Adult Cardiothoracic Anesthesiology

ACGME

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Milestones Supplemental Guide

This document provides additional guidance and examples for the Adult Cardiothoracic Anesthesiology Milestones. This is not designed to indicate any specific requirements for each level, but to provide insight into the thinking of the Milestone Work Group.

Included in this document is the intent of each Milestone and examples of what a Clinical Competency Committee (CCC) might expect to be observed/assessed at each level. Also included are suggested assessment models and tools for each subcompetency, references, and other useful information.

Review this guide with the CCC and faculty members. As the program develops a shared mental model of the Milestones, consider creating an individualized guide (Supplemental Guide Template available) with institution/program-specific examples, assessment tools used by the program, and curricular components.

Additional tools and references, including the Milestones Guidebook, Clinical Competency Committee Guidebook, and Milestones Guidebook for Residents and Fellows, are available on the Resources page of the Milestones section of the ACGME website.

Patient Care 1: Peri-Procedural Assessment and Management **Overall Intent:** To evaluate, manage and optimize pre-existing medical conditions; engage the patient and significant family members in discussing the options for peri-operative care; consult and communicate with multispecialty teams to address additional patient evaluation and care	
Milestones	**Examples**
Level 1 *Performs pre-procedural evaluation of patients with common cardiothoracic disease*	● Performs pre-operative assessment of a patient scheduled for a routine elective coronary artery bypass graft (CABG) ● Discusses the findings of the pre-operative evaluation with the attending cardiac anesthesiologist and makes suggestions for patient care
Identifies the components of a pain management plan for patients undergoing cardiothoracic surgery	● Describes the need for opioid and/or non-opioid analgesics and the use of regional anesthesia/peripheral nerve blocks as part of a multimodal analgesia pain management plan
Level 2 *Performs pre-procedural evaluation of patients with complex and less common cardiothoracic disease*	● Performs pre-operative assessment of a patient with aortic stenosis and reduced left ventricular ejection fraction who is scheduled for CABG surgery ● Discusses the findings of the pre-operative evaluation with the attending cardiac anesthesiologist and makes suggestions for patient care
Implements a simple peri-operative pain management plan	● Describes a systematic approach for peri-operative pain management, including the risks and benefits of opioid analgesics, non-opioid analgesics, and regional anesthesia/peripheral nerve blocks
Level 3 *Performs and interprets the pre-procedural evaluation and makes recommendations for optimization of patients with complex and less common cardiothoracic disease*	● Performs pre-operative assessment of a patient with corrected tetralogy of Fallot who is scheduled for a nephrectomy and makes recommendations for peri-operative management; evaluates a Jehovah's Witness scheduled for transcatheter endovascular aortic repair (TEVAR) and recommends options for management of surgical blood loss
Identifies patients with a history of chronic pain who require a modified peri-operative pain management plan	● Documents the patient's pre-operative opioid analgesic regimen in Morphine Equivalent Daily Dose (MEDD) and anticipates the patient's potential increased analgesic and opioid requirements due to their long-term use of opioids
Level 4 *Serves as the consultant anesthesiologist in pre-procedural care*	● Esophageal laceration management following a transesophageal echocardiography (TEE) exam ● Identifies patients who are candidates for early tracheal extubation and recommends management with appropriate rationale ● Develops a peri-operative pain management protocol to facilitate early tracheal extubation of cardiac surgery patients and improve patient outcomes

Implements the anesthetic plan for patients with complex pain history and polypharmacy	● Uses enhanced recovery after cardiac surgery protocols to minimize the use and requirement of opioid analgesics following a CABG ● Contacts the patient's chronic pain management physician and discusses the risks/benefits of pre-operative opioid reduction to reduce peri-operative opioid requirements; continues prescribed sustained release opioid analgesics during the peri-operative period; implements opioid withdrawal mitigation strategies
Level 5 *Leads the interprofessional care team in the peri-operative management of patients with complex and less common cardiac conditions for cardiac and non-cardiac surgery* *In collaboration with other specialists, develops protocols for multimodal analgesia plan for patients with a complex pain history and substance use disorder (SUD)*	● Leads the Clinic for Peri-Operative Care, obtains appropriate consults and develops best practices to optimize patients and improve patient outcomes ● Serves on a multidisciplinary task force to develop multimodal analgesia protocols for patients with complex pain and substance use disorder and conducts outcome studies to determine the effectiveness of the protocols
Assessment Models or Tools	● Case discussion ● Direct observation ● Medical record (chart) audit ● Simulation
Curriculum Mapping	●
Notes or Resources	● American Society of Anesthesiologists, *Basic Standards for Preanesthesia Care.* *https://www.asahq.org/standards-and-guidelines/basic-standards-for-preanesthesia-care*. Accessed 2020. ● American Society of Anesthesiologists, *Standards for Postanesthesia Care.* *https://www.asahq.org/standards-and-guidelines/standards-for-postanesthesia-care*. Accessed 2019. ● Centers for Disease Control and Prevention (CDC). Guidelines Resources. https://www.cdc.gov/drugoverdose/prescribing/resources.html. Accessed 2020. ● Edwards DA, Hedrick TL, Jayaram J, et al. American Society for Enhanced Recovery and Perioperative Quality Initiative joint consensus statement on perioperative management of patients on preoperative opioid therapy. *Anesth Analg*. 2019;129(2):553-566. doi:10.1213/ANE.0000000000004018. ● Enhanced Recovery After Cardiac Surgery Society (ERAS) . List of Guidelines https://www.erascardiac.org/recommendations/expert-recommendations. ● MD CALC. Morphine Milligram Equivalents (MME) Calculator. https://www.mdcalc.com/morphine-milligram-equivalents-mme-calculator. Accessed 2020.

Patient Care 2: Technical/Procedural Skills - Transesophageal Echocardiography (TEE) **Overall Intent:** To independently perform and interpret an advanced diagnostic transesophageal echocardiogram	
Milestones	**Examples**
Level 1 *Acquires a basic TEE exam using basic ultrasound modalities* *Identifies normal anatomy and basic pathology on TEE imaging*	● Performs a basic echocardiographic exam using two dimensions, , color, M mode, and Doppler ● Places a TEE probe atraumatically ● Recognizes normal anatomy in all comprehensive views
Level 2 *Acquires a comprehensive 2D TEE exam, with assistance* *Performs broad quantification of TEE imaging*	● Obtains TEE images with optimal windows but requires assistance for image optimization when the echocardiographic windows are suboptimal ● Grades and quantifies left ventricular ejection fraction (LVEF) ● Identifies and quantifies wall motion abnormalities ● Applies basic knowledge of ultrasound physics and knobology to optimize echocardiographic image
Level 3 *Acquires a comprehensive 2D TEE exam* *Performs and interprets a comprehensive quantified TEE exam*	● Applies objective criteria to grade severity of mitral regurgitation ● Distinguishes between actual structural anomalies and artifact
Level 4 *Acquires a comprehensive TEE exam, including use of advanced modalities* *Integrates TEE exam to guide standard surgical decision-making and clinical care*	● Performs three-dimensional echocardiography exam ● Provides the anatomical description of mitral valve pathology ● Assesses suitability of mitral valve for repair
Level 5 *Serves as a departmental resource for challenging TEE exams* *Integrates TEE exam within clinical context and existing patient data to guide complex surgical decision-making and clinical care*	● Provides echocardiographic guidance for minimally invasive mitral valve repair ● Performs a rapid diagnostic echocardiographic assessment to identify cause of hemodynamic instability
Assessment Models or Tools	● Direct observation ● Reviewing echocardiogram exams ● Reviewing echocardiogram reports
Curriculum Mapping	●

Notes or Resources	● Hahn RT, Abraham T, Adams MS: Guidelines for performing a comprehensive transesophageal echocardiographic examination: recommendations from the American Society of Echocardiography. *Journal of the American Society of Echocardiography and The Society of Cardiovascular Anesthesiologists*. http://dx.doi.org/10.1016/j.echo.2013.07.009009009

Patient Care 3: Technical/Procedural Skills - Fiberoptic Bronchoscopy and Lung Isolation Techniques **Overall Intent:** To independently perform a comprehensive fiberoptic bronchoscopic exam; use fiberoptic bronchoscopy to identify and manage airway pathology and troubleshoot lung isolation	
Milestones	**Examples**
Level 1 *Performs a basic bronchoscopic exam and identifies the anatomy* *Establishes lung isolation in standard situations*	● Identifies secretions, mucus plug ● Cleans airway by aspiration of secretions ● Identifies the tracheobronchial tree structures including the subsegmental bronchi ● Places a bronchial blocker
Level 2 *Performs a bronchoscopic exam and identifies complex anatomy and basic pathology* *Establishes lung isolation in standard situations and troubleshoots problems*	● Uses fiberoptic bronchoscopy to position double lumen tube (right and left sided double lumen tube) ● Identifies tracheal stenosis with fiberoptic bronchoscopy ● Uses fiberoptic bronchoscopy to reposition a double lumen tube when displaced during surgery
Level 3 *Performs bronchoscopic evaluation to diagnose and manage airway pathology* *Manages complex lung isolation, with assistance*	● Cleans the airway using suction and lavage ● Uses fiberoptic bronchoscopy to select the appropriate size endotracheal tube in a patient with tracheal stenosis ● Identifies tumor invasion during initial fiberoptic bronchoscopy screening and selects an appropriate lung isolation device
Level 4 *Advises and supervises others with bronchoscopy in routine clinical situations* *Manages complex lung isolation using multiple modalities*	● Teaches residents how to perform fiberoptic bronchoscopy ● Independently uses a systematic approach for troubleshooting hypoxemia ● Manages successful lung isolation in a patient with severe hemoptysis ● Performs lung isolation in a patient with laryngectomy
Level 5 *Advises and supervises others with difficult bronchoscopy in complex clinical situations* *Advises and supervises others with complex lung isolation strategies*	● Suggests alternative methods of lung isolation when routine methods fail or are contraindicated ● Troubleshoots difficult placement of a left-sided double lumen tube in a patient with a descending thoracic aortic aneurysm
Assessment Models or Tools	● Case discussion ● Direct observation ● Simulation ● Written exam

Curriculum Mapping	●
Notes or Resources	● Jaeger JM, Titus BJ, Blank RS: Essential airway anatomy and physiology of the respiratory system and pulmonary circulation. In: Slinger PD, ed. *Principles and Practice of Anesthesia for Thoracic Surgery*, 2nd ed. New York: Springer Science and Business Media, Inc.; 2019, 65-92. ● Schisler T and Loehser J: Clinical management of one-lung ventilation. In: Slinger PD, ed. *Principles and Practice of Anesthesia for Thoracic Surgery*, 2nd ed. New York: Springer Science and Business Media, Inc.; 2019, 107-129.

