# The Thoracic Surgery Milestone Project

January 2014

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The milestones are designed only for use in evaluation of resident physicians in the context of their participation in ACGME-accredited residency or fellowship programs. The milestones provide a framework for the assessment of the development of the resident physician in key dimensions of the elements of physician competency in a specialty or subspecialty. They neither represent the entirety of the dimensions of the six domains of physician competency, nor are they designed to be relevant in any other context.

# Thoracic Surgery Milestones

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# Milestone Reporting

This document presents milestones designed for programs to use in semi-annual review of resident performance and reporting to the ACGME. Milestones are knowledge, skills, attitudes, and other attributes for each of the ACGME competencies organized in a developmental framework from less to more advanced. They are descriptors and targets for resident performance as a resident moves from entry into residency through graduation. In the initial years of implementation, the Review Committee will examine milestone performance data for each program's residents as one element in the Next Accreditation System (NAS) to determine whether residents overall are progressing.

For each period, review and reporting will involve selecting milestone levels that best describe a resident's current performance and attributes. Milestones are arranged into numbered levels. Tracking from Level 1 to Level 5 is synonymous with moving from novice to expert. These levels do not correspond with post-graduate year of education. Please note that residents in a traditional program may start at a higher level for many of the milestones due to their previous experience within the general surgery program.

Selection of a level implies that the resident substantially demonstrates the milestones in that level, as well as those in lower levels (see the diagram on page v).

**Level 1:** The resident demonstrates milestones expected of an incoming resident.

**Level 2:** The resident is advancing and demonstrates additional milestones, but is not yet performing at a mid-residency level.

**Level 3:** The resident continues to advance and demonstrate additional milestones, consistently including the majority of milestones targeted for residency.

**Level 4:** The resident has advanced so that he or she now substantially demonstrates the milestones targeted for residency. This level is designed as the graduation target.

**Level 5:** The resident has advanced beyond performance targets set for residency and is demonstrating "aspirational" goals which might describe the performance of someone who has been in practice for several years. It is expected that only a few exceptional residents will reach this level.

**Additional Notes**

Level 4 is designed as the graduation *target* and does not represent a graduation *requirement*. Making decisions about readiness for graduation is the purview of the residency program director. Study of milestone performance data will be required before the ACGME and its partners will be able to determine whether milestones in the first four levels appropriately represent the developmental framework, and whether milestone data are of sufficient quality to be used for high-stakes decisions.

Some milestone descriptions include statements about performing independently. These activities must conform to ACGME supervision guidelines, as well as institutional and program policies. For example, a resident who performs a procedure independently must, at a minimum, be supervised through oversight.

Examples are provided with some milestones. Please note that the examples are not the required element or outcome; they are provided as a way to share the intent of the element.

*Answers to Frequently Asked Questions about Milestones are available on the Milestones web page:* *http://www.acgme.org/acgmeweb/Portals/0/MilestonesFAQ.pdf.*

The diagram below presents an example set of milestones for one sub-competency in the same format as the milestone report worksheet. For each reporting period, a resident's performance on the milestones for each sub-competency will be indicated by:

- selecting the level of milestones that best describes that resident's performance in relation to the milestones

or

- for Patient Care and Medical Knowledge milestones, selecting the option that says the resident has "Not yet rotated"

or

- for Interpersonal and Communication Skills, Practice-based Learning and Improvement. Professionalism, and Systems-based Practice milestones, selecting the option that says the resident has "Not yet achieved Level 1"

### Systems Based Practice – Patient Safety

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Understands the differences between medical errors, near misses, and sentinel events.<br><br>• Understands the roles of care team members. | • Participates in the use of tools to prevent adverse events (e.g., checklists and briefings).<br><br>• Describes the common system causes for errors. | • Consistently uses tools to prevent adverse events (e.g., checklists and briefings).<br><br>• Reports problematic behaviors, processes, and devices including errors and near misses.<br><br>• Demonstrates structured communication tool for hand-offs. | • Participates in the analysis of shared team experiences to prevent future errors using proven analysis techniques (e.g., root cause analysis, failure mode effects analysis).<br><br>• Leads team by promoting situational awareness and input by all team members.<br><br>• Conducts morbidity and mortality conference to improve patient safety. | • Leads curriculum design to teach teamwork and communication skills to healthcare professionals.<br><br>• Leads multidisciplinary teams (e.g., human factors engineers, social scientists) to address patient safety issues. |

Comments:

Not yet achieved Level 1

Selecting a response box in the middle of a level implies that milestones in that level and in lower levels have been substantially demonstrated.

Selecting a response box on the line in between levels indicates that milestones in lower levels have been substantially demonstrated as well as **some** milestones in the higher level(s).

v

## Ischemic Heart Disease — Medical Knowledge

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Knows basic anatomy and pathology (identifies coronary anatomy on angiogram)<br>• Knows basic cellular and vascular physiology<br>• Lists clinical manifestations of ischemic heart disease (e.g., angina, myocardial infarction)<br>• Lists diagnostic tools available for evaluation of ischemic heart disease<br>• Lists treatment options for ischemic heart disease (e.g., coronary artery bypass graft [CABG], percutaneous coronary intervention [PCI])<br>• Knows basic complications for ischemic heart disease | • Understands common variations in anatomy and pathology (e.g., left dominant system)<br>• Understands physiologic changes accompanying ischemic heart disease (e.g., ischemia, ischemia reperfusion injury, infarction, recovering myocardium)<br>• Generates differential diagnosis of disease with similar manifestations (e.g., esophageal and aortic problems, pleurisy)<br>• Understands advantages and disadvantages of diagnostic tools in evaluating ischemic heart disease (e.g., electrocardiogram [EKG] vs. echocardiogram vs. angiogram)<br>• Understands advantages and disadvantages of various treatment options for ischemic heart disease<br>• Understands risks, benefits and complications of treatment modalities | • Understands complex integrations between anatomy and pathology (e.g., anomalous coronary artery)<br>• Understands the role of treatment on physiology of ischemic heart disease<br>• Identifies the common variants of the clinical manifestations of ischemic heart disease (e.g., unstable angina, acute myocardial infarction, silent ischemia)<br>• Interprets normal and common abnormalities associated with ischemic heart disease (e.g., reads coronary angiogram, complex EKG)<br>• Identifies appropriate treatment for routine patient with ischemic heart disease.<br>• Familiar with American College of Cardiology [ACC]/Society for Thoracic Surgery [STS]/Association of American Thoracic Surgeons [AATS] guidelines<br>• Knows basic outcome literature for ischemic heart disease (e.g., SYNTAX Trial) | • Understands complex variations in anatomy and pathology, including congenital (e.g., able to identify coronary anatomy in reoperative surgery)<br>• Adapts therapeutic management based on understanding of physiology of complications of ischemic heart disease (e.g., post infarct ventricular septal defect [VSD], ischemic mitral regurgitation)<br>• Distinguishes the complex clinical manifestations and complications of ischemic heart disease<br>• Interprets and integrates complex abnormalities associated with ischemic heart disease<br>• Identifies appropriate treatment for complex patient with ischemic heart disease (e.g., hybrid CABG)<br>• Knows outcomes for all treatment modalities and complications, including databases and clinical trials (e.g., STS Database) | • Understands implications of SYNTAX score<br>• Presents on outcomes of ischemic heart disease at local, regional, or national meeting |
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**Comments:**

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## Ischemic Heart Disease — Patient Care and Technical Skills

