

1. Administration and Quality Improvement

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate competency in the implementation of different clinical protocols to the care of critically ill patients
- Demonstrate competency in the implementation of institutional quality improvement protocols to the care of critically ill patients
- Demonstrate competency in the implementation of methods for monitoring patient outcomes and reporting complications

Competency 2: Medical Knowledge

- Demonstrate knowledge of the difference between a protocol and guideline, and demonstrate competency in their development and implementation
- Demonstrate familiarity with the standards of critical care practice for physicians
- Demonstrate familiarity with critical care nursing standards of care
- Describe institutional and regional disaster management protocols
- Demonstrate an understanding of financial management of the intensive care unit, including the monitoring of costs, charges, appropriate coding, billing, and collection
- Demonstrate an understanding of appropriate federal and state regulations and laws that apply to critical care practice, and develop a basic understanding of the medicolegal aspects
- Demonstrate an appreciation for equitable, logical, ethical and fair allocation of limited resources
- Cite the criteria used for faculty recruitment and advancement
- Cite the criteria used for recruitment and retention of nursing staff and ancillary personnel

Competency 3: Practice-Based Learning and Improvement

- Demonstrate an understanding of the importance of multimodality care
- Demonstrate an appreciation for the role of effective communication strategies, and leadership skills
- Cite the different styles and roles of critical care practice in open, closed, and consultative units
- Demonstrate an understanding of the role of critical care units in the health system

Competency 4: Interpersonal and Communication Skills

- Communicate effectively with members of multi-modality critical care team
- Develop and demonstrate strategies for conflict resolution
- Demonstrate leadership skills

Competency 5: Professionalism

- Develop effective relationships with consultants, surgeons, nurses, and other health care providers
- Demonstrate sound ethical principles
- Demonstrate an understanding of the need for the enforcement of quality control measures

Competency 6: Systems-Based Practice

- Demonstrate an understanding of the need for developing and implementing effective patient safety protocols
- Demonstrate an understanding of the need for developing and implementing quality improvement measures
- Demonstrate an understanding of the need for developing and implementing tools for tracking clinical outcomes
- Demonstrate an understanding of the need for developing and implementing methods for ensuring physician training, maintenance of skills, credentialing and testing
- Participate actively in quality improvement activities
- Demonstrates understanding of the National Surgical Quality Improvement Program (NSQIP) and Trauma Quality Improvement Program (TQIP).

2. Burn Care

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate knowledge and competency in the initial evaluation and management of the patient with thermal injury (eg, early airway management, burn severity)
- Demonstrate knowledge and competency in the evaluation of burn size (using Rule of 9's and Lund-Browder charts) and depth
- Demonstrate knowledge and competency in the management of the patient with inhalation injury, including physical examination, analysis of arterial blood gas and carboxyhemoglobin data, airway management, application of hyperbaric oxygen, and interventions (including bronchoscopy)
- Demonstrate knowledge and competency in selection and rate of administration of resuscitation fluids and application of other therapies in resuscitation
- Demonstrate knowledge and competency in wound care and selection of appropriate wound care modalities
- Demonstrate knowledge and competency in prevention of early burn-associated complications, including eschar-related respiratory insufficiency and the appropriate use of escharotomy
- Demonstrate knowledge and competency in the appropriate management of patients with electrical burns, including arrhythmias, tissue injury, compartment syndrome, and rhabdomyolysis
- Demonstrate knowledge in the appropriate management of patients with chemical burns, including prevention of absorption, and recognition of potential pulmonary and renal toxicities
- Demonstrate knowledge and competency in the management of the patient with burn-related hypermetabolism
- Demonstrate knowledge in the evaluation and management of patients with Stevens-Johnson syndrome, toxic epidermal necrolysis syndrome (TENS)
- Demonstrate knowledge and competency in the evaluation of burn wound etiology and the consideration of intentional injury

Competency 2: Medical Knowledge

- Describe the pathophysiology of inhalational injury and demonstrate competence in its diagnosis and management including ventilator strategies and use of adjunct measures
- Describe the pathophysiology and differences between partial and full-thickness burns and minor and major burns
- Describe the different wound management strategies (early versus delayed excision, various topical measures) and cite their relative strengths and weaknesses
- Describe the early and long-term metabolic effects of major burns and strategies to address this including appropriate use of pharmacology, wound management, temperature control, and nutritional therapies
- Describe the different etiologies of electrical injuries (AC, DC, lightning) and associated injury patterns and complications
- Demonstrate an understanding of the significance of different types of chemical exposure (acid versus alkali, petrochemical absorption) and strategies for managing topical and systemic effects
- Cite the causes of Stevens-Johnson syndrome and TENS and appropriate diagnosis and treatment strategies

Competency 3: Practice-Based Learning and Improvement

- Describe measures and techniques for improving quality of care and patient and family satisfaction
- Review published information critically to understand current evidence-based information to optimize resuscitation, (eg, fluid selection), problem-specific management (eg, TENS, chemical injury)

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective communication with nurses, pharmacists, respiratory therapists, speech therapists, occupational and physical therapists, and consulting services for collaborative management of the thermally injured patient
- Demonstrate effective communication with patients and family members (both listening and conveying information with appropriate degree of complexity)

Competency 5: Professionalism

- Demonstrate respect, compassion, integrity, and responsiveness to the needs of the patients and their families
- Approach and discuss ethical issues, including advanced directive and end-of-life issues
- Demonstrate accurate self-assessment, knowledge of professional limits, and an ongoing desire for self-improvement

Competency 6: Systems-Based Practice

- Serve as an advocate for quality patient care, with due attention to costs and resources in a complex health care system, including acceptance of transfers and arranging repatriation
- Partner appropriately with other health care providers, including consulting physicians, nurses, pharmacists, respiratory therapists, and physical and speech therapists
- Collaborate with other health care providers, including consulting physicians, nurses, and social workers, to evaluate and refer issues related to intentional injury