Patient Care 4: Technical/Procedural Skills - Vascular Access **Overall Intent:** To demonstrate proficiency in placement of vascular access catheters and in using of ultrasound for vascular access procedures	
Milestones	**Examples**
Level 1 *Performs basic radial artery cannulation procedures* *Performs basic right internal jugular central venous cannulation procedures* *Identifies relevant vascular access anatomy and uses ultrasound in vascular access procedures*	● Independently describes applicable anatomy, procures and prepares appropriate equipment, demonstrates proper patient positioning and sterile technique, and secures and labels lines mitigating improper use and dislodgement ● Selects appropriate ultrasound probe, correctly identifies relevant vascular anatomy and surrounding structures, uses image for real-time needle guidance
Level 2 *Performs complex radial artery cannulation procedures* *Performs complex right internal jugular central venous cannulation procedures* *Interprets ultrasound to optimize technique and reduce complications in vascular access procedures*	● Anticipates challenging arterial catheterization in a patient with a heavily calcified, tortuous radial artery by selecting a micropuncture cannulation kit ● Anticipates challenges during arterial cannulation in a patient who had prior radial access for cardiac catheterization ● Safely inserts a right internal jugular central venous catheter in a patient with respirophasic collapse of their central veins ● Rescues a failed right internal jugular venous cannulation by a more junior provider and uses the same right internal jugular approach ● Optimizes ultrasound settings and scanning technique to visualize exact needle tip position during vascular access procedures with sterile technique, and recognizes when the needle imaging may be foreshortened or inaccurate
Level 3 *Performs arterial cannulation at various locations (e.g., femoral, axillary)* *Performs central venous cannulation at various locations (e.g., subclavian, left internal jugular, femoral)*	● Recognizes appropriate time to move away from radial artery cannulation to an alternate site, while understanding risks and potential complications of doing so ● Successfully cannulates femoral artery after failed bilateral upper extremity arterial access using sterile technique in a safe and efficient manner ● Recognizes appropriate time to move away from right internal jugular (RIJ) access site to an alternate site ● Successfully cannulates left internal jugular vein in a patient with an established right internal jugular hemodialysis catheter

Independently conducts and interprets complex vascular access ultrasound (e.g., intravenous)	● Identifies the presence of valves, intravascular thrombi and hematomas during routine vascular access ultrasound and selects an appropriate alternative site for cannulation ● Knows alternative methods to confirm venous access
Level 4 *Performs complex arterial cannulation at various locations (e.g., femoral, axillary)* *Performs complex central venous cannulation at various locations (e.g., subclavian, left internal jugular, femoral)* *Advises and supervises others with ultrasound for vascular access*	● Safely establishes appropriate invasive arterial pressure monitoring in a patient with an extensive aortic dissection ● Successfully establishes arterial access in a patient with extensive arteriovenous fistulas for hemodialysis access in all extremities, safely and efficiently ● Recognizes signs of a previously undiagnosed persistent left superior vena cava during left internal jugular central venous catheter insertion ● Recognizes abnormal resistance to wire passage during subclavian central venous cannulation may be due to venous stenosis from a prior cardiac implantable electronic device ● Teaches a more junior provider during ultrasound-guided central venous catheterization
Level 5 *Serves as a departmental resource for challenging arterial cannulation procedures* *Serves as a departmental resource for challenging central venous cannulation procedures* *Serves as a departmental resource for challenging vascular access ultrasound*	● Assists colleagues in arterial access during complicated line placement outside of the cardiothoracic operating room setting ● Assists colleagues in central venous access during complicated line placement outside of the cardiothoracic operating room setting ● Assists colleagues in identifying safe cannulation access sites during complicated line placement outside of the cardiothoracic operating room setting ● Coaches and teaches residents and faculty members on vascular access ultrasound techniques
Assessment Models or Tools	● Direct observation ● Quality improvement audit ● Simulation
Curriculum Mapping	●
Notes or Resources	● No author. Practice guidelines for central venous access 2020: An updated report by the American Society of Anesthesiologists Task Force on Central Venous Access. *Anesthesiology* 2020; 132:8-43. https://doi.org/10.1097/ALN.0000000000002864. ● Nuttall G, Burckhardt J, Hadley A, Kane S, Kor D, Marienau MS, Schroeder DR, Handlogten K, Wilson G, Oliver WC. Surgical and patient risk factors for severe arterial line complications in adults. *Anesthesiology*. 2016 Mar;124(3):590-7. doi: 10.1097/ALN.0000000000000967. PMID: 26640979.

Patient Care 5: Cardiac Procedures not Involving Extracorporeal Circulation **Overall Intent:** To evaluate and manage patients undergoing structural and electrophysiologic cardiac interventions; to apply knowledge of specific echocardiographic assessment in real time to guide structural cardiac procedures	
Milestones	**Examples**
Level 1 *Demonstrates a basic understanding of catheter-based structural heart procedures, including electrophysiology procedures* *Identifies abnormal echocardiographic findings commonly treated with transcatheter interventions*	● Describes the indications for left atrial appendage occlusion devices ● Recognizes the potential for tamponade in a patient undergoing an ablation for atrial fibrillation ● Recognizes significant mitral valve pathology in high-risk patients who are referred for mitral edge-to-edge repair
Level 2 *Creates an appropriate care plan for a patient presenting for catheter-based structural heart/electrophysiology interventions* *Performs qualitative and quantitative echocardiographic assessment of pathology for transcatheter procedures*	● Describes the key characteristics differentiating balloon-expandable and self-expanding transcatheter aortic valve implants ● Anticipates the need for post-procedural pacing in patients receiving self-expanding transcatheter aortic valve implants ● Understands and interprets the necessary images and calculations used to guide the successful performance of transcatheter mitral edge-to-edge repair
Level 3 *Manages patient pathophysiology and anesthetic support for transcatheter procedures* *Describes the necessary echocardiographic support for the technical aspects of the catheter-based procedure and predictors for successful transcatheter procedures*	● Determines need for sedation versus general anesthesia with a secure airway for a transaortic valve replacement (TAVR) procedure based on surgical approach and patient comorbidities ● Communicates the echocardiographic features for suboptimal device placement in an undergoing mitral edge-to-edge repair
Level 4 *Responds to intra-operative events/complications specifically associated with a given catheter structural heart intervention/advanced electrophysiology procedure* *Assesses (interprets) echocardiographic imaging relevant to the transcatheter procedure*	● Recognizes the clinical signs of intra-operative tamponade during an atrial fibrillation ablation procedure and initiates resuscitation ● Recognizes deviations from the expected hemodynamic recovery following rapid pacing and TAVR deployment and promptly initiates resuscitation as indicated ● Identifies the presence of residual moderate mitral regurgitation following placement of a mitral edge-to-edge repair device and assess for suitability of a second device placement

Level 5 *Consults with multidisciplinary teams for selection and peri-operative planning for patients undergoing structural heart intervention (e.g., transcatheter aortic valve insertions, mitral valve clipping)* *Utilizes intra-operative echocardiography to guide and lead catheter- based procedures (e.g., advising on device deployment)*	● Participates in collaborative heart valve team discussion during the planning phase of a complex transcatheter valve repair ● Performs intra-operative echocardiographic guidance, communicates real-time findings to proceduralists to optimize device approach/trajectory, and assesses for successful placement
Assessment Models or Tools	● Direct observation ● Multisource feedback ● Simulation
Curriculum Mapping	●
Notes or Resources	● Hahn RT, Saric M, Faletra FF, Garg R, Gillam LD, Horton K, Khalique O, Little SH, Mackensen GB, Oh J, Quader N, Safi L, Scalia GM, Lang RM. Recommended standards for the performance of transesophageal echocardiographic screening for structural heart intervention: From the American Society of Echocardiography. *J Am Soc Echocardiogr*. 2021 Jul 17:S0894-7317(21)00594-0. doi: 10.1016/j.echo.2021.07.006. PMID: 34280494. ● Nicoara A, Skubas N, Ad N, Finley A, Hahn RT, Mahmood F, Mankad S, Nyman CB, Pagani F, Porter TR, Rehfeldt K, Stone M, Taylor B, Vegas A, Zimmerman KG, Zoghbi WA, Swaminathan M. Guidelines for the use of transesophageal echocardiography to assist with surgical decision-making in the operating room: a surgery-based approach: from the American Society of Echocardiography in collaboration with the Society of Cardiovascular Anesthesiologists and the Society of Thoracic Surgeons. *J Am Soc Echocardiogr*. 2020 Jun;33(6):692-734. doi: 10.1016/j.echo.2020.03.002. Erratum in: J Am Soc Echocardiogr. 2020 Nov;33(11):1426. PMID: 32503709. ● Wu IY, Barajas MB, Hahn RT. The MitraClip procedure-A comprehensive review for the cardiac anesthesiologist. *J Cardiothorac Vasc Anesth*. 2018 Dec;32(6):2746-2759. doi: 10.1053/j.jvca.2018.05.020. Epub 2018 Sep 27. PMID: 30268642.

Patient Care 6: Aortic Surgery **Overall Intent**: To evaluate and manage patients undergoing aortic surgical interventions	
Milestones	**Examples**
Level 1 *Demonstrates appropriate hemodynamic management of acute and chronic aortic pathology*	● Provides appropriate pharmacological interventions such anti-impulse therapy versus vasopressor/inotropic support during acute and chronic aortic surgical conditions
Identifies the need for and basic components of spinal cord and cerebral protection during aortic surgery	● Describes the purpose of neuromonitoring such as cerebral oximetry or electroencephalogram (EEG) ● Explains the principles behind spinal cord perfusion and cerebral spinal fluid drainage
Identifies the potential of coagulopathy during aortic surgery	● Discusses with staff members the appropriateness of obtaining coagulation studies intra-operatively to guide coagulopathy management
Level 2 *Creates an appropriate anesthetic plan for both endovascular and open aortic surgical interventions*	● Presents appropriate anesthetic plans for open aortic procedures including management during hypothermic circulatory arrest ● Presents an appropriate plan for endovascular aortic procedures including spinal cord perfusion optimization and end organ protection
Identifies the specific indicators for risk to spinal cord perfusion and cerebral ischemia during endovascular and open aortic surgical procedures	● Recognizes patients at risk for post-operative renal dysfunction ● Recognizes patients at risk for post-procedural paraplegia ● Recognizes patients at risk for post-procedural cerebral injury
Understands utilization of laboratory data in diagnosing coagulopathy during aortic surgery	● Orders coagulations studies and identifies coagulopathy
Level 3 *Manages the intra-operative care of aortic surgical patients for open and endovascular aortic surgical procedures*	● Induces anesthesia while maintaining appropriate hemodynamic goals ● Manages intraoperative hemodynamic changes within appropriate goals
Integrates neuromonitoring and spinal cord perfusion techniques into patient care during open and endovascular aortic surgeries	● Uses available neuromonitoring data (cerebral oximeter, EEG, etc) ● Uses spinal cord protection strategies including cerebral spinal fluid drainage
Manages peri-operative coagulopathy by integrating laboratory data and appropriate therapy	● Analyzes coagulation study results and initiates appropriate correction of coagulopathy