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Orders basic diagnostic and pre-operative assessment tests for ischemic heart disease (e.g., cardiac cath, stress test)<br>• Lists basic treatment options for routine ischemic heart disease (e.g., medical management, PCI vs. CABG)<br>• Demonstrates basic surgical skills (simulation vs. operation room [OR]) | • Interprets and prioritizes diagnostic and physiologic assessment tests for routine patient with ischemic heart disease<br>• Recognizes routine post-operative complications (e.g., cerebral vascular accident [CVA], shock, tamponade, interprets abnormal EKG)<br>• Suggests treatment plan for patient with routine ischemic heart disease<br>• Assesses and harvests conduits (e.g., vein mapping)<br>• Performs surgical opening and closing<br>• Provides basic intra-operative assisting<br>• Performs proximal coronary anastomosis | • Establishes a diagnostic and assessment plan for patients with routine ischemic heart disease (e.g., role of functional testing in ischemic heart disease)<br>• Manages routine post-operative complications (e.g., return to the OR vs. return to cath lab)<br>• Selects ideal treatment option for patient with routine ischemic heart disease (e.g., institutes treatment per ACC/STS/AATS guidelines)<br>• Institutes and weans patient from cardiopulmonary bypass<br>• Performs routine CABG | • Establishes a diagnostic and assessment plan for complex patients with ischemic heart disease<br>• Manages complex post-operative complications (e.g., need for ventricular assist)<br>• Selects ideal treatment option for patient with complex ischemic heart disease (e.g., combined coronary and carotid disease)<br>• Manages complex coronary disease (e.g., redo CABG, VSD, ischemic mitral regurgitation [MR], off pump) | • Independently performs reoperative coronary bypass grafting<br>• Independently performs coronary endarterectomy |

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**Cardiopulmonary Bypass, Myocardial Protection and Temporary Circulatory Support — Medical Knowledge**

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Lists basic components of cardiopulmonary bypass apparatus (e.g., oxygenator, pump heads, heat exchanger, low level alarm, in line monitoring)<br>• Understands pulsatile vs. non-pulsatile pump physiology<br>• Understands basic myocardial protection. (e.g., oxygen requirement, oxygen delivery, myocardial relaxation)<br>• Understands coagulation cascade (e.g., intrinsic and extrinsic pathways)<br>• Lists complications of cardiopulmonary bypass (e.g., bleeding, renal failure, pulmonary dysfunction) | • Discusses options for myocardial protection (e.g., cardioplegia vs. beating heart)<br>• Discusses cannulation techniques and options for cardiopulmonary bypass (e.g., single venous, bicaval, aortic, peripheral arteries, cold, full or partial)<br>• Understands intra-aortic balloon pump physiology (e.g., diastolic augmentation and presystolic dip)<br>• Understands coagulation cascade inhibitors (e.g., heparin, argatroban)<br>• Understands complications of cardiopulmonary bypass<br>• Lists treatment strategies for cardiac injury without cardiac bypass, including trauma | • Demonstrates knowledge of cardioplegia solutions and delivery modes (e.g., crystalloid, blood, antegrade, retrograde)<br>• Demonstrates knowledge of acid-base and anticoagulation management on cardiopulmonary bypass (e.g., pH stat, alpha stat, activated clotting time [ACT])<br>• Demonstrates knowledge of pharmacologic management of postcardiotomy hemodynamics (e.g., inotropes, vasodilators)<br>• Discusses advantages and disadvantages of different myocardial protection strategies<br>• Lists management strategies of routine complications related to cardiopulmonary bypass (e.g., air in the heart, inadequate drainage, incomplete arrest)<br>• Demonstrates knowledge of post-operative sequelae from cardiopulmonary bypass (e.g., low cardiac output syndrome, coagulopathies, arrhythmias, heparin-induced thrombocytopenia [HIT]) | • Explains advanced cardiopulmonary support (e.g., circulatory arrest or extracorporeal membrane oxygenation [ECMO])<br>• Explains the management of postcardiotomy shock syndrome (e.g., inotropes, intra-aortic balloon pump [IABP], mechanical support)<br>• Explains management strategies of complex complications related to cardiopulmonary bypass (e.g., aortic dissection, air embolism)<br>• Explains treatment strategies for post-operative sequelae from cardiopulmonary bypass (e.g., low cardiac output syndrome, coagulopathies, arrhythmias, HIT) | • Develops simulation scenarios for complications related to cardiopulmonary bypass |

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## Cardiopulmonary Bypass, Myocardial Protection and Temporary Circulatory Support — Patient Care and Technical Skills

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Demonstrates basic surgical skills (simulation vs. OR) | • Performs axillary, femoral, arterial, or venous cannulation<br>• Performs peripheral vascular access<br>• Performs surgical opening and closing<br>• Assists perfusionist with cardiopulmonary bypass setup and pump run | • Cannulates and institutes cardiopulmonary bypass, including myocardial protection in routine cases<br>• Manages cardiopulmonary bypass and myocardial protection in routine cases<br>• Weans and decannulates from cardiopulmonary bypass for routine cases<br>• Recognizes and manages common acute complications (e.g., coagulopathy, pump failure) | • Cannulates and institutes cardiopulmonary bypass, including myocardial protection in complex cases<br>• Manages cardiopulmonary bypass and myocardial protection in complex cases<br>• Weans and decannulates from cardiopulmonary bypass for complex cases<br>• Institutes temporary circulatory support for cardiogenic shock (e.g., intraaortic balloon pump, ECMO, short term left ventricular [LV] assist)<br>• Recognizes and manages unusual acute complications (e.g., aortic dissection) | • Operates in a hostile chest (e.g., radiation, porcelain aorta, use of epiaortic probe, patent grafts)<br>• Performs left ventricular assist device procedures or transplant |

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## Valvular Disease — Medical Knowledge

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Knows basic anatomy and pathology of valvular heart disease<br>• Knows basic normal valve physiology<br>• Lists clinical manifestations of isolated valvular heart disease (e.g., dyspnea, angina, edema, syncope)<br>• Lists diagnostic tools available for evaluation of valvular heart disease<br>• Lists treatment options for valvular heart disease<br>• Knows basic complications for valvular heart disease (e.g., peri-operative complications for aortic valve replacement) | • Knows common variations in anatomy and pathology of valvular heart disease (e.g., Mitral Regurgitation, Types II and III)<br>• Explains physiologic changes accompanying valvular heart disease (e.g., pulmonary hypertension)<br>• Generates differential diagnosis of diseases with similar manifestations (e.g., coronary artery disease, emphysema)<br>• Explains advantages and disadvantages of diagnostic tools in evaluating valvular heart disease (e.g., surface vs. transesophageal echo)<br>• Recites advantages and disadvantages of various treatment options for valvular heart disease (e.g., repair vs. replacement)<br>• Recites risks, benefits and complications of treatment modalities (e.g., cites frequency of common complications) | • Explains complex integrations between anatomy and pathology of valvular heart disease (e.g., bicuspid aortic valve and stenosis, functional mitral and tricuspid regurgitation)<br>• Explains the role of treatment on physiology of valvular heart disease, including arrhythmia management, (e.g., the mechanism of surgical atrial fibrillation treatment)<br>• Identifies the common variants of the clinical manifestations of valvular heart disease (e.g., fatigue, exercise intolerance)<br>• Interprets normal and common abnormalities associated with valvular heart disease, including intra-operative transesophageal echocardiography<br>• Identifies appropriate treatment for routine patient with valvular heart disease<br>• Familiar with ACC/STS/AATS guidelines<br>• Explains basic outcome literature for valvular heart disease (e.g., durability of | • Explains complex variations in anatomy and pathology, including congenital (e.g., contribution of coronary disease to mitral regurgitation, bicuspid aortic valve and ascending aneurysm)<br>• Adapts therapeutic management based on understanding of physiology (e.g., explains when to correct mitral or tricuspid regurgitation in setting of aortic stenosis or coronary artery disease)<br>• Distinguishes the complex clinical manifestations and complications of valvular heart disease (e.g., staging of congestive heart failure)<br>• Interprets and integrates complex abnormalities associated with valvular heart disease (e.g., hypertrophic obstructive cardiomyopathy)<br>• Identifies appropriate treatment for complex patient with valvular heart disease (e.g., combined coronary artery disease, aortic aneurysm, or aortic root enlargement)<br>• Explains outcomes for all | • Presents on outcomes valvular heart disease at local, regional, or national meeting |

| | | mitral valve repair) | treatment modalities and complications, including databases and clinical trials (e.g., outcome after minimally invasive valves, success of sinus restoration in surgery for atrial fibrillation) | |
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## Valvular Disease — Patient Care and Technical Skills

