences as allowed by clinical schedules. The fellow will assist the attending physician in teaching residents as per the residents' curriculum, and will provide the team with appropriate state-of-the-art articles on patient management germane to cases.

**Systems-based learning** – The fellow will attend meetings (one each) of the Quality Council and Risk Mortality Committee over the first 6 months of their training. They will attend multidisciplinary rounds regarding their patients as appropriate. They will meet with discharge planners and representatives of Respiratory Therapy Services to evaluate and understand resources available for patients with lung disease. The fellow will spend time with personnel from the Pulmonary Function Laboratory, Respiratory Therapy Department, Pulmonary Rehabilitation, and the Sleep Center to learn the particulars of these aspects of Pulmonary Medicine. The fellow will be expected to participate in some form of quality improvement project either within the Section or the Hospital.

Fellows will be expected to take on greater responsibility for patient care and management as well as educational pursuits during the course of their training. Their level of performance of and progress within each of these areas of core competency will be regularly evaluated by the attending staff, residents and students, the nursing staff, and other staff as appropriate.

| Expectations for Progression of ACGME Competencies for Pulmonary Fellows |   |  |  |
|--|---|--|--|
| Competency   | 0 – 6 months  | 6 – 18 months  | 18 – 24 months                                   |
| Medical Knowledge  | That of a skilled internist                         | Progressively more in-depth regarding pulmonary medicine | That of a specialist in pulmonary medicine       |
| Patient Care   | That of a skilled internist with little supervision | Progressively more independent                           | That of an independent consultant                |
| IPCS   | That of a skilled internist                         | Progressively more specialized                           | That of an independent consultant                |
| Professionalism  | That of a skilled internist                         | Commensurate with level of experience                    | That of an independent consultant                |
| PBL and I  | That of a skilled internist                         | Progressively more involved in pulmonary topics          | Dedication to life long learning as a consultant |
| SBL  | That of a skilled internist                         | That of a developing specialist                          | That of an independent consultant                |

## **ACGME Competencies Further Defined:**

### **Patient Care**

Residents must be able to provide patient care that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health. Residents are expected to:

### **Medical Knowledge**

Residents must demonstrate knowledge of established and evolving biomedical, clinical, epidemiological and social-behavioral sciences, as well as the application of this knowledge to patient care. Residents are expected to:

### **Practice-based Learning and Improvement**

Residents must demonstrate the ability to investigate and evaluate their care of patients, to appraise and assimilate scientific evidence, and to continuously improve patient care based on constant self-evaluation and life-long learning. Residents are expected to develop skills and habits to be able to meet the following goals:

1. Identify strengths, deficiencies, and limits in one's knowledge and expertise;
2. set learning and improvement goals;
3. Identify and perform appropriate learning activities;
4. Systematically analyze practice using quality improvement methods, and implement changes with the goal of practice improvement;
5. Incorporate formative evaluation feedback into daily practice;
6. Locate, appraise, and assimilate evidence from scientific studies related to their patients' health problems;
7. Use information technology to optimize learning; and,
8. Participate in the education of patients, families, students, residents and other health professionals.

### **Interpersonal and Communication Skills**

Residents must demonstrate interpersonal and communication skills that result in the effective exchange of information and collaboration with patients, their families, and health professionals. Residents are expected to:

1. Communicate effectively with patients, families, and the public, as appropriate, across a broad range of socioeconomic and cultural backgrounds;
2. Communicate effectively with physicians, other health professionals, and health related agencies;
3. Work effectively as a member or leader of a health care team or other professional group;
4. Act in a consultative role to other physicians and health professionals; and,
5. Maintain comprehensive, timely, and legible medical records, if applicable.

## **Professionalism**

Residents must demonstrate a commitment to carrying out professional responsibilities and an adherence to ethical principles. Residents are expected to demonstrate:

1. Compassion, integrity, and respect for others;
2. Responsiveness to patient needs that supersedes self-interest;
3. Respect for patient privacy and autonomy;
4. Accountability to patients, society and the profession; and,
5. Sensitivity and responsiveness to a diverse patient population, including but not limited to diversity in gender, age, culture, race, religion, disabilities, and sexual orientation.

