

**Augusta University  
Medical College of Georgia  
Neuro-Critical Care Program Curriculum**

This program curriculum has been reviewed and adapted to ensure that it combines basic aspects of general critical-care medicine that are relevant to neuro-critical care, as well as specialized skills that are specific to neuro-critical care. Our program curriculum contains a listing of cognitive and procedural skills that are fundamental to the training of specialists in neurological-critical care, and it is based on national recommendations.

**PROGRAM CONTENT - COGNITIVE SKILL SET**

Acquisition of the following cognitive skills by trainees can be accomplished through the use of any of a number of techniques, including supervised direct patient care, didactic sessions, journal clubs, or literature reviews.

**I. Neurological Disease States:**

The following are specific diseases, conditions, and clinical syndromes commonly managed by a neurocritical care provider (neurointensivist, neurocritical care nurse practitioners):

**1. Cerebrovascular Diseases**

- a. Infarction and ischemia
  - Massive hemispheric infarction
  - Basilar artery occlusion and stenosis
  - Carotid artery occlusion and stenosis
  - Crescendo TIAs
  - Occlusive vasculopathies (Moya-Moya, sickle cell)
  - Spinal cord infarction
- b. Intracerebral hemorrhage
  - Supratentorial
  - Cerebellar
  - Brainstem
  - Intraventricular
- c. Subarachnoid hemorrhage – aneurysmal and other Vascular malformations
  - Arteriovenous malformations
  - AV fistulas
  - Cavernous malformations
  - Developmental venous anomalies
- d. Dural sinus thrombosis
- e. Carotid-cavernous fistulae
- f. Cervical and cerebral arterial dissections

## 2. Neurotrauma

- a. Traumatic brain injury
  - “Diffuse axonal injury”
  - Epidural hematoma
  - Subdural hematoma
  - Skull fracture
  - Contusions and lacerations
  - Penetrating craniocerebral injuries
  - Traumatic subarachnoid hemorrhage
- b. Spinal cord injury
  - Traumatic injury (transection, contusion, concussion)
  - Vertebral fracture and ligamentous instability

## 3. Disorders, Diseases, Seizures, and Epilepsy

- a. Seizures and epilepsy
  - Status epilepticus (SE)
    - Convulsive
    - Non-convulsive (partial-complex and “subtle” secondarily generalized SE)
    - Myoclonic
- b. Neuromuscular diseases
  - Myasthenia gravis
  - Guillain-Barre syndrome
  - ALS
  - Rhabdomyolysis and toxic myopathies
  - Critical illness myopathy and neuropathy
- c. Infections
  - Encephalitis (viral, bacterial, parasitic)
  - Meningitis (viral, bacterial, parasitic)
  - Brain and spinal epidural abscess
- d. Toxic-metabolic disorders
  - Neuroleptic malignant syndrome/malignant hyperthermia
  - Serotonin syndrome
  - Drug overdose and withdrawal (e.g., barbiturates, narcotics, alcohol, cocaine, acetaminophen).
  - Temperature related injuries (hyperthermia, hypothermia)
- e. Inflammatory and demyelinating diseases
  - Multiple sclerosis (Marburg variant, transverse myelitis)
  - Neuro-sarcoidosis
  - Acute disseminated encephalomyelitis (ADEM)
  - CNS vasculitis
  - Chemical or sterile meningitis (i.e. posterior fossa syndrome, NSAID induced)
  - Osmotic demyelination syndrome
  - Others

- f. Neuroendocrine disorders
  - Pituitary apoplexy
  - Diabetes insipidus (including triple phase response)
  - Panhypopituitarism
  - Thyroid storm and coma
  - Myxedema coma
  - Addisonian crisis

#### **4. Neuro-oncology**

- a. Brain tumors and metastasis
- b. Spinal cord tumors and metastasis
- c. Carcinomatous meningitis
- d. Paraneoplastic syndromes

#### **5. Encephalopathies**

- a. Eclampsia, including HELLP Syndrome
- b. Hypertensive encephalopathy
- c. Hepatic encephalopathy
- d. Uremic encephalopathy
- e. Hypoxic-ischemic and anoxic encephalopathy
- f. MELAS

#### **6. Clinical syndromes**

- a. Coma
- b. Herniation syndromes with monitoring & ICP
- c. Elevated intracranial pressure and Intracranial hypotension/hypovolemia
- d. Hydrocephalus detection & treatment
- e. Cord compression
- f. Death by neurologic criteria, end of life issues, and organ donation
- g. Vegetative state
- h. Dysautonomia (cardiovascular instability, central fever, hyperventilation)
- i. Reversible posterior leukoencephalopathy
- j. Psychiatric emergencies (psychosis)