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Orders basic diagnostic and pre-operative assessment tests for valvular heart disease<br>• Lists basic treatment options for routine valvular heart disease<br>• Demonstrates basic surgical skills (simulation vs. OR) | • Interprets and prioritizes diagnostic and physiologic assessment tests for routine patient with valvular heart disease (e.g., echocardiogram, cardiac cath)<br>• Suggests treatment plan for patient with routine single valvular heart disease (e.g., single valve replacement in a symptomatic patient with aortic stenosis)<br>• Recognizes routine post-operative complications (e.g., identifies surgically significant bleeding)<br>• Identifies surgical approach for each valve<br>• Performs surgical opening and closing<br>• Performs basic Intra-operative assisting | • Provides a diagnostic and assessment plan for patients with routine valvular heart disease (e.g., intra-operative transesophageal echocardiogram)<br>• Selects ideal treatment option for patient with acquired valvular heart disease (e.g., double valve replacement)<br>• Manages routine post-operative complications (e.g., decides to return to operating room, management of heart block)<br>• Institutes and weans patient from cardiopulmonary bypass<br>• Performs optimal myocardial protection strategy<br>• Performs routine valvular replacement | • Forms a diagnostic and assessment plan for complex patients with valvular heart disease (e.g., intra-operative mitral regurgitation on a patient scheduled for isolated coronary artery bypass)<br>• Selects ideal treatment option for patient with complex valvular heart disease (e.g., valvular repair, congenital valve repair)<br>• Manages complex post-operative complications, including arrhythmias (e.g., management of paravalvular leak or systolic anterior motion [SAM])<br>• Performs complex valvular replacement<br>• Performs valvular repair | • Selects ideal plan for a patient with prior transcatheter valve, minimally invasive valve<br>• Performs minimally invasive, percutaneous, or robotic approaches to valvular heart disease<br>• Performs atrial and ventricular arrhythmia surgery<br>• Performs reconstruction of fibrous trigone in patient with endocarditis of mitral and aortic valves |

Comments:

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**Great Vessel Disease — Medical Knowledge**

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Knows basic anatomy and pathology of great vessels (e.g., aortic dissection classification, including spinal cord and cerebral perfusion)<br>• Lists clinical manifestations of great vessel disease, acquired and traumatic (e.g., chest pain syndromes, Marfan's syndrome)<br>• Lists diagnostic tools available for evaluation of great vessel disease<br>• Lists treatment options for great vessel disease<br>• Knows basic complications for great vessel disease (e.g., natural history treated and untreated) | • Understands common variations in anatomy and pathology of adult great vessel disease, acquired and traumatic (e.g., descending aortic tear from blunt trauma)<br>• Generates differential diagnosis of diseases with similar manifestations (e.g., myocardial infarction, esophageal spasm)<br>• Understands advantages and disadvantages of diagnostic tools in evaluating great vessel disease (e.g., computerized tomography [CT] scan vs. magnetic resonance imaging [MRI] vs. echocardiography vs. angiography)<br>• Understands advantages and disadvantages of various treatment options for great vessel disease (endovascular vs. open)<br>• Understands risks, benefits and complications of treatment modalities | • Understands integrations between anatomy and pathology of great vessel disease, acquired, congenital, and traumatic (e.g., atherosclerosis, penetrating ulcer, aortic dissection)<br>• Identifies the common variants of the clinical manifestations of great vessel disease, acquired, congenital, and traumatic (e.g., bowel ischemia, renal insufficiency)<br>• Interprets normal and common abnormalities associated with great vessel disease (e.g., sensitivity, specificity, accuracy of aortic imaging techniques)<br>• Identifies appropriate and/or adjunct treatment for routine patient with great vessel disease (neuroprotection, spinal cord protection, renal)<br>• Knows basic outcome literature for great vessel disease | • Understands complex variations in anatomy and pathology of great vessel disease, acquired, congenital, and traumatic (e.g., congenital arch anomalies leading to tracheal or esophageal compression)<br>• Distinguishes the complex clinical manifestations and complications of great vessel disease, acquired, congenital, and traumatic (e.g., myocardial infarction vs. acute aortic dissection)<br>• Interprets and integrates complex abnormalities associated with great vessel disease (e.g., aneurysm, dissection, pseudo-aneurysm, penetrating ulcer)<br>• Identifies appropriate treatment for complex patient with great vessel disease (e.g., cardiopulmonary bypass [CPB] techniques)<br>• Knows outcomes for all treatment modalities and complications, including databases and clinical trials | • Surgically manages acute and chronic pulmonary thromboembolic disease |

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| Great Vessel Disease — Patient Care and Technical Skills | | | | |
|---|---|---|---|---|
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| • Orders basic diagnostic and pre-operative assessment tests for great vessel disease (e.g., CT, echo, need for cath)<br>• Lists basic treatment options for routine great vessel disease (e.g., Type A vs. Type B dissections; timing of intervention)<br>• Demonstrates basic surgical skills (simulation vs. OR)<br>• Obtains advanced trauma life support (ATLS) certification | • Interprets and prioritizes diagnostic assessment tests for routine patient with great vessel disease (e.g., risk/benefit options)<br>• Suggests treatment plan for patient with routine great vessel disease (e.g., endovascular vs. open repair)<br>• Recognizes routine post-operative complications<br>• Identifies surgical approach<br>• Performs surgical opening, closing, and vascular access<br>• Provides basic intra-operative assisting | • Establishes a diagnostic and assessment plan for patients with routine great vessel disease (e.g., blunt aortic injury)<br>• Selects ideal treatment option for patient with routine great vessel disease, including peri-operative monitoring, perfusion, and neuroprotective strategies<br>• Manages routine post-operative complications<br>• Institutes and weans patient from cardiopulmonary bypass<br>• Provides optimal perfusion and myocardial/neuroprotection<br>• Performs routine aortic valvular replacement<br>• Performs simple vascular anastomosis | • Establishes a diagnostic and assessment plan for complex patients with great vessel disease (e.g., great vessel interventions in the elderly or patients with collagen vascular disease)<br>• Selects ideal treatment option for patient with complex great vessel disease, including peri-operative monitoring, perfusion and neuroprotective strategies (e.g., thoracoabdominal disease, chronic aortic dissections)<br>• Manages complex post-operative complications (e.g., multisystem organ failure)<br>• Performs complex great vessel replacement<br>• Performs aortic repair<br>• Participates in endovascular aortic surgery | • Performs endovascular aortic surgery<br>• Performs pulmonary thromboendarterectomy<br>• Performs hybrid approaches to complex aortic disease (e.g., debranching followed by endovascular procedure) |