3. Cardiovascular Physiology, Pathophysiology and Therapy

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate knowledge and competency in the interpretation and application of data from noninvasive and invasive, diagnostic, and monitoring techniques (eg, echocardiography, arterial catheters, central venous pressure monitors, pulmonary artery catheter, tissue perfusion monitors, and other methods for measuring cardiac performance)
- Demonstrate competency in the appropriate selection and effective use of different inotropic and vasoactive agents in patients with different types of shock (cardiogenic, neurogenic, septic, or mixed)
- Display a logical approach towards goal directed resuscitation and optimization of tissue oxygen delivery in patients with shock
- Display competency in selecting and using appropriate mechanical support devices in patients with cardiogenic shock (eg, ventricular assist device, intra-aortic balloon pump) or poor oxygenation (extra corporeal membrane oxygenation)
- Demonstrate an ability to interpret radiographic studies, including chest X-rays, computed tomography (CT) scans, arteriograms, and magnetic resonance studies, and apply the data to the management of patients with cardiovascular diseases
- Develop competency in performing cardiovascular procedures, including:
 - Ultrasound to diagnose pericardial tamponade
 - Pericardiocentesis
 - Closed and open cardiac compression
 - Placement of arterial and venous catheters for hemodynamic monitoring and/or delivery of therapies
 - Placement of temporary pacemakers
- Demonstrate knowledge and competency in the diagnosis and management of cardiac arrhythmias and ischemic events
- Demonstrate knowledge and competency in the appropriate application of advanced cardiac support (ACLS) guidelines
- Demonstrate competency in diagnosis and management of arterial diseases due to various etiologies (eg, thrombotic, embolic, atherosclerosis, aneurismal)
- Competency in appropriate control of high blood pressure in various patient populations (eg, aortic aneurysm, dissections, intra-cerebral bleeding)
- Demonstrate competency in the diagnosis and management of various venous diseases, including deep venous thrombosis (DVT), venous insufficiency, venous ulcers/gangrene
- Demonstrate appropriate selection and application of various prevention strategies for thromboembolic events, including sequential compression devices, drugs, and vena caval filters

Competency 2: Medical Knowledge

- Demonstrate competency in the interpretation of cardiac data obtained from electrocardiograms (ECGs), catheterization, echocardiography, and various monitoring devices
- Demonstrate an understanding of the application of various arterial and venous diagnostic studies
- Describe the different etiologies, diagnostic workup, and management strategies for different types of shock

- Demonstrate an understanding of the concepts of oxygen content, delivery, and consumption, and develop a logical approach towards their correction in critically ill patients
- Cite the risk factors for perioperative myocardial adverse events and describe specific strategies for decreasing their incidence
- List the most common causes of acute and chronic cardiac failure and their treatment
- Describe the different types of cardiac arrhythmias and their appropriate treatment
- Describe the different types of cardiac valve diseases and appropriate strategies for diagnosis and treatment
- Cite the different causes of arterial insufficiency and/or occlusion and describe appropriate treatment
- Cite the different types of arterial aneurysms/dissections and various treatment options
- Describe the causes of venous insufficiency and their treatment
- Describe the etiologies of thromboembolic events and different strategies for their prevention and treatment
- Describe the rationale and the appropriate use of different cardiovascular tools, including:
 - Hemodynamic monitoring devices
 - Ultrasound and echocardiography
 - Pacemakers
 - Cardiac assist devices
 - Cardiopulmonary bypass and extracorporeal membrane oxygenation (ECMO) equipment
- Describe techniques for weaning patients from mechanical cardiac support/ECMO, and for titrating cardiac drugs
- Demonstrate familiarity with new literature related to cardiovascular diseases in critically ill surgical patients

Competency 3: Practice-Based Learning and Improvement

- Demonstrate familiarity with effective strategies for the prevention, diagnosis, and treatment of perioperative adverse cardiac events
- Demonstrate familiarity with protocols for the prompt diagnosis and treatment of cardiac arrhythmias
- Cite evidence-based recommendations for the management of patients with shock
- Demonstrate familiarity with strategies for the prevention, diagnosis, and treatment of thromboembolic complications

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective communication skills with nurses, technicians, and physicians that are involved in the care of patients with cardiovascular diseases
- Develop effective management plans in collaboration with the surgeons and other consulting services for patients with cardiovascular diseases

Competency 5: Professionalism

- Develop effective relationships with consultants, surgeons, nurses and other health care providers
- Demonstrate sound ethical principles in the care of critically ill patients that refuse cardiovascular support, and/or request withdrawal of care
- Develop compassionate and effective methods for communicating with patients and their family members

Competency 6: Systems-Based Practice

- Demonstrate an understanding of the role and cost-effectiveness of cardiac ischemic event prevention protocols in the intensive care unit
- Demonstrate an understanding of the role and cost-effectiveness of DVT/pulmonary embolism (PE) prevention protocols in the intensive care unit
- Demonstrate an understanding of the role and cost-effectiveness of surveillance protocols for the early diagnosis and treatment of DVT/PE in critically ill patients

4. Endocrine disorders

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate knowledge and competency in the evaluation and management of critically ill patients with thyroid, parathyroid, pancreatic, and adrenal disorders
- Demonstrate knowledge and competency in the evaluation and management of postoperative complications for thyroid, parathyroid, pancreatic, and adrenal operations, including acute airway emergencies associated with neck exploration, hypocalcemia from parathyroid operations, and fluid collections and fistulas associated with pancreatic and adrenal operations
- Demonstrate knowledge and competency in the evaluation and management of hyperglycemia and diabetes
- Demonstrate knowledge in the evaluation and management of endocrine insufficiencies secondary to pituitary operations

Competency 2: Medical Knowledge

- Explain the neuroendocrine axis in response to stress
- Discuss the hemodynamics associated with hypothyroidism, hyperthyroidism, and adrenal insufficiency
- Describe a thyroid storm and its therapy
- Discuss the role of thyroid replacement in euthyroid sick syndrome
- Explain the components of multiple endocrine neoplasia (MEN) I and II syndromes
- Discuss therapy for hypercalcemia
- Explain the postoperative complications of thyroid and parathyroid operations
- Describe the role of hemoglobin A_{1c} in operative patients
- Describe the treatment of diabetic ketoacidosis and hyperglycemic coma
- Contrast the pros and cons of glucose control in the intensive care unit (ICU)
- Explain therapy for pheochromocytoma
- Debate the issues of steroid replacement for adrenal insufficiency in the critically ill

Competency 3: Practice-Based Learning and Improvement

- Measure the effectiveness of glucose control
- Observe the effectiveness of steroid replacement strategies
- Review evidence-based recommendations for steroid and glucose control

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective team communication between nurses, pharmacists, and physicians (including endocrinologists) to manage glucose control in patients
- Develop an effective plan of care with surgeons, endocrinologists, and nurses for patients with endocrine conditions

Competency 5: Professionalism

- Develop effective relationships with consultants, surgeons, nurses, and pharmacists

Competency 6: System-Based Practices

- Evaluate the role and cost-effectiveness of glucose control protocol in critically ill patients
- Demonstrate awareness of the roles of the intensivists, endocrinologists, and clinical pharmacists
- Evaluate the outcome and cost-effectiveness of steroid replacement

5. Ethics and Palliative Care

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate awareness of own feelings, attitudes, and beliefs about death and dying
- Demonstrate ways to integrate ethics and palliative care into curative care
- Demonstrate empathy to patients during critical illness
- Demonstrate management of pain and other symptoms during critical illness
- Demonstrate understanding of determining goals of care
- Demonstrate understanding of advanced care planning, specifically roles of decision-maker and advance care directives
- Demonstrate skills required to resolve conflicts between and amongst families and medical care-givers
- Demonstrate effective concern over patient privacy
- Demonstrate effective communication to patients and their families
- Demonstrate understanding of traditions, beliefs and practices among major religions, cultures, and ethnic groups and their effect on medical decision-making
- Demonstrate an understanding of end-of-life issues