## **Systems-based Practice**

Residents must demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care. Residents are expected to:

1. Work effectively in various health care delivery settings and systems relevant to their clinical specialty;
2. Coordinate patient care within the health care system relevant to their clinical specialty;
3. Incorporate considerations of cost awareness and risk-benefit analysis in patient and/or population-based care as appropriate;
4. Advocate for quality patient care and optimal patient care systems;
5. Work in multidisciplinary teams to enhance patient safety and improve patient care quality; and
6. Participate in identifying system errors and implementing potential systems solutions.

The above are as approved by the ACGME 2/13/2007 and are copied from their web site (acgme.org). They are subject to change from time to time as revised and amended by the ACGME.

**I have been given a printed copy of the entire fellowship curriculum, understand its goals, and will work to achieve its objectives:**

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**Fellow's Signature**

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**Date**

## **FELLOWSHIP YEAR 1**

### **ROTATION PCS 1 & PCS 2: GENERAL CHEST RADIOGRAPHY, PULMONARY FUNCTION PHYSIOLOGY/CARDIOPULMONARY EXERCISE TESTING, OBSTRUCTIVE LUNG DISEASE, AND INTRODUCTION TO SLEEP MEDICINE**

Although included as part of PCS 1 and PCS 2, the learning of these topics will be longitudinal throughout the fellowship and the fellows' abilities and knowledge will be expected to progress over the course of their training.

#### **Chest Radiography:**

##### **Normal Anatomy**

1. Name and define the three zones of the airways (West 1-3, ? 4);
2. Define a secondary pulmonary lobule;
3. Define an acinus;
4. List the lobar and segmental bronchi of both lungs;
5. Identify the following structures on the posteroanterior (PA) chest radiograph:
  - a. Lungs – the lobes of each lung;
  - b. Fissures – minor, superior accessory, inferior accessory, azygous;
  - c. Airway – trachea, carina, main bronchi;
  - d. Heart – right atrium, left atrial appendage, left ventricle, right ventricle, location of valves;
  - e. Pulmonary arteries – main, right, left, interlobar;
  - f. Aorta – ascending, arch, descending;
  - g. Veins – superior vena cava, azygous, left superior intercostal (“aortic nipple”);
  - h. Bones – spine, ribs, clavicles, scapulae, humerus;
  - i. Right paratracheal stripe;
  - j. Junction lines – anterior, posterior;
  - k. Aortopulmonary window;
  - l. Azygoesophageal recess;
  - m. Paraspinal lines;
  - n. Left subclavian artery;
6. Identify the following structures on the lateral chest radiograph:
  - a. Lungs – right, left, right upper, middle and lower lobes, left upper and lower lobes, lingula;
  - b. Fissures – major, minor, superior accessory;
  - c. Airway – trachea, upper lobe bronchi, posterior wall of bronchus intermedius;
  - d. Heart – right ventricle, right ventricular outflow tract, left atrium, left ventricle, the location of the four cardiac valves;
  - e. Pulmonary arteries – right, left;
  - f. Aorta – ascending, arch, descending;
  - g. Veins – SVC, IVC, left brachiocephalic (innominate), pulmonary vein confluences;
  - h. Bones – spine, ribs, scapulae, humerus;
  - i. Retrosternal space;
  - j. Posterior tracheal stripe;
  - k. Right and left hemidiaphragms;
  - l. Brachiocephalic (innominate artery).

#### Additional Anatomical Structures:

- Pleura and extrapleural fat;
- Pericardium – including pericardial recesses;
- Arteries - brachiocephalic (innominate), common carotid, subclavian, axillary, vertebral, internal mammary;
- Veins – pulmonary, superior vena cava, inferior vena cava, brachiocephalic, subclavian, internal jugular, external jugular, azygous, hemiazygous, left superior intercostal (aortic nipple), internal mammary;
- Esophagus;
- Thymus;
- Thyroid;
- Muscles – sternocleidomastoid, anterior and middle scalene, strap, pectoralis (major and minor), deltoid, trapezius, infraspinatus, supraspinatus, subscapularis, latissimus dorsi, serratus anterior;
- Azygoesophageal recess;
- Gastrohepatic ligament.