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| Congenital Heart Disease — Medical Knowledge | | | | |
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| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| • Lists clinical manifestations of common congenital heart diseases (e.g., cyanosis, tachypnea, mottling, failure to thrive)<br>• Lists diagnostic tools available for evaluating congenital heart disease (e.g., EKG, chest x-ray, echocardiogram, cardiac cath) | • Lists basic congenital cardiac abnormalities (e.g., atrial septal defect [ASD], VSD, tetralogy of Fallot, transposition of great arteries)<br>• Lists physiologic changes accompanying congenital heart disease (e.g., right to left and left to right shunt, excessive or insufficient pulmonary blood flow)<br>• Discusses possible diagnostic modalities for various conditions<br>• Lists basic treatment options for congenital heart disease (e.g., diuretics, digoxin, palliative vs. definitive operations) | • Knows basic anatomy and pathology of congenital heart disease<br>• Understands physiologic changes accompanying congenital heart disease (e.g., Eisenmenger syndrome)<br>• Generates a differential diagnosis of diseases with similar manifestations (e.g., tachypnea due to increased pulmonary blood flow caused by ASD or VSD)<br>• Understands the advantages and disadvantages of diagnostic tools in evaluating congenital heart disease<br>• Understands advantages and disadvantages of various treatment options in congenital heart disease (e.g., pulmonary artery [PA] band vs. primary closure VSD)<br>• Knows basic complications of congenital heart disease (e.g., residual VSD, heart block) | • Understands common variations in anatomy and pathology (e.g., partial and complete atrioventricular [AV] septal defect, types of VSD)<br>• Understands the basics of the single ventricle pathway (e.g., Truncus, Norwood, transposition of the great arteries [TGA])<br>• Understands the role of treatment on physiology of congenital heart disease (e.g., role of pulmonary artery banding, acid-base balance benefits of pH stat or alpha stat)<br>• Understands the role of physiology of congenital heart disease on treatment modality options (e.g., patent foramen ovale [PFO], increased pulmonary vascular resistance in newborns)<br>• Identifies clinical manifestations of elective vs. emergent vs. urgent scenarios.<br>• Recognizes simple vs. complex disease<br>• Interprets normal and | • Understands complex integrations between anatomy and pathology (e.g., right ventricular [RV] dependent coronary sinusoids) |

common abnormalities associated with congenital heart disease, including echocardiography (e.g., identifies valve stenosis and regurgitation)
- Identifies appropriate treatment for common patient with congenital heart disease (e.g., selection of palliative vs. definitive, identifies for urgent vs. elective procedures)
- Understands strategies for complex reoperative surgery
- Understands risks, benefits and complications of various treatment modalities

**Comments:**

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**End Stage Cardiopulmonary Disease — Medical Knowledge**

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Knows basic cardiothoracic normal anatomy<br>• Knows basic normal respiratory and cardiovascular physiology<br>• Lists clinical manifestations of cardiac and pulmonary failure (e.g., dyspnea, fatigue, exercise intolerance, peripheral edema, pulmonary edema)<br>• Lists diagnostic tools available for evaluation of cardiac and pulmonary failure (e.g., arterial blood gas [ABG], CXR, PA line, echo)<br>• Understands the natural history of cardiac and pulmonary failure (e.g., end-stage emphysema) | • Knows basic pathology as it relates to cardiac and pulmonary failure (e.g., lung-pneumonia, ARDS, pathology of end-stage lung disease; heart-myocardial infarction, types of cardiomyopathy)<br>• Understands physiologic changes accompanying cardiac and pulmonary failure (e.g., increased work of breathing hypoxemia, hypercarbia, elevated lactate, tachycardia, hypotension, reduced cardiac output [CO])<br>• Generates differential diagnosis of causes of heart and pulmonary failure (e.g., heart-cardiomyopathy, coronary artery disease; pulmonary—interstitial lung disease, trauma)<br>• Understands advantages and disadvantages of diagnostic tools in evaluating cardiac and pulmonary failure (e.g., cardiac-PA catheter measurements, echo vs. cath, MRI pulmonary-transbronchial biopsy vs. | • Understands common variations in anatomy and pathology (e.g., advanced valvular disease, pulmonary fibrosis, sarcoidosis)<br>• Understands the role of treatment on physiology of cardiac and pulmonary failure (e.g., cardiac—medical management vs. IABP vs. mechanical support; pulmonary-medical treatment vs. need for mechanical ventilation)<br>• Identifies the common variants of the clinical manifestations of cardiac and pulmonary failure (e.g., cardiac—ischemic, post viral, postpartum, idiopathic; pulmonary—acute lung injury/ARDS, infectious)<br>• Interprets normal and common abnormalities associated with cardiac and pulmonary failure (e.g., cardiac—distinguishes various types of shock; pulmonary—surgical biopsy; acute vs. chronic cardiopulmonary failure)<br>• Understands advantages | • Understands complex integrations between anatomy and pathology (e.g., adult with congenital heart disease)<br>• Adapts therapeutic management based on understanding of physiology of cardiac and pulmonary failure (cardiac—need for mechanical support such as VAD; pulmonary—need for advanced mechanical ventilation)<br>• Distinguishes the complex clinical manifestations and complications of cardiac and pulmonary failure (e.g., adult congenital disease manifestations, mechanical complications of myocardial infarction)<br>• Interprets and integrates complex abnormalities associated with cardiac and pulmonary failure (e.g., distinguishes RV vs. LV vs. biventricular failure)<br>• Identifies appropriate treatment for patients with cardiac and | • Understands complex variations in anatomy and pathology as related to cardiac and pulmonary failure (e.g., Eisenmenger's complex)<br>• Understands the immunologic mechanisms in cardiac and pulmonary transplantation<br>• Understands non-pulsatile ventricular assist physiology<br>• Understands clinical manifestations of allograft rejection (e.g., hyperacute, acute, and chronic rejection)<br>• Understands clinical manifestations of complications of mechanical cardiopulmonary support (e.g., bleeding, line infection, sepsis, stroke, tamponade)<br>• Diagnoses complications of transplant and mechanical cardiopulmonary support (e.g., heart failure due to pulmonary hypertension, acute and chronic rejection, assist device failure, |

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| open biopsy, advanced pulmonary stress test) <br> • Lists treatment options for cardiac and pulmonary failure (e.g., medical vs. surgical management) <br> • Understands signs of decompensation and need for intervention for cardiac and pulmonary failure | and disadvantages of various treatment options for cardiac and pulmonary failure <br> • Understands risks, benefits and complications of treatment modalities (e.g., risk-benefit ratio) | pulmonary failure, and indications for transplantation or mechanical cardiopulmonary support (e.g., selection criteria for transplantation) <br> • Knows basic outcome literature for cardiac and pulmonary failure <br> • Understands limitations of mechanical support (e.g., recognizes when risks exceed benefits) | endomyocardial biopsy) <br> • Identifies appropriate treatment for complex patient with cardiac and pulmonary failure <br> • Understands how to treat acute and chronic transplant rejection (e.g., need for single vs. bi-VAD assist, cardiac vs. cardiopulmonary support, ECMO) <br> • Knows outcomes for all treatment modalities and complications, including databases and clinical trials |

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| Esophagus — Medical Knowledge | | | | |
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| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| • Knows basic anatomy and pathology (e.g., identifies gastrointestinal anatomy innervation and blood supply, endoscopic landmarks)<br>• Knows basic foregut physiology (e.g., basic esophageal motility)<br>• Lists clinical manifestations of benign and malignant disorders (e.g., heart burn, chest pain, dysphagia, odynophagia<br>• Lists diagnostic and/or staging tools available for the evaluation of benign and malignant disorders (e.g., manometry, pH testing, EUS)<br>• Lists treatment options for benign and malignant disorders (e.g., surgery vs. chemo/RT vs. chemo/RT alone for malignancy)<br>• Knows basic complications for benign and malignant disorders (e.g., perforation, recurrent reflux, pulmonary aspiration) | • Understands common variations in anatomy and pathology (e.g., lymphatic drainage)<br>• Understands physiologic changes accompanying malignancy and motility disorders (e.g., achalasia, reflux, esophageal spasm)<br>• Generates differential diagnosis of disease with similar manifestations (e.g., achalasia vs. pseudoachalasia; coronary syndrome vs. esophageal spasm)<br>• Understands advantages and disadvantages of diagnostic tools in evaluating benign and malignant disorders (e.g., endoscopy vs. EUS vs. barium swallow)<br>• Understands advantages and disadvantages of various treatment options for benign and malignant disorders, including the impact of staging (e.g., pluses and minus of treatment options for esophageal cancer; dilation vs. myotomy for achalasia)<br>• Understands risks, benefits and | • Understands complex integrations between anatomy and pathology (e.g., fascial planes in descending mediastinitis)<br>• Understands the role of treatment on physiology of malignancy and motility disorders (e.g., post-operation esophagectomy complications: dumping syndrome)<br>• Identifies the common variants of the clinical manifestations of benign and malignant disorders (e.g., benign vs. malignant stricture)<br>• Interprets normal and common abnormalities associated with benign and malignant disorders (e.g., interprets EUS, common motility tracings)<br>• Identifies appropriate treatment for routine patient with benign and malignant disorders (e.g., treatment options for high grade dysplasia – EMR vs. esophagectomy)<br>• Knows basic outcome | • Understands complex variations in anatomy and pathology, including congenital (e.g., esophageal atresia)<br>• Adapts therapeutic management based on understanding of physiology for various disease states (e.g., partial vs. total fundoplication)<br>• Distinguishes the complex clinical manifestations and complications of benign and malignant disorders (e.g., Type IV hernias, tracheoesophageal fistula [TEF])<br>• Interprets and integrates complex abnormalities associated with benign and malignant disorders (e.g., short esophagus, achalasia with sigmoid esophagus)<br>• Identifies appropriate treatment for complex patient with benign and malignant disorders (e.g., primary vs. redo Nissen, redo myotomy vs. esophagectomy)<br>• Knows outcomes for all treatment modalities | • Understands imaging for colon interposition<br>• Understands need for colon interposition<br>• Presents on outcomes of benign or malignant disorders at local, regional, or national meetings |