Competency 2: Medical Knowledge

- Explain the trajectories of the dying process and how surgical disease affects this process
- Explain the guidelines used to determine prognosis
- Define medical futility
- Explain how to determine goals of care
- Explain the nonpharmacological and pharmacological management of pain and other associated end-of-life symptoms (eg, nausea, dyspnea, cough, excessive secretions)
- Explain the difference between “hospice” and “palliative care”
- Explain the difference between euthanasia and physician-assisted suicide
- Explain the methods of pronouncing a patient dead
- Define the manifestations of normal grieving

Competency 3: Practice-Based Learning and Improvement

- Identify the best practice patterns to facilitate care of the terminally ill

Competency 4: Interpersonal and Communication Skills

- Demonstrate appropriate understanding and effective communication with patients and their families
- Demonstrate effective communication with all members of the medical care team

Competency 5: Professionalism

- Demonstrate proper performance of all expected professional responsibilities related to end of life decision making

Competency 6: Systems-Based Practice

- Evaluate and demonstrate cost-effectiveness of diagnostic and management individualized to each critically ill patient
- Evaluate and define the roles of various health care professionals when providing end-of-life care
- Demonstrate effective and appropriate utilization of hospital-based resources for conflict resolution in the care of critically ill (eg, optimal care/ethics committees)
- Demonstrate consultation skills by identifying specific patient needs or concerns for which social work, a palliative care service, or clergy would be appropriate

6. Gastrointestinal disorders

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Distinguish upper from lower gastrointestinal (GI) bleeding sources
- Demonstrate how to resuscitate patients with GI bleeding
- Describe the indications for urgent or emergent endoscopy for upper GI bleeding
- Describe the various endoscopic techniques for control of upper GI bleeding as they apply to the various causes of upper GI bleeding
 - Injection
 - Sclerosis
 - Heater probe
 - Clips/banding
- Cite the indications for bleeding scans and arteriography for localization of GI bleeding
- Demonstrate familiarity with potential interventional techniques that can be performed during arteriography (eg, catheter-based infusions and embolization) for control of GI bleeding
- Describe the causes and medical management of liver failure
- Describe the causes and treatment of hepatic encephalopathy
- Cite the indications for a Sengstaken-Blakemore tube for bleeding esophageal varices and demonstrate its placement
- Know the acute medical management of bleeding varices
- Know the complications and management of splenic vein thrombosis and left-sided portal hypertension
- Cite the indications and complications for the placement of a transjugular intrahepatic portosystemic shunt (TIPS)
- Demonstrate an ability to manage hepatorenal syndrome
- Cite the causes, differential diagnosis, and management of ileus
- Describe the workup and indications for the neostigmine challenge for colonic pseudo-obstruction
- Describe the workup and management of patients with bowel ischemia
- Identify patients at risk for acalculus cholecystitis and describe its workup and management
- Cite the signs, symptoms, and management of ascending cholangitis
- Demonstrate a thorough knowledge of the management of pancreatitis, including interpretation of CT scan findings, signs of pancreatic necrosis and abscess, indications for needle aspiration, controversies regarding prophylactic antibiotics, and indications and timing of surgical debridement of the pancreas

Competency 2: Medical Knowledge

- Cite the most common causes of upper GI bleeding
- Explain the role of various systemic agents in the control of upper GI bleeding
- Cite the most common causes of lower GI bleeding
- Cite the incidence, epidemiology, and indications to treat *Helicobacter pylori* infection
- Describe the pathophysiology and medical and surgical treatment of stress gastritis and Cushing's ulcers
- Describe the pathophysiology and management of Mallory-Weiss tears and Dieulafoy lesions
- Cite the etiologies of bowel ischemia and describe different strategies for its management

- Describe the epidemiology, treatment, and infectious disease precautions for *Clostridium difficile* infection
- Describe the pathophysiology, management, and surgical indications of colonic pseudo-obstruction and toxic megacolon
- Cite the causes and types of hepatorenal syndrome
- Cite the causes of pancreatitis and the cellular pathophysiology of the disease process

Competency 3: Practice-Based Learning and Improvement

- Demonstrate familiarity with controversial gastrointestinal topics described in the critical care literature
- Demonstrate the ability to base treatment on best evidence-based practices available for patients with gastrointestinal illness
- Demonstrate familiarity with best demonstrated practices for stress ulcer prophylaxis
- Establish protocols relevant to stress ulcer prophylaxis in the ICU environment
- Describe an ICU “bundle” and the recommended standards of care as they pertain to GI medicine

Competency 4: Interpersonal and Communication Skills

- Demonstrate an understanding of the role of the surgical intensivist as a GI consultant
- Develop open lines of communication with the primary team regarding patient status and necessary treatments and interventions
- Demonstrate an understanding of the importance of nursing concerns, and incorporate nursing input into a team-building ICU environment

Competency 5: Professionalism

- Demonstrate how effective leadership skills on the part of the surgical intensivist can broaden the scope of GI practice in the ICU environment
- Demonstrate broad-based knowledge of gastroenterology and interact with effectively with nursing and other ancillary personnel to enhance their understanding of treatment and patient care.

Competency 6: Systems-Based Practice

- Describe the factors that govern the availability of critical resources (eg, the GI laboratory and skilled personnel) and demonstrate understanding that these factors are often institution-specific
- Demonstrate an understanding that surgical intensivists and GI physicians may have similar scopes of practice and that these services can complement each other in improving patient care
- Explain how standardized care plans and ICU policies improve outcomes and encourage consistent referral patterns
- Use skills laboratories and courses effectively to learn various endoscopic techniques

7. Hematologic disorders

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate knowledge and competency in the evaluation and assessment of white blood cell (WBC), red blood cell (RBC), and platelet disorders that affect critically ill patients
- Demonstrate knowledge and competency in the evaluation and management of bleeding and clotting disorders in critically ill patients
- Demonstrate knowledge and competency in the management of critically ill patients with WBC, RBC, and platelet disorders
- Describe the clinical presentation of heparin-induced thrombocytopenia and thrombosis (HITT)

Competency 2: Medical Knowledge

- Explain normal hemostasis and the clotting cascade
- Discuss common abnormalities and effects of common medications on hemostasis and the clotting cascade
- Explain the difference between surgical bleeding and coagulopathy
- Review laboratory tests used for evaluating bleeding and clotting abnormalities and demonstrate familiarity with the use of thromboelastographs in the assessment of coagulopathy
- Describe massive transfusion, its complications, and therapy
- Explain the benefits and risks of transfusion
- Explain the risks and benefits of epoetin and recombinant factor VIIa
- Explain the etiology and management of HITT and alternatives to heparin
- Compare the pharmacology of medications for anticoagulation

Competency 3: Practice-Based Learning and Improvement

- Demonstrate familiarity with the effectiveness of transfusion protocol and literature regarding transfusion ratios of packed RBCs to fresh frozen plasma (FFP) and platelets