#### **7. Perioperative Neurosurgical Care.**

#### **8. Pharmacotherapeutics.**

## II. General Critical Care:

### 1. Cardiovascular Physiology, Pathology, Pathophysiology, and Therapy

- a. Shock (hypotension) and its complications (vasodilatory and cardiogenic)
- b. Myocardial infarction and unstable coronary syndromes
- c. Neurogenic cardiac disturbances (ECG changes, stunned myocardium)
- d. Cardiac rhythm and conduction disturbances; use of antiarrhythmic medications; indications for and types of pacemakers
- e. Pulmonary embolism
- f. Pulmonary edema: cardiogenic versus non-cardiogenic (including neurogenic)
- g. Acute aortic and peripheral vascular disorders (dissection, pseudo-aneurysm)
- h. Recognition, evaluation and management of hypertensive emergencies and urgencies
- i. Calculation of derived cardiovascular parameters, including systemic and pulmonary vascular resistance, alveolar-arterial gradients, oxygen transport and consumption

### 2. Respiratory Physiology, Pathology, Pathophysiology and Therapy

- a. Acute respiratory failure
  - Hypoxemic respiratory failure (including ARDS)
  - Hypercapnic respiratory failure
  - Neuromuscular respiratory failure
- b. Aspiration
- c. Bronchopulmonary infections
- d. Upper airway obstruction
- e. COPD and status asthmaticus, including bronchodilator therapy
- f. Neurogenic breathing patterns (central hyperventilation, Cheyne-Stokes respirations)
- g. Mechanical ventilation
  - Positive pressure ventilation (BIPAP)
  - PEEP, CPAP, inverse ratio ventilation, pressure support ventilation, pressure control, and noninvasive ventilation
  - Negative pressure ventilation
  - Barotrauma, airway pressures (including permissive hypercapnia)
  - Criteria for weaning and weaning techniques
- h. Pleural Diseases
  - Empyema
  - Massive effusion
  - Pneumothorax
- i. Pulmonary hemorrhage and massive hemoptysis
- j. Chest X-ray interpretation
- k. End tidal CO<sub>2</sub> monitoring
- l. Sleep apnea
- m. Control of breathing

**3. Renal Physiology, Pathology, Pathophysiology and Therapy**

- a. Renal regulation of fluid and water balance and electrolytes
- b. Renal failure: Prerenal, renal, and postrenal
- c. Derangements secondary to alterations in osmolality and electrolytes
- d. Acid-base disorders and their management
- e. Principles of renal replacement therapy
- f. Evaluation of oliguria and polyuria
- g. Drug dosing in renal failure
- h. Management of rhabdomyolysis
- i. Neurogenic disorders of sodium and water regulation (cerebral salt wasting and SIADH).

**4. Metabolic and Endocrine Effects of Critical Illness**

- a. Enteral and parenteral nutrition
- b. Endocrinology
  - Disorders of thyroid function (thyroid storm, myxedema coma, euthyroid sick syndrome)
  - Adrenal crisis
  - Diabetes mellitus
    - Ketotic and hyperglycemic hyperosmolar coma
    - Hypoglycemia
- c. Disorders of calcium and magnesium balance
- d. Systemic Inflammatory Response Syndrome (SIRS)
- e. Immune Reconstitution Inflammatory Syndrome (IRIS)
- f. Fever, thermoregulation, and cooling techniques

**5. Infectious Disease: Physiology, Pathology, Pathophysiology and Therapy**

- a. Antibiotics
  - Antibacterial agents
  - Antifungal agents
  - Antituberculosis agents
  - Antiviral agents
  - Antiparasitic agents
- b. Infection control for special care units
  - Development of antibiotic resistance
  - Universal precautions
  - Isolation and reverse isolation
- c. Tetanus and botulism
- d. Hospital acquired and opportunistic infections in the critically ill
- e. Acquired Immune Deficiency Syndrome (AIDS)
- f. Evaluation of fever in the ICU patient
- g. Central fever
- h. Interpretation of antibiotic concentrations, sensitivities