| | complications of treatment modalities (e.g., slipped Nissen, anastomotic leak) | literature for benign and malignant disorders | and complications, including databases and clinical trials | |
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**Comments:**

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**Esophagus — Patient Care and Technical Skills**

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Performs pre-operative assessment<br>• Orders basic diagnostic/assessment tests for routine benign and malignant esophageal disease (e.g., endoscopic ultrasound [EUS], CT/ positron emission tomography [PET], pH testing, manometry)<br>• Demonstrates basic surgical skills (simulation vs. OR) | • Interprets hemodynamics and suggests appropriate diagnostic imaging<br>• Recognizes routine post-operative complications<br>• Prioritizes diagnostic/assessment tests for routine benign and malignant esophageal disease (e.g., Barium swallow vs. EUS vs. endoscopy)<br>• Lists basic treatment options for routine benign and malignant esophageal disease (e.g., Nissen fundoplication, esophageal resection, Toupet)<br>• Recognizes common post-operative complications (e.g., leak, slipped Nissen, cardiac arrhythmia)<br>• Demonstrates basic endoscopic skills<br>• Demonstrates basic minimally invasive skills (Fundamentals of Laparoscopic Surgery [FLS])<br>• Provides basic intra-operative assistance<br>• Performs basic hand sewn and stapled anastomosis | • Develops a treatment plan for routine patient with benign and malignant disorders<br>• Manages routine post-operative complications<br>• Interprets diagnostic/assessment tests for routine benign and malignant esophageal disease (e.g., basic manometry tracings, EUS, and PET/CT scan results)<br>• Selects ideal treatment option after assessment of diagnostic test results for routine benign and malignant esophageal disease<br>• Manages common post-operative complications (e.g., surgical vs. medical management, reintubation)<br>• Demonstrates advanced endoscopic skills (endoscopic mucosal resection [EMR], EUS, stenting)<br>• Performs routine open and minimally invasive motility operations | • Develops a treatment plan for complex patient with benign and malignant disorders<br>• Manages complex post-operative complications<br>• Able to establish a diagnostic and assessment plan for complex patients with benign and malignant esophageal disease (e.g., short esophagus, sigmoid esophagus)<br>• Selects ideal treatment option for complex benign and malignant esophageal disease (e.g., consideration of comorbidities, chemo/ radiotherapy [RT]/surgery vs. surgery vs. chemo/RT, does patient have short esophagus)<br>• Manages complex post-operative complications (e.g., fistula, gastric necrosis)<br>• Performs routine esophageal resections<br>• Operatively manages esophageal perforation/trauma | • Performs complex esophageal resections (e.g., colon interposition)<br>• Performs redo motility operations<br>• Performs minimally invasive esophagectomy |

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**Comments:**

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| Lung and Airway — Medical Knowledge | | | | |
|---|---|---|---|---|
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| • Knows basic anatomy and pathology (e.g., segmental anatomy, types of lung cancer)<br>• Knows basic pulmonary physiology (e.g., A-a gradient, pulmonary function tests, ventilation perfusion scan, diffusion, respiratory mechanics, V/Q mismatch)<br>• Lists clinical manifestations of benign, malignant, and traumatic disorders (e.g., clinical diagnosis of chronic obstructive pulmonary disease [COPD], signs and symptoms of advanced metastatic lung neoplasms, of immediate life-threatening traumatic injuries, gas exchange)<br>• Lists diagnostic and/or staging tools available for the evaluation of benign, malignant, and traumatic disorders (e.g., CXR, CT, PET, EBUS, PFTs, mediastinoscopy, flexible/rigid bronchoscopy) | • Understands common variations in anatomy and pathology (e.g., azygous lobe, mixed lung cancer histologies)<br>• Understands physiologic changes accompanying benign, malignant, and traumatic disorders (e.g., pulmonary shunt, tension pneumothorax causing decreased venous return, secondary pulmonary hypertension with COPD, pulmonary vascular resistance)<br>• Generates differential diagnosis of disease with similar manifestations (e.g., lung nodules, airway tumors, hemoptysis work-up)<br>• Understands advantages and disadvantages of diagnostic tools in evaluating benign, malignant, and traumatic disorders (e.g., CXR vs. CT, EBUS vs. mediastinoscopy, CT vs. angiogram)<br>• Understands advantages and disadvantages of various treatment options for benign, | • Understands the role of treatment on physiology of benign and malignant disorders (e.g., pneumonectomy increases pulmonary pressure and RV strain)<br>• Identifies the common variants of the clinical manifestations of benign, malignant, and traumatic disorders (e.g., various bronchial adenomas, traumatic tracheobronchial injuries)<br>• Interprets normal and common abnormalities associated with benign, malignant, and traumatic disorders (e.g., PET abnormalities, interpret EBUS findings, interpret PFT results, acid-base)<br>• Identifies appropriate treatment for routine patient with benign, malignant, and traumatic disorders (e.g., medical therapy for pulmonary fibrosis, less than lobectomy for compromised lung function, rationale for sublobar resection)<br>• Knows basic outcome literature for benign and | • Understands complex variations in anatomy and pathology, including congenital (e.g., cystic adenomatoid formation, AV malformation, tracheo-esophageal fistula, pulmonary sequestration, subtypes of adenocarcinoma)<br>• Adapts therapeutic management based on understanding of physiology for various disease states (e.g., changes associated with lung volume reduction)<br>• Distinguishes the complex clinical manifestations and complications of benign, malignant, and traumatic disorders (e.g., post-pneumonectomy BPF, tracheoesophageal fistula, traumatic disruption mainstem bronchi)<br>• Interprets and integrates complex abnormalities associated with benign, malignant, and traumatic disorders (e.g., applies results from quantitative V/Q scans, myocardial oxygen consumption | • Presents on outcomes of benign or malignant disorders at local, regional, or national meetings (e.g., using STS or institutional database for outcomes research) |

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| • Lists treatment options for benign, malignant, and traumatic disorders (e.g., lobectomy, operative intervention for hemothorax)<br>• Know basic outcomes for benign and malignant disorders (e.g., morbidity and mortality for lobectomy) | malignant, and traumatic disorders, including the impact of staging (e.g., use of induction therapy, airway stents)<br>• Understand risks, benefits and complications of treatment modalities (e.g., morbidity and mortality for VATS and open lobectomy) | malignant disorders (e.g., International Association for the Study of Lung Cancer [IASLC] survival data for lung cancer stages, survival rates for advanced lung diseases like COPD, idiopathic pulmonary fibrosis [IPF]) | [mVO2] max toward the decision making for lung resection)<br>• Identifies appropriate treatment for complex patient with benign, malignant, and traumatic disorders (e.g., radiofrequency ablation [RFA] for high risk lung cancer patients, lung reduction surgery, stents for arteriovenous malformation [AVM], tracheal disorders)<br>• Knows outcomes for all treatment modalities and complications, including databases and clinical trials (e.g., National Emphysema Treatment Trail [NETT] trial results, induction therapy for stage IIIa disease) | |