Competency 4: Interpersonal and communication skills

- Demonstrate effective communication with the surgeon, ICU team, blood bank, and hematologist

Competency 5: Professionalism

- Demonstrate the importance of obtaining informed consent for transfusions
- Demonstrate ethical principles in the care of patients who refuse to accept blood transfusions

Competency 6: Systems-Based Practice

- Evaluate the cost-effectiveness of transfusion triggers
- Describe the importance of a quality improvement system for a massive transfusion protocol

8. Infectious Diseases

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate a working knowledge of the workup of the febrile patient in the surgical ICU
- Demonstrate an understanding of the diagnosis, management and differences between sepsis, systemic inflammatory response system (SIRS), and septic shock
- Demonstrate an understanding of the workup of ventilator-associated pneumonia (VAP)
- Demonstrate an understanding of the diagnosis and treatment of invasive line infections
- Demonstrate a working knowledge of the care and treatment of the patient with necrotizing soft tissue infection
- Demonstrate an understanding of invasive burn wound sepsis and infections occurring in patients with thermal injury
- Demonstrate an understanding of the diagnosis and management of primary, secondary, and tertiary peritonitis
- Demonstrate an understanding of the pathophysiology, diagnosis, and management of acalculous cholecystitis
- Demonstrate an understanding of the etiologies, diagnosis, and management of intra-abdominal abscesses
- Demonstrate an understanding of the diagnosis and management of meningitis
- Explain the difference between and indications for prophylactic, empiric, and therapeutic antibiotic choices, as well as appropriate drug selection for specific clinical situations
- Demonstrate the ability to monitor antibiotic levels and appropriate dose adjustment
- Demonstrate knowledge of the workup of nonbacterial sources of infections (eg, fungal, viral, and other unusual pathogens) in ICU patients
- Demonstrate an understanding of the special considerations in patients who are immunosuppressed by disease processes (e.g., HIV infection, diabetes, and cirrhosis) and medications (e.g., steroids, chemotherapy, and anti-rejection medications)

Competency 2: Medical Knowledge

- Cite the etiology and the pathogenesis of septic shock in the surgical ICU patient, including potential causative organisms
- Explain the principles of antibiotic management in detail, including antibiotic selection, potential adverse effects of treatment, and appropriate length of treatment
- List the risk factors for ventilator-associated pneumonia and potential preventative strategies based on evidence-based guidelines
- Discuss the risk factors for line sepsis and develop a management strategy using evidence based guidelines to evaluate and treat patients with line infections
- Cite the risk factors and the care of the patient with complex necrotizing soft tissue infection
- Cite the risk factors for peritonitis and describe its management
- Evaluate and treat patients with intra-abdominal abscesses in the ICU
- Discuss the risk factors for development of urinary tract infections in the ICU patient
- Evaluate the risk factors for central nervous system (CNS) infection patients with brain injury, including the specific issues associated with invasive brain monitoring devices
- Discuss the risk factors for fungal and viral infections in the ICU patient

Competency 3: Practice-Based Learning and Improvement

- Recognize when a patient is not responding to treatment and when the antibiotic strategy should be changed, including stopping antibiotic treatment when appropriate

Competency 4: Interpersonal and Communication Skills

- Demonstrate the ability to communicate with infectious disease consultants in a clear and concise fashion
- Demonstrate the ability to appropriately order microbiological tests and interpret the results

Competency 5: Professionalism

- Demonstrate broad-based knowledge of infectious disease and interact effectively with nursing and other ancillary personnel to enhance their understanding of preventative measures and treatment.

Competency 6: Systems-Based practice

- Demonstrate knowledge of standard infection control procedures
- Demonstrate knowledge of the specific antibiotic resistance patterns at the hospital and in the ICU setting
- Demonstrate knowledge of resistance patterns in the patient population
- Demonstrate the ability to make cost-effective antibiotic selections

9. Monitoring and Bioengineering

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate knowledge of the indications for central venous catheter placement, including monitoring and venous access
- Demonstrate competency in central venous catheter placement
- Demonstrate knowledge of the indications for pulmonary artery catheter monitoring
- Demonstrate competency in pulmonary artery catheter placement
- Demonstrate understanding of the mechanics of measurement of cardiac output
- Demonstrate understanding of oxygen delivery and consumption and therapeutic implications of abnormalities in these parameters as well as appropriate therapeutic interventions
- Demonstrate knowledge of the indications for arterial catheter monitoring
- Demonstrate competency in arterial catheter placement
- Demonstrate knowledge of the technical aspects of hemodynamic monitoring, including setting up and troubleshooting a pressure transducer line

Competency 2: Medical Knowledge

- Cite the complications (immediate and subsequent) of central venous access and demonstrate competence in recognizing and managing these complications
- Cite the complications of invasive arterial access and demonstrate competence in recognizing and managing these complications

Competency 3: Practice-Based Learning and Improvement

- Demonstrate the ability to learn from complications related to vascular access procedures.

Competency 4: Interpersonal and Communication Skills

- Demonstrating effective communication with nursing staff and other ancillary medical professionals when setting up and troubleshooting monitoring devices

Competency 5: Professionalism

- Demonstrate an understanding of the need for the enforcement of quality control measures to prevent complications from vascular access procedures.

Competency 6: Systems-Based Practice

- Demonstrate knowledge of the controversies and literature-based evidence regarding the use of pulmonary artery catheters
- Demonstrate knowledge of developing hemodynamic monitoring technologies in the care of the critically ill patient

10. Neurology

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate appropriate and timely evaluation and management of acute neurologic decompensation
- Demonstrate appropriate utilization and interpretation of brain and spinal cord imaging
- Demonstrate an understanding of algorithms for clinical clearance of spine injuries
- Demonstrate appropriate understanding and interpretation of information from monitors of intracranial pressure (ICP), neurophysiology (including electroencephalography and evoked potentials), brain tissue oxygenation, and cerebral blood flow
- Demonstrate appropriate management of extracerebral parameters to minimize risk of secondary brain injury
- Demonstrate knowledge and competency in the evaluation and nonoperative management of severe closed head injury
- Demonstrate appropriate and timely evaluation and management of patient with anoxic encephalopathy
- Demonstrate knowledge of the diagnosis and treatment of abnormalities of sodium homeostasis related to neurologic diseases, including diabetes insipidus, syndrome of inappropriate antidiuretic hormone (SIADH), and cerebral salt wasting
- Demonstrate proper assessment and management of the patient with a stroke (both ischemic and hemorrhagic)
- Demonstrate proper assessment and management of the patient with subarachnoid hemorrhage, including prevention and management of cerebral vasospasm
- Demonstrate the proper assessment and management of patients with intracranial hypertension, including evaluation of data from intracranial pressure monitors or extraventricular drains
- Demonstrate proper assessment and management of patients with spinal cord injury, including airway and hemodynamic management
- Demonstrate appropriate consultation with consultants in physical medicine and rehabilitation and with rehabilitation facilities
- Demonstrate proper performance of brain death certification
- Demonstrate basic principles of support for potential organ donors