Level 4 *Manages the intra-operative care of complex aortic surgical patients, including anesthetic planning*	● Induces hemodynamically unstable aortic surgical patients and initiates therapies to maintain hemodynamic goals appropriate for organ perfusion
Analyzes neuromonitoring information and spinal cord perfusion optimization to manage peri-operative ischemic events during aortic surgery	● Recognizes that cerebral oximetry or EEG values are unfavorable and implements changes to improve cerebral perfusion ● Recognizes indicators of decreased spinal cord perfusion and implements spinal cord protection optimization techniques
Manages coagulopathy during aortic surgery with goal-directed therapy, and utilizes progressive therapies, such as concentrates, during aortic surgery	● Recognizes challenges to routine treatment of coagulopathy and appropriately recommends factor concentrates
Level 5 *Consults for multidisciplinary peri-operative best practices for management of aortic surgical patients*	● Contributes evidence-based guidance for best practice guidelines for aortic surgery
Contributes to planning and utilizing advanced techniques to prevent spinal and cerebral protection during aortic surgery	● Acts as a consultant regarding perfusion adjuncts for neuroprotection when indicated ● Acts as a consultant regarding strategies for cord perfusion optimization
Creates protocols for goal directed management of coagulopathy and transfusion during aortic surgery	● Contributes evidence-based guidance for best practice guidelines for coagulopathy during aortic surgery
Assessment Models or Tools	● Direct observation ● Multisource feedback
Curriculum Mapping	●
Notes or Resources	● Anton JK, Herald KJ. Anesthetic management of open thoracoabdominal aortic aneurysm repair. *Int Anesthesiol Clin*. 2016 Spring;54(2):76-101. ● Cheruku S, Huang N, Meinhardt K and Aguirre M. Anesthetic management for endovascular repair of the thoracic aorta. *Anesthesiol Clin* 2019 Dec;37(4):593-607. ● Miller LK, Pael VI, Wagener G. Spinal Cord protection for Thoracoabdominal Aortic Surgery. *J Cardiothrac Vasc Anesth*. 2021 Jun 26:S1053-0770(21)00530-9 ● Patel P, Augoustides J, Pantin E, Cheung A. Thoracic aorta. *Kaplan's Cardiac Anesthesia: For Cardiac and Noncardiac Surgery,* 7th Edition. 2016; chapter 23, 834-82.

Patient Care 7: Circulatory Support Transitions **Overall Intent:** To evaluate and manage patients undergoing circulatory support transitions (e.g., initiation or weaning from extracorporeal membrane oxygenation (ECMO))	
Milestones	**Examples**
Level 1 *Discusses the basic principles and indications for cardiopulmonary bypass (CPB)* *Discusses the basic principles and indications for circulatory assist devices*	● Describes components and function of the CPB machine ● Explains when CPB is required for cardiac surgery ● Describes how ECMO differs from CPB ● Discusses veno-arterial verses veno-venous ECMO and indications ● Discusses the principles of and indications for mechanical circulatory support devices
Level 2 *Guides a patient on and off CPB with assistance* *Uses available hemodynamic data to guide a patient on and off circulatory assist devices, with assistance*	● Appropriately manages hemodynamic goals during aortic cannulation ● Uses the pre-CPB separation checklist ● With the assistance of staff members, guides cardiac volume status and decreasing CPB flows ● Integrates mean arterial pressure, central venous pressure (CVP) and other intra-cardiac monitoring to guide volume status while initiating or decreasing mechanical circulatory support
Level 3 *Guides a patient on and off routine CPB* *Integrates available hemodynamic and echocardiographic data to guide a patient on and off circulatory assist devices, with assistance*	● Guides perfusion to appropriately increase intra-cardiac volume and decrease CPB flows without staff assistance ● Interprets arterial, CVP and pulmonary artery (PA) waveforms along with values to assess volume status and to assess cardiac function during the initiation of cardiac support
Level 4 *Guides a patient on and off complex CPB* *Integrates available hemodynamic and echocardiographic data to guide a patient on and off circulatory assist devices*	● Uses echocardiography to assess cardiac function and volume status during initiation and removal of ECMO, CPB, other mechanical circulatory support devices, etc. ● Guides separation from CPB and appropriately manages hemodynamic instability (initiates vasopressors and inotropes) ● Uses TEE for appropriate placement of ECMO cannulas and mechanical circulatory support devices ● Identifies, manages, and communicates problems with CPB

Level 5 *Develops policies with the interdisciplinary team to guide institutional CPB protocols*	● Acts as a consultant for evidence-based practice protocols for CPB, ECMO, and other mechanical support devices
Assessment Models or Tools	● Direct observation ● Multisource feedback
Curriculum Mapping	●
Notes or Resources	● Chauhan S, Subin S. Extracorporeal membrane oxygenation, an anesthesiologist's perspective: physiology and principles, part I. *Ann Card Anesth*.2011;14:218-29 ● Chauhan S, Subin S. Extracorporeal membrane oxygenation - an anesthesiologist's perspective - part II: clinical and technical consideration. *Ann Card Anaesth* 2012;15:69-82 ● Monaco F, Dr Prima AL, Kim J, et al. Management of challenging cardiopulmonary bypass separation. *J Cardiothorac Vasc Anesth*. 2020 Jun;34(6):1622-1635. ● Kaplan J. *Kaplan's Cardiac Anesthesia: For Cardiac and Noncardiac Surgery*, 7th ed. Philadelphia, PA: Elsevier; 2016. Note: Focus on chapters 31, 33, and 36.

Medical Knowledge 1: Extracorporeal Circulation and Circulatory Assist Device Principles **Overall Intent:** To thoroughly understand the principles, indications, and uses of extracorporeal circulation and circulatory assist devices	
Milestones	**Examples**
Level 1 *Describes components and physiology of CPB*	● Identifies the differences in roller pump versus centrifugal pump ● Understands the cannulation strategy of various cardiac procedures, such as bicaval cannulation for mitral valve repair versus ascending aortic aneurysm repair with antegrade cerebral perfusion ● Articulates various pathophysiology from cardiopulmonary bypass such as hemodilution and hypothermia
Describes physiologic effects of intra-aortic balloon counter-pulsation	● Understands the indication for intra-aortic balloon pump in weaning from cardiopulmonary bypass in patients with severely depressed left ventricular function ● Correctly identifies the changes on an arterial line tracing in a patient with intra-aortic balloon pump augmentation
Level 2 *Describes components and physiology of extracorporeal circulation and ventricular assist devices*	● Articulates the physiologic implications of what changes in the pulsatility index, flow, and power mean in a patient with an implantable left ventricular assist device (LVAD) ● Describes the various cannulation strategies used in ECMO cannulation
Describes the components and physiology of percutaneous circulatory assist devices	● Articulates the physiologic benefits of a percutaneous device such as reducing preload and increasing cardiac output ● Identifies the differences between various mechanical circulatory devices ● Correctly identifies the cannulation strategies for the various percutaneous assist devices used in right heart failure
Level 3 *Demonstrates knowledge of CPB, extracorporeal membrane oxygenation (ECMO), and ventricular assist device (VAD) management in standard situations*	● Articulates the physiologic changes that occur while weaning a patient from ECMO ● Understands the meaning and implications of a ramp study
Demonstrates knowledge of percutaneous circulatory assist device management in standard situations	● Understands the clinical indication for a percutaneous assist device in acute left heart failure or high-risk percutaneous coronary intervention ● Describes the benefit of using a mechanical circulatory device (e.g., percutaneous ventricular assist devices) in ventricular tachycardia ablation in a patient with severely depressed left ventricular function
Level 4 *Demonstrates knowledge of CPB, ECMO, and VAD management in atypical situations*	● Creates an anesthetic plan involving ECMO for a patient with a large tracheal tumor causing airway compromise

Demonstrates knowledge of percutaneous circulatory assist device management in atypical situations	● Understands the conversion of venous arterial ECMO to an oxygenating percutaneous circulatory assist device in someone with COVID pneumonia ● Explains the utility of a percutaneous mechanical circulatory device placement for left ventricle unloading in a patient on venous arterial ECMO
Level 5 *Is recognized as a departmental resource in extracorporeal circulation* *Is recognized as a departmental resource for complex circulatory assist devices*	● Composes a divisional guide for the indications and contraindications for extracorporeal circulation in acute right heart failure ● Participates in a multi-departmental research project exploring patient outcomes in novel circulatory assist devices
Assessment Models or Tools	● Direct observation ● Multisource feedback ● Simulation
Curriculum Mapping	●
Notes or Resources	● Chauhan S, Subin S. Extracorporeal membrane oxygenation, an anesthesiologist's perspective: physiology and principles. part I. *Ann Card Anesth.* 2011;14:218-29. ● Sidebotham D. Venovenous extracorporeal membrane oxygenation in adults: practical aspects of circuits, cannulae, and procedures. *Journal of Cardiothoracic and Vascular Anesthesia* 2012:6(5);893-909 ● Sidebotham D. Extracorporeal membrane oxygenation for treating severe cardiac and respiratory failure in adults: part 1- technical considerations. *Journal of Cardiothoracic and Vascular Anesthesia* 2010;4(1):166-172.

Medical Knowledge 2: Non-Ultrasound-Based Cardiovascular/Pulmonary Imaging and Monitoring **Overall Intent:** To develop working knowledge of imaging modalities used in the care of cardiothoracic patients	
Milestones	**Examples**
Level 1 *Interprets data from non-invasive cardiac imaging and monitoring (e.g., electrocardiogram (ECG), stress testing, magnetic resonance imaging (MRI), computed tomography (CT) scans) to guide routine clinical decision-making*	● Uses pre-operative stress test data for a patient scheduled for lung resection with limited current physical activity to estimate peri-operative myocardial ischemic risk and develop an appropriate perioperative plan
Interprets data from invasive cardiac imaging and monitoring to guide routine clinical decision-making	● Understands classification principles for pulmonary artery catheter data, and can outline implications for perioperative management, for a patient undergoing cardiac surgery
Interprets data from pulmonary imaging and monitoring to guide routine clinical decision-making	● Identifies chronic pulmonary disease through pre-operative respiratory function test data and end-tidal carbon dioxide waveform interpretation, and uses these data to influence ventilator adjustments
Level 2 *Interprets data from non-invasive cardiac imaging and monitoring to guide intermediate complexity clinical decision-making*	● Demonstrates understanding of the implications of pre-operative cardiac MRI findings for the anesthesiologist and surgeon in a patient undergoing surgical myectomy of left ventricular septum for idiopathic hypertrophic subaortic stenosis
Interprets data from invasive cardiac imaging and monitoring to guide intermediate complexity clinical decision-making	● Understands coronary sinus catheter data parameters and their application to safely manage a patient receiving retrograde cardioplegia during cardiac surgery
Interprets data from pulmonary imaging and monitoring to guide intermediate complexity clinical decision-making	● Demonstrates understanding of pulmonary function testing criteria in considering a patient for lung volume reduction surgery
Level 3 *Integrates data from non-invasive cardiac imaging and monitoring to guide advanced clinical decision-making*	● Describes appropriate anesthetic/surgical plan for arrhythmia management in the context of urgent cardiac surgery when episodes of 2:1 heart block noted on intensive care unit (ICU) EKG monitoring prior to operating room transfer
Integrates data from invasive cardiac imaging and monitoring to guide advanced clinical decision-making	● Outlines appropriate timing adjustments for optimizing the effectiveness of intra-aortic balloon counter pulsation related to specific arterial waveform patterns