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## Lung and Airway — Patient Care and Technical Skills

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
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| • Orders basic diagnostic/assessment tests for routine benign, malignant, and traumatic disorders (e.g., chest x-ray [CXR], PET, CT, angiogram)<br>• Lists basic treatment options for routine benign, malignant, and traumatic disorders (e.g., chemo/radiation therapy, needle decompression for tension pneumothorax)<br>• List common complications for benign, malignant, and traumatic disorders and their treatment (e.g., bronchopleural fistula [BPF], prolonged air leak, hemoptysis)<br>• Demonstrates basic surgical skills (simulation vs. OR) (e.g., positioning patient, suturing)<br>• Obtains ATLS certification | • Interprets diagnostic/assessment tests for routine benign, malignant, and traumatic disorders (e.g., interprets pulmonary function tests [PFTs], recognizes false positives on PET)<br>• Recognizes routine post-operative and disease-related complications (e.g., complications after lobectomy)<br>• Demonstrates basic endoscopic skills (e.g., making ports, running videoscope)<br>• Demonstrates basic minimally invasive skills (FLS)<br>• Provides basic intra-operative assistance<br>• Performs common bedside procedures (e.g., tracheostomy, chest tube, central line) | • Prioritizes diagnostic/assessment tests for routine benign, malignant, and traumatic disorders (e.g., obtain magnetic resonance imaging [MRI] based on CT results, bronchoscopy for pneumomediastinum)<br>• Selects ideal treatment option for routine benign, malignant, and traumatic disorders (e.g., combination therapy for advanced lung cancer, when not to operate for lung cancer, interventions for tension pneumothorax, need for surgical lung biopsy, contraindications for lung cancer surgery)<br>• Manages routine post-operative and disease-related complications (e.g., post-operative air leak, spontaneous pneumothorax)<br>• Demonstrates advanced endoscopic skills (e.g., endobronchial ultrasound [EBUS], stenting, proper placement of ports)<br>• Performs routine open lung resection<br>• Performs basic video-assisted thoracoscopic surgery (VATS) procedures | • Establishes a diagnostic and assessment plan for complex patients with benign, malignant, and traumatic disorders (e.g., order of tests for TEF, quantitative ventilation/perfusion [V/Q] for compromised lung function)<br>• Selects ideal treatment option for complex benign, malignant, and traumatic disorders (e.g., interventions for TEF, guide for stage III and intravenous [IV] lung cancer, Pancoast tumor)<br>• Manages complex post-operative and disease-related complications (e.g., BPF, right middle lobe [RML] torsion)<br>• Performs complex open lung resection (e.g., Pancoast, sleeve)<br>• Performs VATS lobectomies | • Performs tracheal resections/traumatic tracheal repair<br>• Performs robotic lung resections, VATS segmentectomy |

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## Chest Wall/Pleura/Mediastinum — Medical Knowledge

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
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| • Knows basic chest wall, pleural, and mediastinal anatomy and pathology (e.g., anatomic features on a CT scan)<br>• Knows basic chest wall and pleural physiology (e.g., physiology of chest tube drainage and pleural pressures)<br>• Lists clinical manifestations of benign, malignant, and traumatic disorders of the chest wall, pleura, and mediastinum (e.g., cough, shortness of breath with pleural effusion, or painless mass with chest wall tumor)<br>• Lists diagnostic and/or staging tools available for the evaluation of benign, malignant, and traumatic disorders (e.g., CT, chest x-ray, MRI, PET, ultrasound, fine needle aspiration [FNA], EBUS, mediastinoscopy, EUS)<br>• Lists treatment options for benign, malignant, and traumatic disorders (e.g., medical vs. surgical management of chest | • Understands common variations in anatomy and pathology (e.g., cervical rib, replaced right subclavian vessel)<br>• Understands physiologic changes accompanying benign, malignant, and traumatic disorders (e.g., physiology post lung resection, flail chest, physiologic changes that accompany pleural effusions)<br>• Generates differential diagnosis of disease with similar manifestations (e.g., differential of chest wall masses)<br>• Understands advantages and disadvantages of diagnostic tools in evaluating benign, malignant, and traumatic disorders (e.g., difficulty diagnosing mesothelioma, options for diagnosing mediastinal tumors)<br>• Understands advantages and disadvantages of various treatment options for benign, malignant, and traumatic disorders, | • Understands complex integrations between anatomy and pathology (e.g., thoracic outlet syndrome, Pancoast tumor, dumbbell neurogenic tumors)<br>• Understands the role of treatment on physiology of benign, malignant, and traumatic disorders (e.g., physiologic changes that accompany chest wall resection)<br>• Identifies the common variants of the clinical manifestations of benign, malignant, and traumatic disorders (e.g., neurogenic vs. vascular symptoms for thoracic outlet syndrome, types of pleural effusions)<br>• Interprets normal and common abnormalities associated with benign, malignant, and traumatic disorders (e.g., radiographic features of different chest wall tumors and mediastinal masses)<br>• Identifies appropriate treatment for routine patients with benign, | • Understands complex variations in anatomy and pathology, including congenital (e.g., chest wall tumors requiring multimodality therapy)<br>• Compares and contrasts therapeutic management based on understanding of physiology for various disease states (e.g., resection only vs. resection and reconstruction of various chest wall lesions, pleural drainage techniques for massive pleural effusions<br>• Distinguishes the complex clinical manifestations of benign, malignant, and traumatic disorders, as well as manifestations of the treatment of these disorders (e.g., presentation of an infected chest wall reconstruction)<br>• Interprets and integrates complex abnormalities associated with benign, malignant, and traumatic disorders (e.g., use of MRI for | • Knows complex alternatives for chest wall reconstruction (e.g., flaps available for chest wall reconstruction)<br>• Presents on outcomes of benign or malignant disorders at local, regional, or national meetings |

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| wall tumors, treatment options for pleural effusion)<br>• Knows basic complications for benign and malignant disorders (e.g., bleeding, wound infection, empyema, pneumothorax) | including the impact of staging (e.g., thoracentesis vs. chest tube drainage vs. thoracoscopy for benign and malignant pleural effusion)<br>• Understands risks, benefits and complications of treatment modalities (e.g., complications associated with chest wall reconstruction) | malignant, and traumatic disorders<br>• Knows basic outcome literature for benign and malignant disorders (e.g., survival and local recurrence rate after resection of chest wall tumors) | thoracic outlet tumor, diagnosis of lymphoma vs. Hodgkin's Disease vs. thymoma)<br>• Identifies appropriate treatment for complex patients with benign, malignant, and traumatic disorders<br>• Knows outcomes for all treatment modalities and complications, including databases and clinical trials (e.g., pleurectomy vs. extrapleural pneumonectomy for mesothelioma) | |

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**Comments:**                                                        **Not yet rotated** [ ]