#### Skills:

- Demonstrate ability to recognize normal chest anatomy;
- Demonstrate ability to diagnose common conditions (e.g. collapsed lobes) and life threatening conditions (e.g. pneumothorax) on chest radiographs;
- Demonstrate appropriate use of chest radiography as part of a diagnostic and/or treatment plan;
- Demonstrate the proper use of radiological equipment such as fluoroscopy equipment and special radiographic views (e.g. decubitus views and lordotic views and films in expiration);
- Demonstrate understanding of normal and abnormal cardiac and great vessel anatomy;
- Demonstrate understanding of the physiologic basis for common diseases (e.g. congestive heart failure, pulmonary hypertension, pericardial effusions with tamponade, and coarctation of the aorta), as well as the CXR and CT findings in common diseases of the heart and great vessels;
- Demonstrate knowledge of the use, placement, appropriate position, and complications of the following:
  - Endotracheal tube;
  - Central venous catheter (subclavian, internal jugular, peripheral, PAC);
  - Feeding tube;
  - Nasogastric tube;
  - Chest tubes (including pericardial drains);
  - Intra-aortic balloon pump (including how it works);
  - Pacemaker and pacemaker leads;
  - Automatic implantable cardiac defibrillator;
  - Left ventricular assist device;
  - Intraesophageal manometer, temperature probe or pH probe;
  - Tracheal, bronchial, and endovascular stent.

## Skills:

Be able to define, identify, and state the significance of the following:

- Air bronchogram – indicates a parenchymal process, including non-obstructive atelectasis, as distinguished from pleural or mediastinal processes;
- Air crescent sign – indicates a lung cavity often due to fungal infection;
- Deep sulcus sign on a supine radiograph – indicates pneumothorax;
- Continuous diaphragm sign – indicates pneumomediastinum;
- Ring around the artery sign (around pulmonary artery on lateral chest radiograph) – indicates pneumomediastinum;
- Fallen lung sign – indicates a fractured bronchus;
- Flat waist sign – indicates left lower lobe collapse;
- Gloved finger sign – indicates bronchial impaction;
- Golden S sign – indicates lobar collapse with a central mass, suggesting an obstructing bronchogenic carcinoma in an adult;
- Luftsichel sign – indicates upper lobe collapse, potentially due to an obstructing bronchogenic carcinoma in an adult;
- Hampton's hump – indicates a pulmonary infarct;
- Silhouette sign – loss of the contour of the heart or diaphragm used to localize a parenchymal process (e.g. a process involving the medial segment of the right middle lobe obscures the right heart border; a lingular process obscures the left heart border; a basilar segmental lower lobe process obscures the diaphragm);
- Cervicothoracic sign – a mediastinal opacity that projects above the clavicles is retrotracheal and posteriorly situated, while an opacity effaced along its superior aspect and projecting at or below the clavicles is situated anteriorly;
- Tapered margins sign – a lesion in the chest wall, mediastinum or pleura will have smooth tapered borders and obtuse angles with the chest wall or mediastinum while parenchymal lesions usually form acute angles;
- Figure 3 sign – abnormal contour of the descending aorta, indicating coarctation of the aorta;
- Fat pad sign or sandwich sign – indicates pericardial effusion on lateral chest radiograph;
- Hilum overlay sign and hilum convergence sign – used to distinguish a hilar mass from a non-hilar mass.

## Chest CT Scans:

Be able to identify the following on a CT scan of the chest:

- Lungs – all lobes and segments; secondary pulmonary lobules;
- Fissures – major, minor, azygous, accessory;
- Airway – lobar and segmental bronchi;
- Inferior pulmonary ligament;
- Cardiac structures (chambers, valves, coronary arteries);
- Pulmonary arteries (main, right, left, lobar, segmental);
- Bony structures (spine and spinous processes, ribs, scapulae, humeri);
- Diaphragms;
- Upper abdominal structures including liver, spleen, stomach, and adrenals.