Integrates data from pulmonary imaging and monitoring to guide advanced clinical decision-making	● Describes routine bronchoscopy features of major airways and branches, and relates airway anatomy to other adjacent intrathoracic structures (e.g., aortic arch, esophagus)
Level 4 *Integrates data from non-invasive cardiac imaging and monitoring, including tools used infrequently outside of cardiothoracic surgery, to guide advanced clinical decision-making* *Integrates data from invasive cardiac imaging and monitoring, including tools used infrequently outside of cardiothoracic surgery, to guide advanced clinical decision-making* *Integrates data from pulmonary imaging and monitoring, including tools used infrequently outside of cardiothoracic surgery, to guide advanced clinical decision-making*	● Outlines and contextualizes, for patients with similar degrees of severe left ventricular dysfunction, the use of non-invasive data to support alternate surgical rationales, including aortocoronary bypass, destination ventricular assist device (VAD), or bridging VAD/heart transplant ● Combines evidence of cardiac chamber contractility, valve function etc. from intra-operative invasive monitoring (e.g., TEE, pulmonary artery catheter data) in the context of pulmonary hypertension to describe potential use/risks of inhaled pulmonary vasodilator therapy ● Describes integrated roles of invasive and non-invasive data in developing the safest anesthetic induction plan for a patient with a large mediastinal mass
Level 5 *Is recognized as a departmental resource for cardiovascular/pulmonary imaging and monitoring* *Develops departmental protocols for cardiovascular/pulmonary imaging and monitoring*	● Authors of published original work or review articles ● Invited to give regional/national lectures ● Invited to participate in regional/national workshops teaching ● Invited to educate multidisciplinary groups within the institution as an expert
Assessment Models or Tools	● Direct observation ● Multisource feedback ● Self-assessment ● Simulation
Curriculum Mapping	●
Notes or Resources	● The American Board of Anesthesiology. Certification in Cardiac Anesthesiology (*pending*), http://www.theaba.org ● Libby P et al. *Braunwald's Heart Disease, A Textbook of Cardiovascular Medicine*, 12th edition, Philadelphia, PA: Elsevier; 2022. ISBN 9780323824675

	● Journal of the American College of Cardiology Cardiovascular Imaging collection. https://www.jacc.org/topic/collection/cardiac-mr?seriesKey=jcmg. Accessed 2021.

Medical Knowledge 3: Ultrasound-Based Imaging and Monitoring **Overall Intent:** To develop working knowledge of imaging modalities used to care for cardiothoracic patients	
Milestones	**Examples**
Level 1 *Recognizes all views of a comprehensive TEE exam*	● Names standard TEE views and anatomic structures when reviewing images obtained by different practitioners
Demonstrates knowledge of standard TTE views	● Names the standard TTE views and anatomic structures in which ventricles are visible
Demonstrates knowledge of typical non-cardiac point-of-care ultrasound (POCUS) views	● Describes POCUS lung views on surface ultrasound (e.g., normal “bat sign” appearance of two ribs straddling the air-pleural interface)
Level 2 *Demonstrates knowledge of ultrasound physics sufficient to optimize TEE image quality and limit artifacts, and performs a comprehensive exam*	● Describes ways to adjust gain, depth, focus, and zoom to optimize TEE image quality and interrogate specific cardiac structures
Differentiates normal findings from pathology on standard TTE images	● Describes stenotic aortic valve in the parasternal long axis view
Recognizes normal structures and basic pathology on targeted POCUS exams	● Describes differences between moderately and severely depressed left ventricular systolic function
Level 3 *Interprets quantitative and qualitative findings on TEE images within a comprehensive exam*	● Describes criteria to classify severity of aortic stenosis (mild, moderate, or severe)
Interprets abnormal findings on targeted TTE images	● Describes echocardiographic findings (TTE) that are associated with ischemic ventricular septal defect
Interprets abnormal findings on POCUS	● Describes tamponade physiology (the differences between pericardial effusion and cardiac tamponade)
Level 4 *Interprets quantitative and qualitative findings on TEE images using advanced modalities and describes their use when*	● Describes qualitative and quantitative methods to classify severity of aortic stenosis, defines structural pathology and suggests management strategies

integrated with a clinical picture to form a diagnosis *Integrates multiple complimentary TTE views with the clinical picture to form a diagnosis* *Integrates POCUS findings to form a diagnosis*	● Describes non-planimetry approaches to indirectly estimate aortic valve area, and assist in the diagnosis of aortic stenosis ● Describes inferior vena cava long axis and left ventricular views associated with hypovolemia
Level 5 *Is recognized (through scholarship or education of others) as an expert resource in peri-operative TEE* *Serves as a departmental resource for complex TTE exam interpretation* *Participates in the development of institutional protocols for POCUS*	● Publishes original work or reviews articles on echocardiography ● Is invited to give regional/national lectures on echo/ultrasound topics ● Is invited to participate in regional/national workshops teaching TEE or TTE
Assessment Models or Tools	● Direct observation ● Multisource feedback ● Self-assessment ● Simulation
Curriculum Mapping	●
Notes or Resources	● The American Board of Anesthesiology. Certification in Cardiac Anesthesiology (pending) http://www.theaba.org ● American Society of Regional Anesthesia and Pain Medicine. Why PoCUS? https://www.asra.com/page/310/why-pocus.Accessed2020. ● Hahn RT,et al. American Society of Echocardiography; Society of Cardiovascular Anesthesiologists. Guidelines for performing a comprehensive transesophageal echocardiographic examination: recommendations from the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists. *Anesth Analg*. 2014 Jan;118(1):21-68. doi: 10.1213/ANE.0000000000000016. PMID: 24356157. https://www.asecho.org/wp-content/uploads/2014/05/2013_Performing-Comprehensive-TEE.pdf ● Canty DJ, Royse CF, Kilpatrick D, Bowman L, Royse AG. The impact of focused transthoracic echocardiography in the pre-operative clinic. *Anaesthesia*. 2012;67(6):618-625. https://pubmed.ncbi.nlm.nih.gov/22352785/.

	● New York School of Regional Anesthesia. Ultrasound-Guided Interscalene Brachial Plexus Block. https://www.nysora.com/techniques/upper-extremity/ultrasound-guided-interscalene-brachial-plexus-block/. Accessed 2020. ● Nicoara A et al. Guidelines for the use of transesophageal echocardiography to assist with surgical decision making in the operating room: a surgery-based approach: From the American Society of Echocardiography in collaboration with the Society of Cardiovascular Anesthesiologists and the Society of Thoracic Surgeons. *J Am Soc Echocardiogr*. 2020 Jun;33(6):692-734. doi: 10.1016/j.echo.2020.03.002. Erratum in: *J Am Soc Echocardiogr.* 2020 Nov;33(11):1426. PMID: 32503709. https://www.asecho.org/wp-content/uploads/2020/06/TEE-Surgical-Decision-Making_June2020.pdf ● Ramsingh D, Bronshteyn YS, Haskins S, Zimmerman J. Perioperative Point-of-Care Ultrasound: From concept to application. *Anesthesiology*. 2020;132:908-916. https://anesthesiology.pubs.asahq.org/article.aspx?articleid=2759442. ● The Society of Point of Care Ultrasound. POCUS Practice Guidelines. https://spocus.org/admin-resources/practice-guidelines/. Accessed 2020. ● Spencer KT, Kimura BJ, Korcarz CE, Pellikka PA, Rahko PS, Siegel RJ. Focused cardiac ultrasound: recommendations from the American Society of Echocardiography. *J Am Soc Echocardiogr*. 2013 Jun;26(6):567-81. doi: 10.1016/j.echo.2013.04.001. PMID: 23711341. https://www.asecho.org/wp-content/uploads/2014/01/FCU.pdf ● Jacquet J. Introduction to Point of Care Ultrasound (POCUS) – Basics. MedCram YouTube channel. https://www.youtube.com/watch?v=7Yfe2vOpFmY. Accessed 2020.

Medical Knowledge 4: Cardiovascular/Thoracic Pathophysiology **Overall Intent:** To develop a thorough understanding of cardiovascular and thoracic pathophysiology used in the care of cardiothoracic patients	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of common cardiothoracic pathophysiology and applies this knowledge during non-cardiac and cardiac surgical peri-operative patient care*	● Describes the pathophysiology and management of mitral stenosis and creates and adequate induction plan for mitral valve replacement ● Explains the anesthetic implications in a patient with aortic stenosis undergoing urgent exploratory laparotomy
Level 2 *Demonstrates knowledge of complex cardiothoracic pathophysiology, including adult congenital heart disease, during non-cardiac and cardiac surgical peri-operative patient care*	● Accurately describes the physiology of a patient with a Fontan ● Articulates potential complications in sedation for a TAVR in a patient with pulmonary hypertension and obesity (hypoventilation, hypercarbia, obstructed airway)
Level 3 *Applies advanced understanding of complex cardiothoracic pathophysiology, including adult congenital heart disease, during cardiac and non-cardiac surgical peri-operative care*	● Creates an anesthetic plan with consideration of prone/lateral positioning implications in a patient with an LVAD (potential preload and afterload changes) ● Understands the potential anesthetic complications that could occur during induction of a patient with suprasystemic pulmonary artery pressures for lung transplantation (hypoxemia, hypercarbia, right ventricle failure, the need for central line access and inotrope initiation)
Level 4 *Analyzes the impact of advanced cardiothoracic pathophysiology while preparing patient-specific peri-operative patient management plans*	● Coordinates care between cardiothoracic surgery, transfusion medicine, and hematology/oncology in a patient with biventricular failure and heparin induced thrombocytopenia who presents for heart transplantation for possible plasmapheresis ● Plans, discusses, and revises the peri-operative management of a patient with an ascending aortic dissection with tamponade and new onset renal failure
Level 5 *Demonstrates expertise in the field of advanced cardiothoracic pathophysiology confirmed by scholarly activity, including publication, presentation, or the advanced education of others*	● Collaborates in the publication of a textbook chapter providing education on complex cardiothoracic pathophysiology ● Participates in national society meetings by giving educational lectures pertaining to cardiothoracic pathophysiology such as pulmonary hypertension
Assessment Models or Tools	● Direct observation ● Multisource feedback ● Self-assessment ● Simulation
Curriculum Mapping	●
Notes or Resources	● Pagel, PS. Cardiac physiology. in *Kaplan's Cardiac Anesthesia* 6th ed.Kaplan J ed . St.Louis, MO: Elsevier, 2011; 99-128. ● Slinger, P. *Principles and Practice of Anesthesia for Thoracic Surgery.* Springer 2011.