**Chest Wall/Pleura/Mediastinum — Patient Care and Technical Skills**

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Orders basic diagnostic/assessment tests for routine benign, malignant, and traumatic diseases (e.g., chest x-ray, CT, PET)<br>• Lists basic treatment options for routine benign, malignant, and traumatic diseases<br>• Lists common complications for benign, malignant, and traumatic diseases and their treatment<br>• Demonstrates basic surgical skills (simulation vs. OR) (e.g., knot tying, suturing)<br>• Performs common bedside procedures (e.g., chest drain/tube, thoracentesis, pleurodesis) | • Interprets diagnostic/assessment tests for routine benign, malignant, and traumatic diseases (e.g., distinguish free flowing and loculated pleural effusions, chest wall involvement by tumor)<br>• Suggests treatment options for routine benign, malignant, and traumatic diseases<br>• Recognizes routine post-operative and disease-related complications (e.g., wound infection, pleural fluid loculation)<br>• Demonstrates basic endoscopic and ultrasound guidance skills (e.g., handling video scope)<br>• Demonstrates basic minimally invasive skills<br>• Provides basic intra-operative assistance | • Prioritizes diagnostic/assessment tests for routine benign, malignant, and traumatic diseases (e.g., prioritize use of imaging to evaluate chest wall trauma)<br>• Selects ideal treatment option for routine benign, malignant, and traumatic diseases (e.g., options for malignant mesothelioma)<br>• Manages routine post-operative and disease-related complications (e.g., need for radiologic vs. surgical intervention for wound infection after chest wall reconstruction)<br>• Demonstrates advanced endoscopic skills (e.g., performs uncomplicated EBUS or mediastinoscopy)<br>• Performs open and VATS procedures for uncomplicated pleural or mediastinal disorders (e.g., VATS pleural or mediastinal biopsy, open Stage I/II thymectomy)<br>• Performs simple chest wall resection (e.g., resects a laterally placed small chondrosarcoma [<3cm]) | • Establishes a diagnostic and assessment plan for complex patients with benign, malignant, and traumatic diseases (e.g., evaluation for posterior tumor involving spine)<br>• Selects ideal treatment option for complex benign, malignant, and traumatic diseases (e.g., induction therapy for certain mediastinal malignancies, post-operative empyema with or without BPF)<br>• Manages complex post-operative and disease-related complications (e.g., management of post-resectional empyema with and without BPF)<br>• Performs open and VATS procedures for complex pleural and mediastinal disorders (e.g., open decortication for a complex loculated pleural effusion, thymectomy for a Stage III thymoma)<br>• Performs complex chest wall resection and/or reconstruction (e.g., large chest wall lesion with reconstruction) | • Surgically manages mesothelioma (e.g., radical pleurectomy and decortication with diaphragm reconstruction) |

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## Critical Care — Medical Knowledge

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---------|---------|---------|---------|---------|
| • Knows basic normal cardiopulmonary physiology (e.g., normal left ventricular pressure-volume curve) <br> • Lists clinical manifestations of critically-ill cardiovascular and thoracic patients (e.g., chest pain, shortness of breath, tachycardia) <br> • Lists diagnostic tools available for evaluation of critically-ill patients with cardiovascular and thoracic diseases (e.g., interpretation of hemodynamic data (Swan-Ganz); electrocardiogram [ECG] including exercise data, coronary angiography, cardiac cath hemodynamics, echocardiography) <br> • Lists treatment options for critically-ill patients with cardiovascular and thoracic diseases (e.g., providing hemodynamic support with inotropic and vasoactive drugs, intra-aortic balloon counterpulsation, | • Understands pathophysiologic changes accompanying cardiovascular and thoracic disease (e.g., Frank-Starling curves for the left ventricle) <br> • Generates differential diagnosis of diseases in critically-ill patients with cardiovascular and thoracic diseases (e.g., differential diagnosis of patient with chest pain: cardiac—myocardial infarction, unstable angina, acute pericarditis, coronary spasm, hypertrophic cardiomyopathy, anemia, myocarditis, aortic dissection and pulmonary hypertension; pulmonary—pulmonary embolism, pneumonia, pleuritis and pneumothorax) <br> • Understands advantages and disadvantages of diagnostic tools in evaluating critically-ill patients with cardiovascular and thoracic diseases <br> • Understands advantages | • Understands the role of treatment on pathophysiology of cardiovascular and thoracic disease (e.g., relationship between left ventricular output, left atrial pressure (preload) and aortic pressure (afterload) <br> • Identifies the common variants of the clinical manifestations of critically-ill cardiovascular and thoracic patients (e.g., differential diagnosis of post-operation cardiac surgery patient with chest pain; myocardial ischemia, musculoskeletal pain, pericarditis, pneumothorax) <br> • Interprets normal and common abnormalities associated with critically-ill patients with cardiovascular and thoracic diseases (e.g., echo images of normal ventricular function, systolic and diastolic dysfunction) <br> • Identifies appropriate | • Adapts therapeutic management based on understanding of pathophysiology (e.g., selection of inotropic drugs in the treatment of hypotension and low cardiac output depending on etiology) <br> • Distinguishes the complex clinical manifestations and complications of critically-ill cardiovascular and thoracic patients (e.g., low cardiac output due to right ventricular failure; demonstration of low cardiac output with elevated right-sided filling pressures, and relatively normal or decreased left-sided filling pressures) <br> • Interprets and integrates complex abnormalities associated with critically-ill patients with cardiovascular and thoracic diseases <br> • Identifies appropriate treatment for complex critically-ill patients with cardiovascular and thoracic diseases (e.g., | • Understands the need for complex ventilation strategies (e.g., oscillating ventilation) <br> • Conducts research on critical care and presents at a local, regional or national meeting |

| circulatory assist devices) | and disadvantages of various treatment options for critically-ill patients with cardiovascular and thoracic diseases (e.g., indications for inotropes, IABP, and ventricular assist device [VADs]) | treatment for routine critically-ill patients with cardiovascular and thoracic diseases (e.g., management strategies for post-operative arrhythmias, nutrition, mechanical ventilation modes, premature ventricular contractions, atrial fibrillation, atrial flutter, ventricular fibrillation)<br>• Manages post-operation low cardiac output<br>• Knows basic outcome literature for critically-ill patients with cardiovascular and thoracic diseases | treatment of wall motion abnormalities after CABG, dialysis options)<br>• Understands risk adjustment and outcome databases (e.g., scoring systems) | |

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**Comments:**

**Not yet rotated**  ⬭

**Critical Care — Patient Care and Technical Skills**

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Orders basic diagnostic, nutritional and assessment tests for critically-ill patients with cardiovascular and thoracic diseases (e.g., pre- and post-operative)<br>• Lists basic treatment options for critically-ill patients with cardiovascular and thoracic diseases<br>• Orders appropriate prophylactic intensive care unit (ICU) measures to prevent complications (e.g., nutritional support, glucose management, ulcer and deep venous thrombosis [DVT] prophylaxis)<br>• Obtains Advanced Cardiac Life Support [ACLS] certification<br>• Demonstrates basic ICU surgical skills (simulation or bedside), including IV, arterial line, Foley catheter, nasogastric (NG) tube | • Interprets and prioritizes diagnostic and physiologic assessment tests for critically-ill patients with cardiovascular and thoracic diseases<br>• Suggests treatment plans for critically-ill patients with cardiovascular and thoracic diseases, including preventive care (e.g., prophylactic antibiotics)<br>• Recognizes routine ICU related complications (e.g., line sepsis, DVT, ventilator acquired pneumonia, pneumothorax)<br>• Performs cardioversion for arrhythmias<br>• Demonstrates advanced ICU surgical skills (simulation or bedside), including central line, pulmonary artery (PA) catheter, chest tube<br>• Demonstrates routine ventilator management<br>• Manages temporary pace maker | • Establishes a diagnostic and assessment plan for critically-ill patients with cardiovascular and thoracic diseases<br>• Selects ideal treatment option for critically-ill patients with cardiovascular and thoracic diseases<br>• Manages routine ICU complications (e.g., line sepsis, DVT, ventilator acquired pneumonia, pneumothorax)<br>• Demonstrates complex ventilator management<br>• Performs open chest resuscitation<br>• Performs emergency pericardiocentesis | • Establishes a diagnostic and assessment plan for complex critically-ill patients with cardiovascular and thoracic diseases (e.g., patient with multi-system organ failure)<br>• Selects ideal treatment options for complex critically-ill patients with cardiovascular and thoracic diseases<br>• Manages complex ICU-related complications (e.g., acute respiratory distress syndrome [ARDS], acute renal failure, low cardiac output, stroke, metabolic abnormalities)<br>• Troubleshoots assist devices | • Obtains Board certification in critical care |