Competency 2: Medical Knowledge

- Cite the etiology and pathophysiology of severe closed head injury and intracranial hypertension
- List the risks, benefits, indications, and contraindications for ICP monitoring or extraventricular drain placement, and describe the possible limitations and complications of these devices
- Cite the etiology and pathophysiology of patients with spinal cord injury
- Explain the importance of physical therapy, occupational therapy, and rehabilitation in optimizing patient outcomes from central nervous system and spinal cord injury
- Cite the risk factors for blunt cerebrovascular injury, describe its clinical presentations, and explain strategies for evaluating and treating these patients
- Describe the initial evaluation and management of patients with suspected meningitis, and cite the most likely causal organisms
- Describe predictive and outcome scales used to assess neurologic diseases

- Describe the etiology and pathophysiology of imminent brain death, and explain the criteria for identifying potential organ donors
- Describe the indications, limitations, and general process of brain death evaluation and certification, list the adjunctive tests for determining brain death, and describe the indications and limitations of their use

Competency 3: Practice-Based Learning and Improvement

- Identify the best practice patterns to facilitate care of the critically ill patient with severe neurological injury or dysfunction from operating procedures and patient interactions.

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective communication with staff, peers, attending and referring physicians, consultants, and representatives from the local organ procurement organization
- Establish a collegial rapport with patient and family
- Demonstrate effective discussion of patient diagnoses, prognosis, and management plan (including end-of-life decisions) with patient and family by using simple, easily understood language

Competency 5: Professionalism

- Demonstrate the practice of ethical principles in relation to patient care, including obtaining informed consent, implementing “Do Not Resuscitate” orders, withholding or withdrawing life support, and clarifying goals of care from advance directives

Competency 6: Systems-Based Practice

- Demonstrate consultation skills by identifying a specific need or question when communicating with palliative care or ethics consultants and the organ procurement organization.
- Demonstrate awareness of the role of the ICU, organ procurement organizations, and the transplantation service

11. Nutrition

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate competency in the evaluation and assessment of the nutritional needs of critically ill surgical patients
- Demonstrate competency in the management of enteral and parenteral nutrition
- Demonstrate competency in the placement of nasogastric and nasointestinal feeding tubes
- Demonstrate competency in the placement of percutaneous endoscopic gastrostomies, open and laparoscopic gastrostomies, and jejunostomies

Competency 2: Medical Knowledge

- Explain the catabolic and anabolic phases of the response to injury, including the mediators involved in these responses
- Explain the methods of determining resting caloric needs for patients, including the Harris-Benedict equation and indirect calorimetry
- Explain the factors that increase caloric requirements of critically ill surgical patients, including surgical stress, trauma, cancer, sepsis, and previous nutritional status
- Explain estimates of protein stores and protein requirements, including measurement of specific serum proteins and determination of nitrogen balance.
- Compare and contrast the risks and benefits of enteral nutrition versus parenteral nutrition
- Explain the potential electrolyte and glycemic complications of enteral and parenteral nutrition
- Explain the risks involved in placement of enteral access devices, including transnasal, endoscopic, and surgical devices
- Understand the potential use of nutritional support for specific organ system dysfunction
- Understand the principles involved in immuno- or pharmaco-nutrition
- Explain the importance of nutritional status with respect to wound healing

Competency 3: Practice-Based Learning and Improvement

- Assess the effectiveness of the prescribed nutritional support by following the parameters of nutritional status

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective communication with nutritionists, respiratory care, and nursing staff to determine the patients' nutritional needs and to implement the plan of care

Competency 5: Professionalism

- Demonstrate proper performance of all expected professional responsibilities

Competency 6: Systems-Based Practice

- Evaluate and demonstrate cost-effectiveness of nutritional support in critically ill patients
- Demonstrate consultation skills by identifying specific patient needs or questions for which nutritionist consultation would help and provide efficient and effective patient care

12. Obstetrical disorders

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate knowledge regarding the management of the pregnant patient with critical illness unrelated to pregnancy
- Demonstrate knowledge of pregnancy-related conditions, including pre-eclampsia/eclampsia, HELLP (hemolysis, elevated liver enzymes, low platelets) syndrome, gestational cardiomyopathy, amniotic fluid embolism, peripartum hemorrhage (placenta previa, placental abruption), and pulmonary edema
- Demonstrate the ability to appropriately select radiographic studies to maximize maternal and fetal well-being when managing the pregnant patient who is critically ill
- Demonstrate an understanding of strategies for managing obstetrical hemorrhage, including coagulopathy, disseminated intravascular coagulopathy (DIC), and massive transfusion

Competency 2: Medical Knowledge

- Describe the physiologic changes (including respiratory, cardiovascular, renal, and gastrointestinal) associated with pregnancy, delivery, and the immediate postpartum period
- Explain how the physiologic changes of pregnancy influence critical care management, including hemodynamic and pulmonary monitoring, pharmacologic concerns, and selection of imaging studies
- Describe the pathophysiology of fetal oxygenation and appropriate monitoring strategies
- Explain the pathophysiology, diagnosis, and management of pregnancy-related conditions that potentially require critical care intervention, including pre-eclampsia and eclampsia, HELLP syndrome, gestational cardiomyopathy, amniotic fluid embolism, peripartum hemorrhage (placenta previa, placental abruption), and pulmonary edema
- Cite the risks for fetal demise related to maternal diagnosis and condition
- Explain how pregnancy and postpartum states influence the appropriate selection of different pharmacological agents

Competency 3: Practice-Based Learning and Improvement

- Describe measures and techniques for improving quality of care and patient and family satisfaction
- Demonstrate the ability to critically review published literature, and demonstrate familiarity with current evidence-based information regarding pregnancy-specific conditions (pre-eclampsia, eclampsia) and those complicating pregnancy (septic shock, thromboembolic disease)

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective communication with obstetrical colleagues, nurses, respiratory therapists, and consulting services for collaborative management of the peripartum patient
- Demonstrate effective communication with patients and family members, both listening and conveying information with appropriate degree of complexity

Competency 5: Professionalism

- Demonstrate respect, compassion, integrity and responsiveness to the needs of the patients and their families, particularly with regard to potential pre-term delivery or fetal demise
- Demonstrate accurate self-assessment, knowledge of professional limits, and an ongoing desire for self-improvement

Competency 6: Systems-Based Practice

- Serve as an advocate for quality patient care with due attention to costs and resources in a complex health care system
- Collaborate with other health care providers, including consulting physicians, nurses, pharmacists, respiratory, and physical and speech therapists, to develop and implement ICU protocols for the obstetrical patients