Medical Knowledge 5: Diagnostic and Therapeutic Interventions **Overall Intent:** Understands and uses diagnostic and therapeutic interventions in the care of cardiothoracic patients	
Milestones	**Examples**
Level 1 *Interprets information from common pre-operative cardiothoracic diagnostic studies*	● Understands transthoracic echocardiography, cardiac catheterization, and nuclear medicine stress test reports
Recognizes anesthetic implications of routine cardiothoracic therapeutic procedures	● Articulates the pathophysiology of routine cardiothoracic therapeutic procedures and how that would affect anesthetic management
Level 2 *Interprets and integrates information from common pre-operative cardiothoracic diagnostic studies to guide anesthetic management*	● Understands transthoracic echocardiography findings, such as aortic stenosis, and can use that information to manage a patient's hemodynamics during a procedure
Anticipates anesthetic implications of cardiothoracic therapeutic procedures	● Recognizes the critical parts of a transaortic valve replacement that require anticipation and management of hemodynamics
Level 3 *Interprets and integrates information from pre- and intra-operative advanced cardiothoracic diagnostic studies to anticipate procedural decision-making, and to guide anesthetic management*	● Analyzes the similarities and differences of a pre-operative transthoracic echocardiography report with intra-operative transesophageal echocardiography findings during cardiac procedures
Anticipates anesthetic implications of cardiothoracic therapeutic procedures and assesses risks and benefits of different techniques	● Uses transesophageal echocardiography to guide hemodynamic management of discontinuing extracorporeal membrane oxygenation
Level 4 *Interprets and integrates complex information from pre- and intra-operative advanced cardiothoracic diagnostic studies to anticipate and influence procedural decision-making, and to guide anesthetic management*	● Correlates pre-operative studies and intra-operative transesophageal echocardiography findings to guide surgical management of a new peri-valvular leak noted during a valve replacement procedure
Anticipates anesthetic implications of complex and less common cardiothoracic therapeutic procedures, and assesses risks and benefits of	● Diagnoses a fistula from the right ventricle to the pericardium in a trauma patient by transesophageal echocardiography and creates an anesthetic plan based on these findings

different techniques in collaboration with the interventional team	
Level 5 *Is recognized (through scholarship or education of others) as an expert resource in advanced understanding of complex cardiothoracic diagnostic studies and/or in collaboration and influence on procedural planning and conduct*	● Actively recruited by colleagues (both anesthesiologists and other specialties) to perform transesophageal echocardiography to help diagnose the cause and treat hemodynamic instability in patients
Assessment Models or Tools	● Direct observation ● Multisource feedback ● Self-assessment ● Simulation
Curriculum Mapping	●
Notes or Resources	● Chikwe J. Procedures in the hybrid operating room. *Kaplan's Cardiac Anesthesia* 6th ed. Kaplan J. St.Louis, MO: Elsevier; 2011, 807-813. ● Kahn R. Intraoperative transesophageal echocardiography. In *Kaplan's Cardiac Anesthesia* 6th ed, Kaplan J ed. St.Louis, MO: Elsevier; 2011,315-382. ● Kozak, M. Cardiac catheterization laboratory: diagnostic and therapeutic procedures in the adult patient." *Kaplan's Cardiac Anesthesia,* 6th ed, Kaplan J ed. St.Louis, MO: Elsevier; 2011, 33-73. ● Perrino, Albert. *Transesophageal Echocardiography.* Philadelphia, PA: Lippincott Williams & Wilkins; 2014. ● Sidebotham, David. *Practical Perioperative Transesophageal Echocardiography with Critical Care Echocardiography.* Philadephia, PA: Elsevier 2011. ● Weiss, S. "Decision Making and Perioperative Transesophageal Echocardiography," *Kaplan's Cardiac Anesthesia.* 6th ed. Kaplan, Joel ed. St.Louis, MO: Elsevier; 2011, 383-415.

Systems-Based Practice 1: Patient Safety and Quality Improvement (QI) **Overall Intent:** To engage in the analysis and management of patient safety events, including relevant communication with patients, families, and health care professionals; to conduct a QI project	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of common events that impact patient safety*	● Lists patient misidentification or medication errors as common patient safety events
Demonstrates knowledge of how to report patient safety events	● Explains how to report errors in own health system
Demonstrates knowledge of basic quality improvement methodologies and metrics	● Describes fishbone tool
Level 2 *Identifies system factors that lead to patient safety events*	● Identifies a recent change to the transfusion requisition form that did not include space for two-person verification to avoid an error
Reports patient safety events through institutional reporting systems (simulated or actual)	● Reports lack of compliance with antibiotic administration through departmental or institutional reporting systems
Describes divisional quality improvement initiatives	● Summarizes protocols to decrease surgical site infections
Level 3 *Participates in analysis of patient safety events (simulated or actual)*	● Assimilates patient data, evaluates the root cause, and presents the findings of a patient safety event
Participates in disclosure of patient safety events to patients and patients' families (simulated or actual)	● Through simulation, communicates with patients/families about a medication administration error
Participates in divisional quality improvement initiatives	● Participates in a root cause analysis of duplicate acetaminophen administration in post anesthesia care unit
Level 4 *Conducts analysis of patient safety events and offers error prevention strategies (simulated or actual)*	● Collaborates with a team to conduct the analysis of intra-operative antibiotic administration errors and presents suggested policy and EHR design changes at a department meeting
Discloses patient safety events to patients and patients' families (simulated or actual)	● Discusses with patient and patient's family an inadvertent double-dose of acetaminophen administration given to them due to hand-off error

Demonstrates the skills required to identify, develop, implement, and analyze a quality improvement project	● Initiates and develops a fellow quality improvement project to improve peri-operative hand-offs and presents findings to the department
Level 5 *Actively engages teams and processes to modify systems to prevent patient safety events* *Role models or mentors others in the disclosure of patient safety events* *Creates, implements, and assesses quality improvement initiatives at the institutional level or above*	● Assumes a leadership role at the departmental or institutional level for patient safety ● Creates a simulation for disclosing patient safety events ● Initiates and completes a QI project to improve disclosure of serious adverse events to patients and families and shares results with stakeholders
Assessment Models or Tools	● Direct observation ● E-module multiple choice tests ● Multisource feedback ● Reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● Anesthesia Patient Safety Foundation. Patient Safety Initiatives. https://www.apsf.org/patient-safety-initiatives/. Accessed 2020. ● Institute of Healthcare Improvement. http://www.ihi.org/Pages/default.aspx. Accessed 2020.

Systems-Based Practice 2: System Navigation for Patient-Centered Care **Overall Intent:** To effectively navigate the health care system, including the interdisciplinary team and other care providers; to adapt care to a specific patient population to ensure high-quality patient outcomes	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of care coordination* *Identifies key elements for safe and effective transitions of care and hand-offs* *Demonstrates knowledge of population and community health needs and inequities*	● For a critically ill cardiac patient, identifies the surgeons, anesthesiologists, nurses, social workers, advanced practitioner providers, and ICU pharmacist as members of the team ● Lists the essential components of a standardized tool for sign-out, care transition, and hand-offs ● Identifies that inpatients may have different needs than ambulatory patients; identifies barriers to discharge home for ambulatory patients ● Identifies barriers in refilling medications for members of underserved populations
Level 2 *Coordinates care of patients in routine clinical situations effectively using the roles of interprofessional team members* *Performs safe and effective transitions of care/hand-offs in routine clinical situations* *Identifies specific population and community health needs and inequities for the local population*	● Coordinates care with the ICU and primary medical team on arrival to ICU ● Routinely uses a standardized tool for a stable patient during PACU sign-out ● Identifies challenges in communicating with patients with communication barriers (e.g., non-English-speaking patients and families; hearing, visual or cognitive impairment)
Level 3 *Coordinates care of patients in complex clinical situations effectively using the roles of interprofessional team members* *Performs safe and effective transitions of care/hand-offs in complex clinical situations* *Uses institutional resources effectively to meet the needs of a patient population and community*	● Works with the patient, family, and members of the peri-operative team to coordinate the ● care of a patient with a do-not-resuscitate order ● Routinely uses a standardized tool when transferring a patient to and from the ICU ● Follows institutional guidelines to provide safe care for a Jehovah's Witness patient undergoing coronary artery bypass surgery
Level 4 *Role models effective coordination of patient-centered care among different disciplines and specialties*	● Participates in multidisciplinary discussion with perfusionists, cardiologists, and cardiac surgeons

Role models and advocates for safe and effective transitions of care/hand-offs within and across health care delivery systems *Participates in changing and adapting practice to provide for the needs of specific populations*	● Prior to rotating off the ICU service, proactively informs the incoming fellow about a plan of care for a patient awaiting a lung transplant with multiple studies pending ● Assists in the design of protocols for discussing and managing blood product usage in patients who refuse blood products for religious reasons
Level 5 *Analyzes the process of care coordination and participates in the design and implementation of improvements* *Improves quality of transitions of care within and across health care delivery systems to optimize patient outcomes* *Advocates for populations and communities with health care inequities in the peri-operative setting*	● Develops a program to arrange for pre-operative assessment of frailty in elderly patients ● Devises a protocol to improve transitions from ICU to step down or monitored unit ● Partners with the multidisciplinary health care team to create an innovative approach to support disadvantaged patients in refilling medications
Assessment Models or Tools	● Direct observation ● Medical record (chart) audit ● Multisource feedback ● Quality metrics and goals mined from EHRs ● Review of sign-out tools, use and review of checklists
Curriculum Mapping	●
Notes or Resources	● CDC. Population Health Training in Place Program (PH-TIPP). https://www.cdc.gov/pophealthtraining/whatis.html. Accessed 2020. ● Kaplan KJ. In pursuit of patient-centered care. March 2016. http://tissuepathology.com/2016/03/29/in-pursuit-of-patient-centered-care/#axzz5e7nSsAns. Accessed 2020. ● Skochelak SE, Hawkins RE, Lawson LE, Starr SR, Borkan JM, Gonzalo JD. *AMA Education Consortium: Health Systems Science.* 1st ed. Philadelphia, PA: Elsevier; 2016. https://commerce.ama-assn.org/store/ui/catalog/productDetail?product_id=prod2780003. Accessed 2020.