**6. Acute Hematologic Disorders: Physiology, Pathology, Pathophysiology and Therapy**

- a. Acute defects in hemostasis
  - Thrombocytopenia, thrombocytopathies
  - Disseminated intravascular coagulation
  - Acute hemorrhage (GI hemorrhage, retroperitoneal hematoma)
  - Iatrogenic coagulopathies (warfarin and heparin induced)
- b. Anticoagulation and fibrinolytic therapy
- c. Principles of blood component therapy (blood, platelets, FFP)
- d. Hemostatic therapy (vitamin K, aminocaproic acid, protamine, factor VIIa)
- e. Prophylaxis against thromboembolic disease
- f. Prothrombotic states

**7. Acute Gastrointestinal and Genitourinary Disorders: Physiology, Pathology, Pathophysiology and Therapy**

- a. Acute and fulminant hepatic failure (including drug dosing)
- b. Ileus, pseudo-ileus and toxic megacolon
- c. Acute perforations of the gastrointestinal tract
- d. Acute vascular disorders of the intestine, including mesenteric infarction
- e. Acute intestinal obstruction, volvulus
- f. Pancreatitis
- g. Obstructive uropathy, acute urinary retention
- h. Urinary tract bleeding

**8. Immunology and Transplantation**

- a. Principles of transplantation (brain death, organ donation, procurement, maintenance of organ donors, implantation)
- b. Immunosuppression, especially the toxicity and neurotoxicity of these agents

**9. General Trauma and Burns**

- a. Initial approach to the management of multisystem trauma
- b. Skeletal trauma including the spine and pelvis
- c. Chest and abdominal trauma - blunt and penetrating
- d. Burns and electrical injury

**10. Monitoring**

- a. General monitoring and Neuromonitoring
- b. Prognostic, disease severity and therapeutic intervention scores
- c. Principles of electrocardiographic monitoring
- d. Invasive hemodynamic monitoring
- e. Noninvasive hemodynamic monitoring
- f. Respiratory monitoring (airway pressure, intrathoracic pressure, tidal volume, pulse oximetry, dead space, compliance, resistance, capnography)
- g. Metabolic monitoring (oxygen consumption, carbon dioxide production, respiratory quotient)
- h. Use of computers in critical care units for multimodality monitoring

## 11. Ethical and Legal Aspects of Critical Care Medicine

- a. Death and dying
- b. Forgoing life-sustaining treatment and orders not to resuscitate
- c. Rights of patients, the right to refuse treatment
- d. Living wills, advance directives; durable power of attorney
- e. Terminal extubation and palliative care
- f. Rationing and cost containment
- g. Emotional management of patients, families and caregivers
- h. Futility of care and the family in denial

## III. Procedural Skills

### 1. General Neuro-Critical Care

- a. Central venous catheter placement; dialysis catheter placement
- b. Pulmonary artery catheterization
- c. Management of mechanical ventilation, including CPAP/BiPAP ventilation
- d. Administration of vasoactive medications (hemodynamic augmentation and hypertension lysis)
- e. Maintenance airway and ventilation in non-intubated, unconscious patients
- f. Interpretation and performance of bedside pulmonary function tests
- g. Direct laryngoscopy
- h. Endotracheal intubation
- i. BLS & ACLS application
- j. Shunt and ventricular drain tap for CSF sampling
- k. Performance and interpretation of transcranial Doppler
- l. Administration of analgo-sedative medications, including conscious sedation and barbiturate anesthesia
- m. Interpretation of continuous EEG monitoring
- n. Interpretation and management of ICP and CPP data
- o. Jugular venous bulb catheterization
- p. Interpretation of SjvO<sub>2</sub> and PbtO<sub>2</sub> data
- q. Management of external ventricular drains
- r. Management of plasmapheresis and IVIG
- s. Administration of intravenous and intraventricular thrombolysis
- t. Interpretation of CT and MR standard neuroimaging and perfusion studies and biplane contrast neuraxial angiography
- u. Perioperative and postoperative clinical evaluation of neurosurgical and interventional neuroradiology patients
- v. Performance of lumbar puncture and interpretation of cerebrospinal fluid results
- w. Induction and maintenance of therapeutic coma and hypothermia

**IV. METHODS OF TRAINING TO BE USED**

1. The educational experience will be provided in the form of a post-residency fellowship/training, and post-nurse practitioner fellowship/training to be conducted at the Neurocritical Care Division – Department of neurology / Medical College of Georgia/ Augusta University Medical Center, and in compliance with the program requirements.
2. The educational experience will be outlined in the form of a curriculum meeting the standards and requirements specified in the Neurocritical-Care Core Curriculum and Neurocritical-Care Program Requirements.
3. Ongoing feedback in the form of progress reports and evaluations will be performed by the program director and designated faculty and provided to the trainee, and assessments of program success and faculty performance will be provided by trainees to the faculty.