13. Pediatrics

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate appropriate and timely evaluation of pediatric patients with acute respiratory decompensation, including asthma
- Demonstrate appropriate and timely evaluation of pediatric patients with shock
- Demonstrate knowledge of techniques for intubation of infants and children
- Demonstrate knowledge of techniques for vascular access procedures in infants and children

Competency 2: Medical Knowledge

- Explain ventilator management strategies used for children, including pressure-regulated volume control (PRVC) and high-frequency oscillatory ventilation (HFOV)
- Discuss the methods for evaluation and treatment of children with cardiac arrhythmias
- Discuss the management of shock in infants and children and how these strategies vary from those used for adult patients
- Discuss the role of extracorporeal circulation for pulmonary and/or cardiac support in children
- Discuss effects and management of caustic and toxic ingestions
- Discuss methods of dialysis of children, including continuous venovenous hemodialysis (CVVH), hemodialysis, and peritoneal dialysis
- Cite examples of findings suggestive of child abuse and appropriate intervention
- Explain the basic issues of law and ethics specific to pediatric critical care

Competency 3: Practice-Based Learning and Improvement

- Identify the best practice patterns to facilitate care of the critically ill child

Competency 4: Interpersonal and Communication Skills

- Demonstrate appropriate understanding and effective communication with children, parents, and their families

Competency 5: Professionalism

- Demonstrate proper performance of all expected professional responsibilities

Competency 6: Systems-Based Practice

- Evaluate and demonstrate use of cost-effective diagnostic and management strategies for critically ill children
- Demonstrate consultation skills by identifying specific patient needs or concerns for which pediatric and child protective services would help and provide efficient and effective patient care
- Demonstrate knowledge of potential child abuse and how to access appropriate resources within the health care environment to assist the child

14. Pharmacology

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate appropriate choice of medications and adjustments in medication dosing based upon the principles of drug absorption, distribution, metabolism, and excretion
- Demonstrate appropriate identification and management of potential drug interactions

Competency 2: Medical Knowledge

- Explain the principles of pharmacokinetics and pharmacodynamics
- Explain patient factors that affect drug metabolism, including renal dysfunction, hepatic dysfunction, obesity, and critical illness

Competency 3: Patient-Based Learning and Improvement

- Describe common potential adverse drug effects and drug interactions in the critically ill patients

Competency 4: Interpersonal and Communication Skills

- Demonstrate an appreciation for the role played by a pharmacist on a multidisciplinary ICU team
- Demonstrate effective communication skills when consulting pharmacologists

Competency 5: Professionalism

- Demonstrate professional interactions with the pharmacy staff

Competency 6: Systems-Based Practice

- Demonstrate the importance of determining cost-effectiveness when choosing medications
- Appreciate the importance of developing intensive care unit guidelines/protocols for appropriate pharmacologic agents

15. Renal Failure

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate appropriate management of oliguria in the critically ill
- Demonstrate appropriate management of electrolyte concentrations, intravascular volume status, and drug dosing in patients with acute renal failure
- Describe the nutritional requirements of patients with acute and chronic renal failure in the ICU
- Describe the relative and absolute indications for renal replacement therapies
- Understand the principles of the different modes of dialysis and solute transport

Competency 2: Medical Knowledge

- Explain the basic physiology and anatomy of the kidney.
- Define the different manifestations of acute renal failure, including anuric, oliguric, and high-output renal failure
- Describe the causes of acute oliguria, including prerenal, intrinsic, and postrenal causes
- Explain the pathogenesis and cellular mechanisms of acute tubular necrosis (ATN)
- Describe the blood flow distribution and oxygen tension in the renal cortex and outer and inner medulla, and explain how these factors affect susceptibility during ischemic insult
- Demonstrate familiarity with the pathologic changes that occur in the tubule from insult to recovery
- Describe the phases of ATN.
- Describe the incidence, risk factors, prevention strategies, and treatment of contrast-induced nephropathy.
- Explain the relationship between acute renal failure and mortality rates in the ICU

Competency 3: Practice-Based Learning

- Describe the controversies between conventional hemodialysis and continuous renal replacement therapy in the ICU environment

Competency 4: Interpersonal and Communication Skills

- Coordinate care between the dialysis staff and critical care nursing
- Develop a treatment plan for dialysis in coordination with the renal medical service and other patient care issues
- Use effective strategies for communicating patient prognosis to family members with respect to degree of organ failure

Competency 5: Professionalism

- Coordinate the management of ICU patients with acute renal failure

Competency 6: Systems-Based Practice

- Explain potential staffing issues unique to ICU patients who require dialysis or continuous renal replacement therapy
- Explain the pros and cons of performing dialysis in the ICU versus in the dialysis unit

16. Respiratory Disorders

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate competency in interpreting and applying arterial blood gas data
- Demonstrate competency in using appropriate ventilator settings and modes in mechanically ventilated patients based on specific patient needs
- Demonstrate familiarity with troubleshooting the ventilator to ensure that patients are adequately ventilated and oxygenated
- Demonstrate the ability to interpret radiographic data, including chest X-rays and CT scans, and to apply these data to clinical management plans
- Demonstrate competency in performing respiratory system–related procedures, including intubation, tracheostomy/cricothyotomy, bronchoscopy, and pleural drainage
- Demonstrate knowledge of difficult airway characteristics and advanced methods for intubation of the difficult airway
- Demonstrate competency in diagnosing and managing patients with pulmonary infections, including pneumonia, ventilator-associated pneumonia, empyema, lung abscess, and tracheobronchitis
- Demonstrate competency in diagnosing and managing pulmonary dysfunction in critically ill patients
- Demonstrate competency in the appropriate application of various weaning strategies to mechanically ventilated patients

Competency 2: Medical Knowledge

- Demonstrate competency in the interpretation of radiographic studies of the chest
- Explain the significance of the different components of pulmonary function tests
- Differentiate the etiologies, diagnostic workup, and management strategies for acute lung injury (ALI) and acute respiratory distress syndrome (ARDS)
- Describe methods for preventing, diagnosing, and treating pneumonia
- Explain the causes of acute respiratory failure, hypoxia, and hypercarbia
- Demonstrate an understanding of the appropriate selection and implementation of appropriate ventilator modalities, including non-invasive positive pressure ventilation, continuous positive airway pressure (CPAP), pressure support, synchronized intermittent mandatory ventilation (SIMV), assist-control, pressure control, bi-level, controlled minute ventilation and inverse I:E ratio ventilation, airway pressure release ventilation (APRV), and high frequency, oscillatory ventilation
- Demonstrate an understanding of the use of adjunctive therapies for patients with acute respiratory failure, including inhaled nitric oxide, prone positioning, and extracorporeal membrane oxygenation
- Describe methods for weaning patients from mechanical ventilation and the rationale behind selecting the appropriate strategy

Competency 3: Practice-Based Learning and Improvement

- Describe effective strategies for the prevention of pneumonia and ventilator-associated pneumonia in critically ill patients
- Explain the effectiveness of different ventilator weaning strategies