Systems-Based Practice 3: Physician Role in Health Care Systems **Overall Intent:** To understand the physician's role in the complex health system and how to optimize the system to improve patient care and the health system's performance	
Milestones	**Examples**
Level 1 *Identifies key components of the complex health care system (e.g., hospital, skilled nursing facility, finance, personnel, technology)*	● Identifies that notes and records must meet billing and coding requirements
States factors impacting the costs of anesthetic care	● Explains relative cost of anesthetic medications, monitors, and supplies
Level 2 *Describes how components of a complex health care system are interrelated, and how they impact patient care*	● Prioritizes planning for tracheostomy/gastrostomy for a patient with brain injury prior to discharge to a skilled nursing facility
Documents anesthetic detail to facilitate accurate billing and reimbursement	● Ensures anesthetic procedure accurately reflects procedure performed ● Documents all Centers for Medicare & Medicaid Services (CMS)-required components of anesthetic care performed during procedure
Level 3 *Discusses how individual practice affects the broader system (e.g., length of stay, readmission rates, clinical efficiency)*	● Ensures that patients with post-operative nausea and vomiting receive adjusted anesthetic plans and adequate prophylaxis to avoid unnecessary hospitalization
Explains the impact of documentation on billing and reimbursement	● Discusses the necessity of including the ultrasound image for an ultrasound guided procedure to receive reimbursement
Level 4 *Manages various components of the complex health care system to provide efficient and effective patient care and transitions of care*	● Effectively works with the social work team to ensure interpretive services are available for non-English-speaking patients both pre- and post-operatively
Practices and advocates for cost-effective patient care	● Effectively plans and implements anesthetic to promote enhanced recovery and rapid discharge
Level 5 *Advocates for or leads systems change that enhances high-value, efficient, and effective patient care*	● Works with peri-operative teams to develop and implement enhanced recovery protocols for surgical service lines
Engages in external activities related to advocacy for cost-effective care	● Improves informed consent process for non-English-speaking patients requiring interpreter services
Assessment Models or Tools	● Direct observation

	● Medical record (chart) audit ● Patient satisfaction data ● Portfolio
Curriculum Mapping	●
Notes or Resources	● Agency for Healthcare Research and Quality (AHRQ). Measuring the Quality of Physician Care. https://www.ahrq.gov/talkingquality/measures/setting/physician/index.html. Accessed 2020. ● AHRQ. Major Physician Measurement Sets. https://www.ahrq.gov/talkingquality/measures/setting/physician/measurement-sets.html. Accessed 2020. ● Andreae MH, Gabry JS, Goodrich B, White RS, Hall C. Antiemetic prophylaxis as a marker of health care disparities in the National Anesthesia Clinical Outcomes Registry. *Anesth Analg*. 2018;126(2):588-599. https://journals.lww.com/anesthesia-analgesia/Fulltext/2018/02000/Antiemetic_Prophylaxis_as_a_Marker_of_Health_Care.35.aspx. ● Dzau VJ, McClellan M, Burke S, et al. Vital directions for health and health care: priorities from a National Academy of Medicine Initiative. *NAM Perspectives*. Discussion Paper, National Academy of Medicine, Washington, DC. https://nam.edu/vital-directions-for-health-health-care-priorities-from-a-national-academy-of-medicine-initiative/. ● Teja BJ, Sutherland TN, Barnett SR, Talmor DS. Cost-effectiveness research in anesthesiology. *Anesth Analg.* 2018;127(5):1196-1201. https://pubmed.ncbi.nlm.nih.gov/29570150/.

Practice-Based Learning and Improvement 1: Evidence-Based and Informed Practice **Overall Intent:** To incorporate evidence and patient values into clinical practice	
Milestones	**Examples**
Level 1 *Accesses and uses current evidence in routine patient care*	● Reviews the most recent practice advisory for pre-anesthesia evaluation and applies it in pre-operative evaluation
Level 2 *Articulates clinical questions and elicits patient preferences and values to guide evidence-based care*	● In a patient who is a Jehovah's Witness calculates and discusses peri-operative surgical risk, and solicits patient perspective regarding blood transfusion peri-operative care
Level 3 *Locates and applies the best available evidence, integrated with patient preference, to the care of complex patients*	● Obtains, discusses, and applies evidence for the peri-operative management of a patient on oral anticoagulants for cardiac surgical procedures
Level 4 *Appraises and applies evidence, even in the face of uncertainty and conflicting evidence, to guide individualized care*	● Reviews primary literature regarding administration of blood products in the peri-operative setting
Level 5 *Coaches others to appraise and apply evidence for complex patients and/or participates in the development of guidelines*	● Leads clinical teaching on application of best practices in peri-operative blood product management
Assessment Models or Tools	● Direct observation ● Presentations ● Research and quality improvement projects ● Simulated patient encounter
Curriculum Mapping	●
Notes or Resources	● ACS. Risk Calculator. https://riskcalculator.facs.org/RiskCalculator/PatientInfo.jsp. Accessed 2020. ● ASA. Standards and Guidelines. https://www.asahq.org/standards-and-guidelines. Accessed 2020. ● Practice advisory for preanesthesia evaluation: an updated report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation. *Anesthesiology.* 2012;116(3):522-538. https://anesthesiology.pubs.asahq.org/article.aspx?articleid=2443414&_ga=2.145847356.943651402.1584821665-1121124875.1575478514. ● Practice alert for the perioperative management of patients with coronary artery Stents: a report by the American Society of Anesthesiologists Committee on Standards and Practice Parameters. *Anesthesiology*. 2009;110(1):22-23. https://anesthesiology.pubs.asahq.org/article.aspx?articleid=1921971&_ga=2.221344784.943651402.1584821665-1121124875.1575478514.

	● US National Library of Medicine. PubMed Online Training. https://www.nlm.nih.gov/bsd/disted/pubmedtutorial/cover.html. Accessed 2020.

Practice-Based Learning and Improvement 2: Reflective Practice and Commitment to Personal Growth **Overall Intent:** To seek clinical performance information with the intent to improve care; to reflect on all domains of practice, personal interactions, and behaviors, and their impact on colleagues and patients (reflective mindfulness); to develop clear objectives and goals for improvement in some form of a learning plan	
Milestones	**Examples**
Level 1 *Accepts responsibility for personal and professional development by establishing goals*	● Completes self-reflective goals prior to meeting with the program director
Identifies the factors that contribute to performance deficits	● Identifies that fatigue, stressors and perceived life-work imbalance contribute to performance deficits
Actively seeks opportunities to improve	● Asks for feedback on performance from faculty and other team members ● Knows institutional resources to improve well-being
Level 2 *Demonstrates openness to performance data (feedback and other input) to inform goals*	● Integrates feedback to optimize ultrasound guided central line placement technique
Analyzes and acknowledges the factors that contribute to performance deficits	● Assesses time management skills and how they impact turnovers and on-time starts
Designs and implements a learning plan, with prompting	● When prompted, develops individual education plan to develop transthoracic echocardiography skills
Level 3 *Seeks performance data episodically, with adaptability and humility*	● Obtains chart data to determine incidence of post-operative atrial fibrillation
Institutes behavioral change(s) to improve performance	● Implements strategies that improve behaviors such as trust, interdependence, genuineness, empathy, risk, team building, and success
Independently creates and implements a learning plan	● Performs a focused literature review prior to providing anesthetic care
Level 4 *Intentionally seeks performance data consistently, with adaptability and humility*	● Obtains a quarterly chart audit to seek faculty member feedback on overall performance
Considers alternatives to improve performance	● After patient encounter, debriefs with the attending and other patient care team members to optimize future collaboration in the care of the patient and family
Integrates performance data to adapt the learning plan	● Based on audit of incidence, identifies knowledge gaps and reads current practice guidelines to improve care

Level 5 *Role models consistently seeking performance data with adaptability and humility* *Models reflective practice* *Facilitates the design and implementation of learning plans for others*	● Shares instances of near misses with more junior learners ● Shares own performance gaps and adapted plan with other learners ● Identifies and shares strategies to improve central line placement based on previously received feedback ● Assists more junior residents in developing their individualized learning plans
Assessment Models or Tools	● Direct observation ● Review of learning plan
Curriculum Mapping	●
Notes or Resources	● Burke AE, Benson B, Englander R, Carraccio C, Hicks PJ. Domain of competence: practice-based learning and improvement. *Acad Pediatr.* 2014;14:S38-S54. https://pubmed.ncbi.nlm.nih.gov/24602636/. ● Hojat M, Veloski JJ, Gonnella JS. Measurement and correlates of physicians' lifelong learning. *Academic Medicine.* 2009;84(8):1066-1074. https://journals.lww.com/academicmedicine/fulltext/2009/08000/Measurement_and_Correlates_of_Physicians__Lifelong.21.aspx. ● Lockspeiser TM, Schmitter PA, Lane JL, Hanson JL, Rosenberg AA, Park YS. Assessing residents' written learning goals and goal writing skill: validity evidence for the learning goal scoring rubric. *Academic Medicine*. 2013;88(10):1558-1563. https://journals.lww.com/academicmedicine/fulltext/2013/10000/Assessing_Residents__Written_Learning_Goals_and.39.aspx. ● Reed S, Lockspeiser TM, Burke A, et al. Practical suggestions for the creation and use of meaningful learning goals in graduate medical education. *Academic Pediatrics*. 2016;16(1):20-24. https://www.academicpedsjnl.net/article/S1876-2859(15)00333-2/pdf.

Professionalism 1: Professional Behavior and Ethical Principles **Overall Intent:** To recognize and address lapses in ethical and professional behavior, demonstrates ethical and professional behaviors, and use appropriate resources for managing ethical and professional dilemmas	
Milestones	**Examples**
Level 1 *Identifies potential triggers for professionalism lapses*	● Describes the impact of fatigue on clinical performance ● Recognizes that personal bias may interfere with professionalism
Describes when and how to report lapses in professionalism	● Identifies fatigue and lists available resources to mitigate impact from fatigue ● Describes institutional safety reporting systems to report a near miss, a process problem or patient event
Demonstrates knowledge of the ethical principles underlying patient care	● Articulates how the principle of "do no harm" applies to a patient who may not need a central line even though the learning opportunity exists ● Discusses the basic principles underlying ethics (e.g., beneficence, nonmaleficence, justice, autonomy) and professionalism (e.g., professional values and commitments), and how they apply in various situations (e.g., informed consent process)
Level 2 *Demonstrates insight into professional behavior in routine situations*	● Respectfully approaches a colleague who is late to call shift about the importance of being on time ● Maintains patient confidentiality in public situations
Takes responsibility for one's own professionalism lapses	● Notifies appropriate supervisor in a timely way when unable to fulfill a responsibility
Analyzes straightforward situations using ethical principles	● Identifies and applies ethical principles involved in informed consent when the fellow is unclear of all the risks ● Identifies surrogate for impaired patients
Level 3 *Demonstrates professional behavior in complex or stressful situations*	● Appropriately responds to a distraught family member, following a peri-operative complication ● Appropriately handles conversations in the operating room during stressful situations such as acute blood loss and hemodynamic instability
Recognizes the need to seek help in managing and resolving complex interpersonal situations	● After noticing a colleague's inappropriate social media post, reviews policies related to posting of content and seeks guidance
Analyzes complex situations using ethical principles	● Offers treatment options for a terminally ill patient, free of bias, while recognizing own limitations, and consistently honoring the patient's choice

	● Reviews institutional policies and offers options for peri-operative management for a patient who is a Jehovah's Witness
Level 4 *Recognizes situations that may trigger professionalism lapses and intervenes to prevent lapses in oneself and others* *Actively solicits help and acts on recommendations to resolve complex interpersonal situations* *Recognizes and utilizes resources for managing and resolving ethical dilemmas*	● Actively solicits the perspectives of others ● Models respect for patients and promotes the same from colleagues, when a patient has been waiting an excessively long time for the surgery ● Recognizes and uses ethics consults, literature, risk-management/legal counsel to resolve ethical dilemmas ● Obtains institutional guidance on obtaining a consent for blood transfusion in Jehovah's Witness patients ● Recognizes and manages situations of medical futility
Level 5 *Coaches others when their behavior fails to meet professional expectations* *Identifies and seeks to address system-level factors that induce or exacerbate ethical problems or impede their resolution*	● Coaches others when their behavior fails to meet professional expectations and creates a performance improvement plan to prevent recurrence ● Identifies and seeks to address system-wide factors or barriers to promoting a culture of ethical behavior through participation in a work group, committee, or taskforce (e.g., ethics committee or an ethics subcommittee, risk management committee, root cause analysis review, patient safety or satisfaction committee, professionalism work group, Institutional Review Board, resident grievance committee)
Assessment Models or Tools	● Direct observation ● Global evaluation ● Multisource feedback ● Oral or written self-reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● ASA. ASA Code of Ethics. https://www.asanet.org/code-ethics. Accessed 2020. ● American Medical Association. Ethics. https://www.ama-assn.org/delivering-care/ama-code-medical-ethics. Accessed 2020. ● Byyny RL, Papadakis MA, Paauw DS. *Medical Professionalism Best Practices*. Menlo Park, CA: Alpha Omega Alpha Medical Society; 2015. https://alphaomegaalpha.org/pdfs/2015MedicalProfessionalism.pdf. ● Domen RE, Johnson K, Conran RM, et al. Professionalism in pathology: a case-based approach as a potential education tool. *Arch Pathol Lab Med.* 2017; 141:215-219. https://pubmed.ncbi.nlm.nih.gov/27763788/.