Other imaging modalities important for the pulmonologist:

1. Know the uses of ultrasound for evaluating pleural effusions and pneumothorax;
2. Know the utility of PET scan evaluation for various lung processes including malignancy.
3. Know the utility of MRI imaging of the chest.

Pulmonary Function Testing:

1. Spend 2 hours with Respiratory Therapy Staff (Joe Horne *et al.*) to learn the actual mechanics and physical principles of pulmonary function testing;
2. Understand the physical principles of spirometry and of body-box vs. gas dilution volume determinations;
3. Understand the physical principles of measuring the diffusing capacity of carbon monoxide (DLCO) and reasons for corrections;
4. Understand the indications for obtaining pulmonary function tests;
5. Master the seminal features of obstructive lung disease on spirometric and lung volume measurements.

Cardiopulmonary exercise testing:

1. Understand how cardiopulmonary exercise testing can help evaluate individuals with dyspnea and or with performance limitations;
2. Know the indications for cardiopulmonary exercise testing;
3. Review important aspects of exercise physiology, methodology, and protocols used in exercise testing;
4. Review the conceptual basis and practical applications of selected measurements used in the interpretation of cardiopulmonary exercise testing results;
5. Recognize usual patterns of exercise response in patients with COPD, interstitial lung disease, vascular disease, heart failure, obesity, and deconditioning.

Obstructive Lung Diseases (OLD)

General knowledge:

1. Understand the respiratory mechanics of OLD (airflow resistance and dynamic hyperinflation);
2. Be familiar with the PFT's of OLD and the physiologic basis of abnormalities seen;
3. Know the pathophysiology of asthma, COPD, bronchiolitis, and bronchiectasis;
4. Management of OLD (medical, surgical, and other);
5. Special cases OLD: cystic fibrosis, alpha-1 antitrypsin disease, allergic bronchopulmonary aspergillosis, Churg Strauss, cardiogenic asthma.

Basic science:

1. Know including the role of inflammatory cells mediators in the cause and sequelae of each disease state;
2. Understand the genetics of asthma and COPD (especially alpha-one antitrypsin);
3. Understand the mechanism of medications used to treat OLD including the effects of the medications at the molecular/receptor level as well as the physiologic effects of surgical interventions;
4. Understand the genetics and role of the cystic fibrosis transmembrane regulator;
5. Understand the role of inflammatory mediators on the pathophysiology of bronchiectasis.



### Radiographic Findings of OLD:

1. Recognize patterns of complete and partial (including combinations) collapse of the right or left lung on a chest radiograph, and list an appropriate differential diagnosis for the etiology of the collapse;
2. Distinguish lung collapse from massive pleural effusion on a frontal chest radiograph;
3. Name the four types of bronchiectasis, and identify each type on a chest CT;
4. Name common causes of bronchiectasis;
5. Recognize the typical appearance of cystic fibrosis on a radiograph and chest CT;
6. Name the important things to look for on a chest radiograph when the patient history is "asthma";
7. Define and recognize tracheomegaly;
8. Recognize tracheal and bronchial stenosis on chest CT, and name the most common causes;
9. Name the three types of pulmonary emphysema, and identify each type on a chest CT;
10. Recognize alpha-1-antitrypsin deficiency on a chest radiograph and chest CT;
11. Recognize Kartagener's syndrome on a chest radiograph, and name the three components of the syndrome;
12. Define the term giant bulla, differentiate giant bulla from pulmonary emphysema and state the role of imaging in patient selection for bullectomy;
13. State the imaging findings used to identify surgical candidates for giant bullectomy and for lung volume reduction surgery.