- Cite evidence-based recommendations for managing patients with ARDS, including the role of pharmacologic agents
- Cite evidence-based recommendations for the diagnosing, treating, and preventing pulmonary infections

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective communication with nurses, respiratory therapists, and physicians who are involved in the management of patients with respiratory failure and/or pulmonary infections
- Develop an effective management plan in collaboration with the surgeons and other consulting services for patients with respiratory failure and/or pulmonary infections

Competency 5: Professionalism

- Develop effective relationships with consultants, surgeons, nurses, and respiratory therapists
- Demonstrate sound ethical principles in the care of critically ill patients that refuse respiratory support, or request withdrawal of care
- Develop compassionate and effective methods for communicating with patients and their family members

Competency 6: Systems-Based Practice

- Describe the role and cost-effectiveness of pneumonia prevention protocols in the ICU
- Understand the role and cost-effectiveness of early diagnosis and aggressive treatment of pneumonia in critically ill patients
- Explain the rationale behind developing and implementing protocols for weaning mechanical support in ventilated patients
- Demonstrate awareness of the role of the respiratory therapists in the management of patients with respiratory failure

17. Statistics

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate an understanding of the importance of evidence-based medicine
- Demonstrate an understanding of the skills required to critically evaluate new knowledge
- Demonstrate the ability to critically evaluate medical literature
- Demonstrate an understanding of the epidemiology of surgical disease process and how this affects patient care
- Demonstrate an understanding of morbidity and mortality and how these affect cost and outcome
- Demonstrate an understanding of the variables used to calculate and the application of severity of illness scoring systems.
- Demonstrate an understanding of the importance of various prediction models.

Competency 2: Medical Knowledge

- Explain the principles of evidence-based medicine
- Demonstrate understanding of the differences between retrospective, prospective, randomized, and blinded clinical trials
- Explain how to grade and evaluate evidence
- Explain basic statistical comparisons, including *t*-tests, chi-square (χ^2), and analysis of variance
- Explain logistic regression modeling and the association between factors

Competency 3: Practice-Based Learning and Improvement

- Apply statistical methodology to the interpretation and understanding of evidence-based practice
- Demonstrate the ability to select statistically valid evidence from the literature to improve the care of critically ill patients

Competency 4: Interpersonal and Communication Skills

- Demonstrate appropriate understanding and effective communication of evidence-based practice

Competency 5: Professionalism

- Demonstrate a willingness to avoid conflict between personal biases and the practice evidence based medicine

Competency 6: Systems-Based Practice

- Demonstrate an understanding of how evidence-based practice plays a role in the management of critically ill patients
- Explain how to incorporate high quality data into practice change for patient care

18. Transplantation

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate competency in managing patients with acute and chronic liver failure, including hepatic encephalopathy, GI bleeding, infections, hepatorenal and hepatopulmonary syndromes, and large volume ascites production
- Demonstrate competency in managing patients with portal hypertension, including indications for and complications of portal-systemic shunts, including transjugular intra-hepatic portal-systemic shunts
- Demonstrate knowledge of the management of patients with variceal bleeding, including placement of esophagogastric balloon tamponade devices
- Cite unique surgical challenges encountered in patients with liver failure, including chronic malnutrition, delayed wound healing, electrolyte derangements (eg, hyponatremia, hyperaldosteronism), and the effects of chronic steroid and/or immunosuppressant use
- Demonstrate appropriate and titrated pre- and postoperative care for the patient with fulminant hepatic failure, with specific focus on the management of encephalopathy, intracranial pressure, and oxygen delivery to the brain
- Demonstrate appropriate management of infection and surgical decision-making in the immunocompromised patient

Competency 2: Medical Knowledge

- Describe pathophysiologic changes in acute and chronic liver failure
- Describe the long-term effects of steroid and/or immunosuppressant use, including chronic malnutrition and electrolyte derangements (eg, hyponatremia, hyperaldosteronism)
- Describe the cardiovascular and hemodynamic consequences of end-stage liver disease
- Describe the various etiologies and pathophysiology of liver failure-related organ dysfunction (eg, hepatic encephalopathy, hepatorenal syndrome, and hepatopulmonary syndrome), and demonstrate appropriate management and monitoring strategies for these patients
- Describe the pathogenesis of altered cerebral blood flow and intracranial hypertension in fulminant hepatic failure, and explain appropriate diagnostic monitoring and management strategies
- Describe key considerations for managing patients who have undergone liver, kidney, pancreas, small bowel, or multivisceral abdominal transplant surgery or placement of portal-systemic shunts, and explain how outcomes for these patients should be evaluated
- Compare and contrast diagnostic evaluations and treatment plans for potential infections in patients who are immunocompetent versus those who are immunosuppressed
- List the opportunistic infections that can occur in patients who have undergone liver transplantation, and cite appropriate diagnostic testing strategies for these infections
- Describe the mechanisms of action and major toxicities of immunosuppressive agents used in solid organ transplantation

Competency 3: Practice-Based Learning

- Explain how to utilize liver failure scoring systems, and describe how organs are allocated

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective team leadership strategies in communicating with families, nursing staff, and organ procurement organizations

Competency 5: Professionalism

- Demonstrate professional interactions with members of organ procurement organizations

Competency 6: Systems-Based Practice

- Demonstrate familiarity with the organ procurement and organ distribution system

19. Trauma

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate competency in the initial assessment, triage, and resuscitation of injured patients
- Demonstrate competency in airway assessment and management, including rapid sequence intubation (RSI) and cricothyroidotomy
- Demonstrate competency in recognizing and managing thoracic injury, including simple and tension pneumothorax, [massive] hemothorax, rib fractures and flail chest, pulmonary contusion, and great vessel injury
- Demonstrate familiarity with such procedures as needle chest decompression and tube thoracostomy
- Demonstrate competency in appropriate performance of emergency department thoracotomy
- Demonstrate familiarity with appropriate use of crystalloids and blood products for resuscitation
- Demonstrate competency in implementing massive transfusion protocol
- Cite the advantages and disadvantages of endpoints of resuscitation, including vital signs and other physical examination findings, base deficit, lactate levels, and global oxygen delivery and consumption variables
- Demonstrate familiarity with the type and placement of vascular access and the use of massive transfusion devices
- Demonstrate competency in diagnosing intra-abdominal injury, including the use of focused assessment with sonography in trauma (FAST) examination and diagnostic peritoneal lavage
- Demonstrate competency in recognizing and managing abdominal compartment syndrome and temporary abdominal closure techniques
- Demonstrate competency in the diagnosis and management of pelvic fractures, including recognition of associated injuries
- Demonstrate competency in the management of patients with traumatic brain injury, spinal cord injury, and blunt cerebrovascular injury, including the selection and use of intracranial pressure monitoring devices and other brain monitoring devices
- Demonstrate competency in appropriate timing and selection of radiographic studies in the evaluation of the injured patient
- Demonstrate the ability to interpret radiologic and laboratory data to develop comprehensive management plans
- Demonstrate knowledge and competency of specific trauma patient populations (eg, pediatric, geriatric, and obstetric)