	● Levinson W, Ginsburg S, Hafferty FW, Lucey CR. *Understanding Medical Professionalism*. 1st ed. New York, NY: McGraw-Hill Education; 2014.

Professionalism 2: Accountability/Conscientiousness **Overall Intent:** To take responsibility for one's own actions and the impact on patients and other members of the health care team	
Milestones	**Examples**
Level 1 *Responds promptly to requests or reminders to complete tasks* *Takes responsibility for failure to complete tasks*	● Responds promptly to reminders from program administrator to complete work hour logs ● Attends conferences and other educational activities on time ● Apologizes to team member(s) for inability to complete tasks on time, without prompting
Level 2 *Performs tasks and responsibilities in a timely manner* *Recognizes situations that may impact one's own ability to complete tasks and responsibilities in a timely manner*	● Completes administrative tasks, documents safety modules, procedure review, and licensing requirements by specified due date ● Before going out of town, completes tasks in anticipation of lack of computer access while traveling
Level 3 *Performs tasks and responsibilities in a timely manner with appropriate attention to detail in routine situations* *Takes responsibility for tasks not completed in a timely manner and identifies strategies to prevent recurrence*	● Notifies attending of multiple competing demands on call in the ICU, appropriately triages tasks, and asks for assistance from other fellows or faculty members as needed ● Appropriately notifies residents and fellows on day service about overnight call events during transition of care or hand-off to avoid patient safety issues and compromise of patient care ● Apologizes to team member(s) for unprofessional behavior without prompting, offers restitution if possible and through self-reflection identifies root cause of failure
Level 4 *Prioritizes tasks and responsibilities in a timely manner with appropriate attention to detail in complex or stressful situations* *Proactively implements strategies to ensure that the needs of patients, teams, and systems are met*	● Takes responsibility for inadvertently omitting key patient information during hand-off and professionally discusses with the patient, family and interprofessional team ● Follows-up with a patient who had a brachial plexus injury after a lung transplant after being discharged from the hospital to evaluate for residual nerve dysfunction
Level 5 *Designs and implements an institutional systems approach to ensure timely task completion and shared responsibility*	● Coordinates a multidisciplinary team to facilitate ICU transfers throughout the institution ● Leads multidisciplinary team in peri-operative root cause analysis to improve system practices around infection control
Assessment Models or Tools	● Compliance with deadlines and timelines ● Direct observation ● Global evaluations ● Multisource feedback

	● Self-evaluations and reflective tools ● Simulation
Curriculum Mapping	●
Notes or Resources	● ASA. ASA Code of Ethics. https://www.asanet.org/code-ethics. Accessed 2020. ● Code of conduct from fellow/resident institutional manual ● Expectations of the fellowship program regarding accountability and professionalism

Professionalism 3: Well-Being **Overall Intent:** To identify, use, manage, improve, and seek help for personal and professional well-being for self and others	
Milestones	**Examples**
Level 1 *Recognizes the importance of addressing personal and professional well-being*	● Acknowledges own response to patient's fatal operative outcome ● Is receptive to feedback on missed emotional cues after a family meeting ● Discusses well-being concerns as they might affect performance
Level 2 *Lists available resources for personal and professional well-being* *Describes institutional resources that are meant to promote/support well-being*	● Independently identifies and communicates impact of a personal family tragedy ● Completes e-learning modules (or other modality) related to fatigue management ● Demonstrates how to access an institutional crisis line ● Independently identifies the stress of relationship issues, difficult patients, and financial pressures, and seeks help
Level 3 *With assistance, proposes a plan to promote personal and professional well-being* *Recognizes which institutional factors affect well-being*	● With the multidisciplinary team, develops a reflective response to deal with personal impact of difficult patient encounters and disclosures ● Identifies institutionally sponsored wellness programs ● Integrates feedback from the multidisciplinary team to develop a plan for identifying and responding to emotional cues during the next family meeting ● With supervision, assists in developing a personal learning or action plan to address factors potentially contributing to burnout
Level 4 *Independently develops a plan to promote personal and professional well-being* *Describes institutional factors that positively and/or negatively affect well-being*	● Independently identifies ways to manage personal stress ● Self-assesses and seeks additional feedback on skills responding to emotional cues during a family meeting ● Works to prevent, mitigate and intervene early during stressful periods in the fellow peer group
Level 5 *Creates institutional-level interventions that promote colleagues' well-being* *Describes institutional programs designed to examine systemic contributors to burnout*	● Assists in organizational efforts to address clinician well-being after patient diagnosis/prognosis/death ● Works with multidisciplinary team to develop a feedback framework for learners around family meetings ● Establishes a mindfulness program open to all employees
Assessment Models or Tools	● Direct observation

	● Group interview or discussions for team activities ● Individual interview ● Institutional online training modules ● Self-assessment and personal learning plan
Curriculum Mapping	●
Notes or Resources	● This subcompetency is not intended to evaluate a fellow's well-being, but to ensure each fellow has the fundamental knowledge of factors that impact well-being, the mechanisms by which those factors impact well-being, and available resources and tools to improve well-being. ● ACGME. Tools and Resources https://dl.acgme.org/pages/well-being-tools-resources. Accessed 2022. ● Hicks PJ, Schumacher D, Guralnick S, Carraccio C, Burke AE. Domain of competence: personal and professional development. *Acad Pediatr*. 2014;14(2 Suppl):S80-97. https://linkinghub.elsevier.com/retrieve/pii/S1876-2859(13)00332-X. ● Local resources, including Employee Assistance Plan (EAP)

Interpersonal and Communication Skills 1: Patient- and Family-Centered Communication **Overall Intent:** To deliberately use language and behaviors to form constructive relationships with patients, to identify communication barriers including self-reflection on personal biases, and minimize them in the doctor-patient relationships; to organize and lead communication around shared decision making	
Milestones	**Examples**
Level 1 *Communicates with patients and their families in an understandable and respectful manner* *Provides timely updates to patients and patients' families*	● Introduces self and faculty member, identifies patient and others in the room, and engages all parties in health care discussion ● Provides updates to the family after an unanticipated ICU admission
Level 2 *Customizes communication in the setting of personal biases and barriers with patients and patients' families* *Actively listens to patients and patients' families to elicit patient preferences and expectations*	● Avoids medical jargon and restates patient perspective when discussing anesthetic options for cardiac surgery ● Responds to questions regarding the risks of general anesthesia, vascular access, or TEE during cardiac surgical procedures
Level 3 *Explains complex and difficult information to patients and patients' families* *Uses shared decision-making to make a personalized care plan*	● Acknowledges patient's request for a do not resuscitate order in the operating room and explains the options ● Following a discussion of the risks and benefits of TEE placement with a minor contraindication, elicits patient and family preference regarding TEE placement; documents discussion and preference
Level 4 *Facilitates difficult discussions with patients and patients' families* *Effectively negotiates and manages conflict among patients, patients' families, and the health care team*	● Explains the risks of neurocognitive dysfunction to an elderly patient prior to administration of anesthesia for a case that requires circulatory arrest ● Explains to a patient and family the medical reasoning behind canceling a procedure ● Explains causes and treatment of a corneal abrasion during post-operative visits
Level 5 *Mentors others in the facilitation of crucial conversations* *Mentors others in conflict resolution*	● Leads a discussion group on personal experience of moral distress ● Develops a curriculum on health care disparities which addresses unconscious bias ● Serves on a hospital bioethics committee
Assessment Models or Tools	● Direct observation ● Self-assessment including self-reflection exercises ● Standardized patients

Curriculum Mapping	●
Notes or Resources	● Laidlaw A, Hart J. Communication skills: an essential component of medical curricula. Part I: Assessment of clinical communication: AMEE Guide No. 51. *Med Teach*. 2011;33(1):6-8. https://www.tandfonline.com/doi/full/10.3109/0142159X.2011.531170. ● Makoul G. Essential elements of communication in medical encounters: The Kalamazoo consensus statement. *Acad Med*. 2001;76:390-393. https://pubmed.ncbi.nlm.nih.gov/11299158/. ● Makoul G. The SEGUE Framework for teaching and assessing communication skills. *Patient Educ Couns*. 2001;45(1):23-34. https://pubmed.ncbi.nlm.nih.gov/11602365/. ● Symons AB, Swanson A, McGuigan D, Orrange S, Akl EA. A tool for self-assessment of communication skills and professionalism in residents. *BMC Med Educ*. 2009;9:1. https://bmcmededuc.biomedcentral.com/articles/10.1186/1472-6920-9-1.