### Sleep Medicine:

1. Learn how to do a sleep clinic patient intake (focused history and physical examination) and how to order studies appropriately;
2. Review parameters measured in polysomnography;
3. Identify different stages of sleep (physiology/EEG) using the most up-to-date scoring criteria;
4. Understand clinical prediction rules for OSA;
5. Recognize patients at risk for OSA and CSA;
  - a. Be aware of familial aggregations of both.
  - b. Know the genetic basis of congenital central hypoventilation syndrome (PHOX2B gene).
6. Be able to explain OSA at a physiologic level (i.e. the concept of the Starling resistor and Pcrit).
7. Be able to enumerate the sequelae of OSA;
  - a. Sleepiness and its consequences.
  - b. Increased risk for cardiovascular morbidity and mortality.
  - c. Metabolic consequences.
  - d. Endocrine dysfunction that may predispose to or eventuate from OSA.
8. Recognize symptoms of restless leg syndrome and periodic limb movements of sleep and be aware of the differences between the two and the association with other medical conditions;
  - a. Be aware of the genetics of RLS/PLMS.
  - b. Understand the role of the iron – dopamine system in these disorders.
  - c. Recognize the similar pathogenesis of these disorders and Parkinson's disease.

9. Know the treatment of RLS/PLMS (medical and adjunctive); including the effects of the medications at the molecular/receptor level as well as the physiologic effects of surgical interventions;
10. Know the manifestations of narcolepsy and understand their pathophysiology;
  - a. Be aware of the genetics of narcolepsy.
  - b. Understand the role of the hypocretin/orexin system in this disorder.
  - c. Be aware of the literature regarding animal models of narcolepsy.
11. Know the appropriate diagnostic strategy for and management of narcolepsy;
12. Develop understanding of the neural control of sleep (including brain areas and neurotransmitters involved in each stage) and the pathophysiologic abnormalities involved in various sleep disorders (especially the hypocretin/orexin system involved in narcolepsy and the neurologic/neuromuscular involvement in RLS/PLMS).

#### Required Reading:

Fellows are required to read, at a minimum, the seminal articles listed below and present at least one of them to the team each week. Additional systematic "area of emphasis reading" can be found in the textbooks listed below and seminal articles can be found for these areas at: <http://www.thoracic.org/fellows/syllabusintro.asp>. Most textbooks are in the fellows' conference room on the 6<sup>th</sup> floor.

#### Articles:

1. Webb, W.R., *Radiology of obstructive pulmonary disease*. AJR Am J Roentgenol, 1997;169(3):637-47.
2. Austin, J.H., et al., *Glossary of terms for CT of the lungs: recommendations of the Nomenclature Committee of the Fleischner Society*. Radiology, 1996;200(2):327-31.
3. Beckh, S., Bolcskei, P.L., and Lessnau, K.E., *Real-time chest ultrasonography: a comprehensive review for the pulmonologist*. Chest 2002;122(5):1759-73.
4. Diacon, A.H., Theron, J., and Bolliger, C.T., *Transthoracic ultrasound for the pulmonologist*. Curr Opin Pulm Med, 2005;11(4):307-12.
5. Nelson HS. B-Adrenergic bronchodilators. NEJM 1995; 333: 499-506.
6. Drazen, J.M., E. Israel, and P.M. O'Byrne, *Treatment of asthma with drugs modifying the leukotriene pathway*. N Engl J Med, 1999. 340(3):197-206.
7. Salpeter, S.R., et al., *Meta-analysis: effect of long-acting beta-agonists on severe asthma exacerbations and asthma-related deaths*. Ann Intern Med, 2006. 144(12): 904-12.
8. Boushey, H.A. et al., *Daily versus as-needed corticosteroids for mild persistent asthma*. N Engl J Med 2005. 352(15): 1519-28.
9. Suissa, S., et al., *Low-dose inhaled corticosteroids and the prevention of death from asthma*. N Engl J Med, 2000. 343(5): 332-6.
10. Nelson, H.S. et al., *The Salmeterol Multicenter Asthma Research Trial: a comparison of usual pharmacotherapy for asthma or usual pharmacotherapy plus salmeterol*. Chest, 2006; 129(1): 15-26.
11. Rodrigo, G.J., Rodrigo, C., and Hall, J.B., *Acute asthma in adults: a review*. Chest, 2004; 125(3): 1081-102.
12. NIH Guidelines for Asthma:  
<http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm>
13. Bilton, D., *Update on non-cystic fibrosis bronchiectasis*. Curr Opin Pulm Med, 2008. 14(6): 595-9.