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**Comments:**

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## Ethics and Values — Professionalism

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
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| • Understands basic bioethical principles and is able to identify ethical issues in CT surgery<br>• Demonstrates behavior that conveys caring, honesty, and genuine interest in patients and their families | • Recognizes ethical issues in practice and is able to discuss, analyze, and manage common ethical situations<br>• Demonstrates behavior that shows insight into the impact of one's core values and beliefs on patient care | • Analyzes and manages ethical issues in complicated and challenging situations<br>• Understands the beliefs, values, and practices of diverse and vulnerable patient populations and the potential impact on patient care | • Uses a systematic approach to analyzing and managing ethical issues, including advertising, billing, and conflicts of interest<br>• Develops a mutually agreeable care plan in the context of conflicting physician and patient values and beliefs | • Leads institutional and organizational ethics programs<br>• Develops programs to ensure equality of care in diverse, vulnerable, and underserved populations |

Comments:

**Not yet achieved Level 1** ▢

| Personal Accountability — Professionalism | | | | |
|---|---|---|---|---|
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| • Understands and manages issues related to fatigue and sleep deprivation<br>• Exhibits professional behavior (e.g., reliability, industry, integrity, and confidentiality) | • Demonstrates management of personal emotional, physical, and mental health<br>• Recognizes individual limits in clinical situations, and asks for assistance when needed<br>• Ensures that the medical record, including EMR, is timely, accurate, and complete | • Identifies and manages situations in which maintaining personal emotional, physical, and mental health is challenged<br>• Understands conflicting interests of self, family, and others and their effects on the delivery of medical care<br>• Understands physician accountability to physicians, society, and the profession | • Recognizes signs of physician impairment, including fatigue, and demonstrates appropriate steps to address impairment in self and in colleagues<br>• Prioritizes and balances conflicting interests of self, family, and others to optimize medical care | • Develops institutional and organizational strategies to improve physician wellness |

Comments:

**Not yet achieved Level 1**

## Interpersonal and Communication Skills

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Develops a positive relationship with patients in uncomplicated situations and recognizes communication conflicts<br>• Recognizes multidisciplinary approach to patient care<br>• Understands the patient's/family's perspective while engaged in active listening<br>• Utilizes interpreters as needed<br>• Appreciates effective communication to prevent medical error<br>• Participates in effective transitions of care | • Negotiates and manages simple patient/family-related and team conflicts<br>• Responds to the social and cultural context of the patient and family to ensure the patient understands and is able to participate in health care decision-making<br>• Understands the effects of computer use on information accuracy and potential effects on the physician/patient relationship | • Sustains working relationships and manages complex and challenging situations, including coordination and transitions of care<br>• Customizes the delivery of emotionally difficult information<br>• Manages transitions of care and optimizes communication across systems<br>• Maintains collegial relationships with other professional staff | • Negotiates and manages conflict in complex and challenging situations (including vulnerable populations), and develops working relationships across specialties and systems of care<br>• Organizes and facilitates family/health care team conferences<br>• Is able to facilitate/lead team-based care activities (e.g., OR team, multidisciplinary cancer conference)<br>• Uses multiple forms of communication (e.g., e-mail, patient portal, social media) ethically and with respect for patient privacy | • Develops models and approaches to managing difficult communications and seeks leadership opportunities within professional organizations<br>• Coaches others to improve communication skills |
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| Comments: | Not yet achieved Level 1 ☐ |
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## Patient Safety — Systems-based Practice

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Understands the differences between medical errors, near misses, and sentinel events<br>• Understands the roles of care team members | • Participates in the use of tools to prevent adverse events (e.g., checklists and briefings)<br>• Describes the common system causes for errors | • Consistently uses tools to prevent adverse events (e.g., checklists and briefings)<br>• Reports problematic behaviors, processes, and devices, including errors and near misses<br>• Demonstrates structured communication tool for hand-offs | • Participates in the analysis of shared team experiences to prevent future errors using proven analysis techniques (e.g., root cause analysis, failure mode effects analysis)<br>• Leads team by promoting situational awareness and input by all team members<br>• Conducts morbidity and mortality conferences to improve patient safety | • Leads curriculum design to teach teamwork and communication skills to health care professionals<br>• Leads multidisciplinary teams (e.g., human factors engineers, social scientists) to address patient safety issues |

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**Comments:**

**Not yet achieved Level 1** ⬭

## Resource Allocation — Systems-based Practice

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
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| • Describes practice variations in resource consumption, such as the utilization of diagnostic tests | • Describes the cost implications of using resources and practice variation | • Participates in responsible use of health care resources seeking appropriate assistance | • Practices cost effective care (e.g., managing length of stay, operative efficiency) | • Designs measurement tools to monitor and provide feedback to providers/teams on resource consumption to facilitate improvement |

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**Comments:**

**Not yet achieved Level 1** ⬭

**Practice Management — Systems-based Practice**

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---------|---------|---------|---------|---------|
| • Understands basic health payment systems, including uninsured care<br>• Uses EMR appropriately | • Understands the importance of documentation for coding<br>• Able to document inpatient diagnoses<br>• Understands different practice models | • Understands principles of diagnosis, evaluation and management, and procedure coding<br>• Compares and contrasts different practice models | • Codes routine diagnoses, encounters, and surgical procedures; documents medical necessity<br>• Recognizes basic elements needed to establish practice (e.g., negotiations, malpractice insurance, contracts, staffing, compliance, facility accreditation)<br>• Establishes timeline and identifies resources for transition to practice (e.g. information technology, legal, financial, personnel) | • Participates in advocacy activities for health policy<br>• Creates curriculum to teach practice management<br>• Codes complex and unusual diagnoses, encounters and surgical procedures |

| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|---|---|

**Comments:**

**Not yet achieved Level 1** ☐

**The ability to investigate and evaluate the care of patients, to appraise and assimilate scientific evidence, and to continuously improve patient care based on constant self-evaluation, evidence based guidelines and life-long learning — Practice-based Learning and Improvement**

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| • Aware of one's own level of knowledge and expertise and uses feedback from teachers, colleagues, and patients<br>• Identifies learning resources | • Continually seeks and incorporates feedback to improve performance<br>• Develops a learning plan and uses published review articles and guidelines | • Demonstrates a balanced and accurate self-assessment of competence, investigates clinical outcomes and areas for continued improvement<br>• Selects an appropriate evidence-based information tool to answer specific questions | • Demonstrates improvement in clinical outcomes based on continual self-assessment and national database participation<br>• Performs self-directed learning with little external guidance using evidence-based information tools; learning plan includes a process to remain current in knowledge over time | • Demonstrates consistent behavior of incorporating evidence-based information in common practice areas |

Comments:

**Not yet achieved Level 1**

| Research and Teaching — Practice-based Learning and Improvement | | | | |
| --- | --- | --- | --- | --- |
| **Level 1** | **Level 2** | **Level 3** | **Level 4** | **Level 5** |
| • Describes basic concepts in clinical epidemiology, biostatistics, and clinical reasoning; can categorize research study design<br>• Participates in the education of patients, families, and junior learners | • Ranks study designs and can distinguish relevant research outcomes (e.g., patient-oriented evidence that matters) from other types of evidence<br>• Teaches patients, families, and junior learners | • Applies a set of critical appraisal criteria to different types of research, including synopses of original research findings, systematic reviews and meta-analyses, and clinical practice guidelines<br>• Teaches colleagues and other health professionals in both formal and informal settings; assesses and provides feedback to junior learners | • Formulates a searchable question, describes a plan to investigate it, and participates in a research project<br>• Organizes educational activities at the program level | • Independently plans and executes a research program<br>• Develops educational curriculum and assessment tools |

Comments:

**Not yet achieved Level 1** ▢