Interpersonal and Communication Skills 2: Interprofessional and Team Communication **Overall Intent:** To effectively communicate with the health care team, including consultants, in both straightforward and complex situations	
Milestones	**Examples**
Level 1 *Respectfully requests or receives consultations*	● Consults gastroenterology for a patient with a history of dysphasia prior to anticipated TEE placement, relays the diagnosis, and respectfully requests an endoscopy
Uses language that values all members of the health care team	● Receives an anesthesia consult for a complicated cardiac surgical patient, asks clarifying questions politely, and expresses appreciation for the motivation behind the consult request
Respectfully receives feedback from the health care team	● Acknowledges the contribution of each member of the patient care team to the patient
Level 2 *Clearly, concisely, and promptly requests or responds to a consultation*	● Communicates pre-operative plans with the attending anesthesiologist concisely in a timely manner
Communicates information effectively with all health care team members	● Communicates intra-operative events to the surgical staff and attending anesthesiologist clearly and concisely in an organized and timely manner
Solicits feedback on performance as a member of the health care team	● Conducts post-operative visits and discusses patient complications with supervising attending while reflecting on personal role in the patient's care
Level 3 *Uses closed-loop communication to verify understanding*	● While leading an intra-operative resuscitation, clearly delegates tasks and asks if team members understand their roles ● Asks other members of the health care team to repeat back recommendations to ensure understanding
Adapts communication style to fit team needs	● When receiving treatment recommendations from an attending physician, repeats back the plan to ensure understanding
Communicates concerns and provides feedback to peers and learners	● Provides constructive feedback to junior learners during arterial line placement
Level 4 *Coordinates recommendations from different members of the health care team to optimize patient care*	● Collaborates with surgical colleagues to plan for postoperative analgesia in a patient on buprenorphine
Maintains effective communication in crisis situations	● Explains rationale for institution of the massive transfusion protocol during intra-operative hemorrhage

Communicates constructive feedback to superiors	● Alerts a faculty member to a breach in sterility during a line placement ● Cautions faculty member about an imminent medication administration error
Level 5 *Role models flexible communication strategies that value input from all health care team members, resolving conflict when needed* *Leads an after-event debrief of the health care team* *Facilitates regular health care team-based feedback in complex situations*	● Mediates a conflict resolution between different members of the health care team ● Leads a post-code team debriefing ● Prompts a post-case sign-out after a case requiring a massive transfusion and ICU care
Assessment Models or Tools	● Direct observation ● Global assessment ● Medical record (chart) audit ● Multisource feedback ● Simulation
Curriculum Mapping	●
Notes or Resources	● AHRQ. Curriculum Materials. https://www.ahrq.gov/teamstepps/curriculum-materials.html. Accessed 2020. ● Tait AR, Teig MK, Voepel-Lewis T. Informed consent for anesthesia: A review of practice and startegies for optimizing the consent process. *Can J Anaesth*. 2014;61(9):832-842. https://pubmed.ncbi.nlm.nih.gov/24898765/. ● Dehon E, Simpson K, Fowler D, Jones A. Development of the faculty 360. *MedEdPORTAL*. 2015;11:10174. https://www.mededportal.org/publication/10174/. ● Green M, Parrott T, Cook G., Improving your communication skills. *BMJ*. 2012;344:e357. https://www.bmj.com/content/344/bmj.e357. ● Henry SG, Holmboe ES, Frankel RM. Evidence-based competencies for improving communication skills in graduate medical education: a review with suggestions for implementation. *Med Teach*. 2013;35(5):395-403. https://www.tandfonline.com/doi/full/10.3109/0142159X.2013.769677. ● Roth CG, Eldin KW, Padmanabhan V, Freidman EM. Twelve tips for the introduction of emotional intelligence in medical education. *Med Teach.* 2018:1-4. https://www.tandfonline.com/doi/full/10.1080/0142159X.2018.1481499..

Interpersonal and Communication Skills 3: Communication within Health Care Systems **Overall Intent:** To effectively communicate using a variety of methods	
Milestones	**Examples**
Level 1 *Accurately records information in the patient record; demonstrates judicious use of documentation shortcuts*	● Creates accurate documentation but may include extraneous information
Safeguards patients' personal health information	● Avoids talking about patients in the elevator, public spaces, or on social media
Communicates through appropriate channels as required by institutional policy	● Identifies institutional and departmental communication hierarchy for concerns and safety issues ● Only uses secure communication modalities when sharing protected health information
Level 2 *Accurately records information in the anesthetic record for basic cases*	● Completes all components of the intra-operative record in a timely manner
Documents required data in formats specified by institutional policy	● Completes report for an urgent TEE using the appropriate template and correct elements ● Correctly uses the institutional system to file a report of a safety issue
Respectfully communicates concerns about the system	● Recognizes that a communication breakdown has happened and respectfully brings the breakdown to the attention of the chief fellow or faculty member
Level 3 *Accurately records information in the anesthetic record and communicates complex care decisions for complex cases*	● Documents critical event notes in the medical record concisely and in a timely manner
Appropriately selects direct and indirect forms of communication based on context	● Follows up with a patient in person regarding a difficult intubation, providing the patient a written description for future anesthetic planning ● Provides a written handout on risks of sugammadex and contraception
Respectfully communicates concerns about the system and contributes to solutions	● Knows when to direct concerns locally, departmentally, or institutionally, i.e., appropriate escalation
Level 4 *Uses medical record functionality to highlight challenges in anesthetic care to facilitate future peri-operative management*	● Creates consistently accurate, organized, and concise documentation, frequently incorporating anticipatory guidance
Models exemplary written or verbal communication	● Creates exemplary pre-operative assessments that are used by a fellow to teach others

Uses appropriate channels to offer clear and constructive suggestions to improve the system	● Talks directly to a surgical colleague about breakdowns in communication to prevent recurrence
Level 5 *Explores innovative uses of the medical record to facilitate peri-operative management* *Guides departmental or institutional policies and procedures around communication* *Initiates difficult conversations with appropriate stakeholders to improve the system*	● Leads a task force established by the hospital QI committee to develop a plan to improve house staff hand-offs ● Actively participates in a committee to develop a pandemic disaster response plan ● Contacts hospital leadership to discuss ways to improve fellow well-being
Assessment Models or Tools	● Direct observation ● Medical record (chart) audit ● Multisource feedback ● Simulation
Curriculum Mapping	●
Notes or Resources	● APSF. Improving Post Anesthesia Care Unit (PACU) Handoff By Implementing a Succinct Checklist. https://lhatrustfunds.com/wp-content/uploads/2015/07/PACU-handoff.pdf. 2020. ● Bierman JA, Hufmeyer KK, Liss DT, Weaver AC, Heiman HL. Promoting responsible electronic documentation: validity evidence for a checklist to assess progress notes in the electronic health record. *Teach Learn Med.* 2017;29(4):420-432. https://www.tandfonline.com/doi/full/10.1080/10401334.2017.1303385. ● Haig KM, Sutton S, Whittington J. SBAR: a shared mental model for improving communication between clinicians. *Jt Comm J Qual Patient Saf*. 2006;32(3):167-175. https://www.jointcommissionjournal.com/article/S1553-7250(06)32022-3/fulltext. ● Starmer AJ, et al. I-pass, a mnemonic to standardize verbal handoffs. *Pediatrics*. 2012;129(2):201-204. https://pediatrics.aappublications.org/content/129/2/201?sso=1&sso_redirect_count=1&nfstatus=401&nftoken=00000000-0000-0000-0000-000000000000&nfstatusdescription=ERROR%3a+No+local+token.

Adult Cardiothoracic Anesthesiology Supplemental Guide

To help programs transition to the new version of the Milestones, the ACGME has mapped the original Milestones 1.0 to the new Milestones 2.0. Indicated below are where the subcompetencies are similar between versions. These are not exact matches but are areas that include similar elements. Not all subcompetencies map between versions. Inclusion or exclusion of any subcompetency does not change the educational value or impact on curriculum or assessment.

Milestones 1.0	Milestones 2.0
PC1: Peri-procedural Assessment and Management	PC1: Peri-Procedural Assessment and Management
PC2: Technical/Procedural Skills	PC2: Technical/Procedural Skills: Transesophageal Echocardiography (TEE) PC3: Technical/Procedural Skills: Fiberoptic Bronchoscopy and Lung Isolation Techniques PC4: Technical/Procedural Skills: Vascular Access
No match	PC5: Cardiac Procedures Not Involving Extracorporeal Circulation PC6: Aortic Surgery PC7: Circulatory Support Transitions
MK1: — Extracorporeal Circulation and Circulatory Assist Device Principles	MK1: — Extracorporeal Circulation and Circulatory Assist Device Principles
MK2: Cardiovascular/Thoracic Imaging and Monitoring	MK2: Non-Ultrasound-Based Cardiovascular/Pulmonary Imaging and Monitoring MK3: Ultrasound-Based Imaging and Monitoring
MK3: Cardiovascular/Thoracic Pathophysiology and Pharmacology	MK4: Cardiovascular/Thoracic Pathophysiology
MK4: Diagnostic and Therapeutic Interventions	MK5: Diagnostic and Therapeutic Interventions
SBP1: Interprofessional and Transitions of Care	SBP2: System Navigation for Patient-Centered Care
SBP2: Incorporation of Patient Safety and Quality Improvement into Clinical Practice	SBP1: Patient Safety and Quality Improvement
SBP3: Understanding of Health Care Economics: Cost Awareness and Cost-benefit Analysis	SBP3: Physician Role in Health Care Systems
PBLI1: Self-directed Learning and Scholarly Activity	PBLI1: Evidence-Based and Informed Practice PBLI2: Reflective Practice and Commitment to Personal Growth
PBLI2: Education of Team Members and Other Health Care Providers	No match
PROF1: Commitment to institution, department, and colleagues	PROF2: Accountability/ Conscientiousness

PROF2: Receiving and giving feedback	PBLI2: Reflective Practice and Commitment to Personal Growth
PROF3: Responsibility to maintain personal emotional, physical, and mental health	PROF3: Self-Awareness and Well-Being
	PROF1: Professional Behavior and Ethical Principles
ICS1: Communication with patients and families	ICS1: Patient- and Family-Centered Communication
	ICS2: Interprofessional and Team Communication
	ICS3: Communication within Health Care Systems

Available Milestones Resources

Milestones 2.0: Assessment, Implementation, and Clinical Competency Committees Supplement, 2021 - *https://meridian.allenpress.com/jgme/issue/13/2s*

Milestones Guidebooks: https://www.acgme.org/milestones/resources/

- *Assessment Guidebook*
- *Clinical Competency Committee Guidebook*
- *Clinical Competency Committee Guidebook Executive Summaries*
- *Implementation Guidebook*
- *Milestones Guidebook*

Milestones Guidebook for Residents and Fellows: https://www.acgme.org/residents-and-fellows/the-acgme-for-residents-and-fellows/

- Milestones Guidebook for Residents and Fellows
- Milestones Guidebook for Residents and Fellows Presentation
- Milestones 2.0 Guide Sheet for Residents and Fellows

Milestones Research and Reports: https://www.acgme.org/milestones/research/

- *Milestones National Report*, updated each fall
- *Milestones Predictive Probability Report,* updated each fall
- *Milestones Bibliography*, updated twice each year

Developing Faculty Competencies in Assessment courses - https://www.acgme.org/meetings-and-educational-activities/courses-and-workshops/developing-faculty-competencies-in-assessment/

Assessment Tool: Direct Observation of Clinical Care (DOCC) - https://dl.acgme.org/pages/assessment

Assessment Tool: Teamwork Effectiveness Assessment Module (TEAM) - https://team.acgme.org/

Improving Assessment Using Direct Observation Toolkit - https://dl.acgme.org/pages/acgme-faculty-development-toolkit-improving-assessment-using-direct-observation

Remediation Toolkit - https://dl.acgme.org/courses/acgme-remediation-toolkit

Learn at ACGME has several courses on Assessment and Milestones - https://dl.acgme.org/