Competency 2: Medical Knowledge

- Explain the significance of mechanism of injury in the care of the injured patient
- Differentiate between blunt and penetrating mechanisms of injury
- Explain the specific concerns in the care of the injured pediatric, geriatric, or obstetric patient
- Cite the principles of initial trauma evaluation and management
- Describe the different types of thoracic injury and appropriate management strategies for each, including initial and subsequent interventions
- Cite the principles and practice of nonoperative management of solid abdominal organ injury, including injury grading scales

- Describe the causes and pathophysiology of elevated intra-abdominal pressure and abdominal compartment syndrome, as well as principles and complications of temporary abdominal closure
- Describe the pathophysiology of various types of traumatic brain injury (including epidural, subdural, intraparenchymal hemorrhage, diffuse axonal injury), and explain techniques for preventing secondary brain injury
- Describe the pathophysiology of intracranial hypertension and its management, including the use of ICP monitoring devices, extraventricular drains, and operative intervention
- Cite key considerations in the management of patients with CNS injury, including fluid selection, nutrition, management of coagulopathy, DVT prophylaxis, and such complications as diabetes insipidus, cerebral salt wasting, and the syndrome of inappropriate antidiuretic hormone release.
- Describe the mechanisms and clinical signs and symptoms of blunt cerebrovascular injury, and explain potential treatment strategies for these patients
- Explain the pathophysiology of spinal cord and spinal column injury and its clinical presentation, and describe management considerations (including complications) for these patients
- Describe clinical issues associated with spinal cord injury (eg, cardiovascular and ventilator considerations, tracheostomy, DVT prophylaxis, skin integrity, and contracture)
- Demonstrate competency in managing extremity fractures, including optimal timing of fracture fixation, recognition of associated vascular and neurologic injuries, and recognition and prevention of compartment syndrome
- Cite the complications associated with extremity injuries, including rhabdomyolysis, fat embolism syndrome, and compartment syndrome
- Explain key considerations in evaluating and managing the patient with a mangled extremity, including the use of appropriate scores and adjunctive measures
- Explain the significance of different types of pelvic fractures, and demonstrate competency in management of associated injuries (eg, urethral trauma and open fractures)
- Cite the indications for and complications of blood component therapy and application of massive transfusion principles

Competency 3: Practice-Based Learning

- Describe measures and techniques for improving trauma system performance, including review of specific indicators (eg, delay to operative intervention)
- Review published information critically to understand current evidence-based information to optimize resuscitation (eg, fluid selection, blood pressure control), select appropriate radiographic imaging, and tailor care to specific problems (eg, thoracic aortic injuries or prevention of secondary brain injury)

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective communication with emergency medicine colleagues, nurses, respiratory therapists, and consulting services for collaborative management of the injured patient
- Demonstrate effective communication with patients and family members, both listening and conveying information with appropriate degree of complexity
- Develop collaborative relationships with consulting services for optimizing the timing of interventional procedures

Competency 5: Professionalism

- Demonstrate respect, compassion, integrity and responsiveness to the needs of the patients and their families
- Approach discussions of ethical issues (including advanced directive and end-of-life issues) with sensitivity
- Demonstrate accurate self-assessment, knowledge of professional limits, and an ongoing desire for self-improvement

Competency 6: Systems-Based Practice

- Demonstrate an understanding of the impact of a trauma system on regionalization of trauma care
- Demonstrate understanding of cost-effective patient care in a tertiary care hospital setting
- Participate actively in triage decision-making in the setting of multiple casualties
- Serve as an advocate for quality patient care with due attention to costs and resources
- Partner appropriately with other health care providers, including consulting physicians, nurses, pharmacists, respiratory therapists, and physical and speech therapists
- Demonstrate understanding of the role of discharge planning and selection of appropriate discharge venue (rehabilitation facility vs skilled nursing facility vs home)

20. Ultrasound Imaging

Upon completion of training, the fellow should be able to:

Competency 1: Patient Care

- Demonstrate competency in the use of general critical care ultrasonography (GCCU) technology to evaluate and manage critically ill patients

Competency 2: Medical Knowledge

- Demonstrate an understanding of the fundamental principles of ultrasound physics as they relate to obtaining high-quality images and recognizing image artifacts
- Demonstrate competency in interpreting high-quality images and recognizing image artifacts
- Demonstrate familiarity with typical machine controls and transducer manipulation to perform the ultrasound examination at bedside
- Distinguish between normal and abnormal ultrasound anatomy, and recognize the pathophysiologic implications of the imaged abnormality
- Demonstrate competency in interpreting images for relevant clinical applications
- Cite the specific technical and interpretive limitations of ultrasonography with respect to the technology and the technician
- Demonstrate understanding that ultrasonography may yield an indeterminate finding instead of a definitive positive or negative result
- Demonstrate understanding of the appropriate follow-up after an indeterminate finding

Competency 3: Practice-Based Learning and Improvement

- Demonstrate the ability to incorporate the ultrasound into daily practice
- Demonstrate competency in the appropriate use of echocardiographic evaluation, including
 - Global left ventricular size and systolic function
 - Wall motion abnormalities
 - Global right ventricular size and systolic function
 - Assessment for pericardial fluid/tamponade
 - Basic color Doppler assessment for severe valvular regurgitation
- Demonstrate competency in the appropriate use of hemodynamic evaluation
 - Inferior vena cava size and respiratory variation
 - Cardiac superior vena cava size estimation
 - Central venous pressure estimation
 - Detection of aortic dissection
 - Pulmonary edema
- Demonstrate competency in the appropriate use of lung and pleural ultrasonography
 - Presence or absence of pneumothorax
 - Detection of pleural effusion
 - Diaphragmatic dysfunction
 - Pulmonary edema
- Demonstrate competency in the appropriate use of abdominal ultrasonography
 - FAST examination
 - Extended FAST examination
- Demonstrate competency in the appropriate use of vascular ultrasonography for guidance of vascular access

- Demonstrate competency in the appropriate use of vascular ultrasonography for diagnosis of venous thrombosis

Competency 4: Interpersonal and Communication Skills

- Demonstrate effective team communication between nurses, respiratory therapists, pharmacists, and physicians to plan for patient care by using ultrasonographic exam results
- Develop an effective plan of care with surgeons and nurses for patients with problems diagnosed by ultrasound

Competency 5: Professionalism

- Develop effective relationships with consultants, surgeons, nurses, pharmacists, and respiratory therapists

Competency 6: Systems-Based Practices

- Evaluate the role and cost-effectiveness of using ultrasound protocol in critically ill patients
- Demonstrate awareness of the role of the radiologist and cardiologist in the management of patients when ultrasound results are inconclusive
- Evaluate the outcome and cost-effectiveness of using ultrasound in the ICU for patient management