



# PHARMACOLOGY ORIENTATION COURSE

## Overview

The Pharmacology Orientation Course is a resource designed for pharmacists, physicians, trainees, and other healthcare professionals working in the field of neurocritical care. It includes organized resources covering a wide variety of foundational as well as disease-specific content for a wide variety of diagnoses encountered in neurocritical care. Each topic outlines required foundational content as well as suggested resources for participants looking for a deeper understanding on neurocritical care content.

## Course Structure

This course is comprised of 4 module sections that include review materials for a subset of topic areas. Suggested competencies are included, with mandatory review materials and optional resources.

## Module Sections

This course includes sections on Neurology Foundations, Critical Care Foundations and Neurocritical Care Skills, Pathology and Disease in Neurocritical Care, Recommended Procedures in the Neurocritical Care Environment. Detailed information on the topics and suggested competencies for each module are included in the following pages.

## Pricing Options

### PHARMACOLOGY ORIENTATION COURSE PURCHASE OPTIONS

BUNDLE OPTIONS	PRICE	BUNDLE INCLUDES
Bundle #1	NCS Member: \$269.00 Non-Member: \$331.50	<ul style="list-style-type: none"><li>• Pharmacy Orientation Course</li><li>• Subscription to Neurocritical Care ON CALL</li><li>• Hard copy of The Pocket Guide to Neurocritical Care</li></ul>
Bundle #2	NCS Member: \$389.00 Non-Member: \$479.00	<ul style="list-style-type: none"><li>• All items included in Bundle #1</li><li>• <b>Emergency Neurological Life Support (ENLS) - eligible for 15 CE credits upon completion</b></li></ul>
Bundle #3	NCS Member: \$499.00 Non-Member: \$649.00	<ul style="list-style-type: none"><li>• All items included in Bundle #1</li><li>• <b>An additional 32.5 CE credits upon completion of associated exams</b></li></ul>
Bundle #4	NCS Member: \$619.00 Non-Member: \$769.50	<ul style="list-style-type: none"><li>• All items included in Bundle #1</li><li>• Emergency Neurological Life Support (ENLS) - eligible for 15 CE credits upon completion</li><li>• An additional 32.25 CE credits upon completion of associated exams</li></ul>

# Module 1: Neurology Foundations

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## Topics:

- Neuroanatomy
- Neuroradiology (CT/MRI/TCD Interpretation)
- ICU Neuro Exam and Localization

## Suggested Competencies

- ✓ Describe the anatomy of the brain and spinal cord, identifying major external and internal structures, coverings, and fluid-filled spaces.
- ✓ Describe the anatomy of the brainstem, demonstrating knowledge of specific functions.
- ✓ Identify and describe the function of the cranial nerves.
- ✓ Illustrate cerebral arterial and venous vascular anatomy supply.
- ✓ Differentiate different types of neuroimaging modalities, selecting appropriate image technique for diagnosis and assessment of neurological injury.
  - Computed Tomography (CT)
  - Computed Tomography Angiography (CTA)
  - Computed Tomography Venography (CTV)
  - Computed Tomography Perfusion (CTP)
  - Cerebral Angiogram
  - Magnetic Resonance Imaging (MRI)
  - Magnetic Resonance Angiography (MRA)
  - Transcranial Doppler (TCD)
  - Positron emission tomography (PET) Myelography
  - Plain film X-ray
- ✓ Demonstrate knowledge of brain anatomy by accurately localizing to specific region of injury.
- ✓ Differentiate between a detailed and rapid neurologic exam, identifying key characteristics of each.
- ✓ Distinguish changes in neuro exam that warrant emergent pharmacologic interventions.

# Module 2: Critical Care Foundations and Neurocritical Care Skills

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## Topics:

- Advanced Hemodynamics
- Cerebral Hemodynamics and Herniation Syndromes
- Multimodality Neuromonitoring
- Airway and Ventilation Management

## Suggested Competencies

- ✓ Interpret measurement of systemic, pulmonary arterial and venous pressures, and of cardiac output.
- ✓ Justify indications for invasive hemodynamic monitoring.
- ✓ Describe stress induced cardiomyopathy, echocardiography (EKG) abnormalities, arrhythmias, and cardiac laboratory abnormalities (e.g. troponin, CK-MB) seen in neurogenic cardiac injury.
- ✓ Discuss commonly used vasoactive agents (including vasopressors, vasodilators, and inotropic therapy)
- ✓ Interpret measurements of cerebral perfusion, intracranial pressure, and brain oxygen monitoring.
- ✓ Recognize both clinical and hemodynamic changes seen in two patients at risk for herniation.
- ✓ Compare and contrast osmotherapy treatment options mannitol and hypertonic saline
- ✓ Design a safe and effective treatment algorithm utilized for raised intracranial pressure and cerebral herniation with appropriate monitoring parameters.
- ✓ Compare and contrast various multimodality neuromonitoring methods and integrate different forms of monitoring in clinical context including:
  - Fiber-optic/cranial bolt
  - External ventricular drain
  - Intracranial PbtO<sub>2</sub> monitor
  - Jugular bulb venous oxygen saturation (SJVO<sub>2</sub>)
  - Cerebral microdialysis (CMD)
  - Electroencephalogram (EEG)
  - Intracortical depth electrodes
  - Somatosensory evoked potential (SSEP)

- Transcranial doppler (TCD)
- Parenchymal thermal diffusion flowmetry
- Near-infrared spectroscopy (NIRS)
- Optic nerve sheath diameter (ONSD)
- Pupillometry
- ✓ Describe the role of transcranial Doppler (TCD) ultrasonography with a focus on vasospasm monitoring in a patient with aneurysmal SAH.
- ✓ Analyze intracranial pressure (ICP) waveforms and interpret cerebral compliance.
- ✓ Summarize appropriate interventions to implement with a non-patent EVD.
- ✓ Identify disease specific considerations and indications for intubation in patients presenting with neurologic injury.
- ✓ Summarize warning signs of neuromuscular respiratory failure.
- ✓ Compare and contrast medication therapy options for induction of rapid sequence intubation in patients with acute neurologic or neuromuscular injury.
- ✓ Identify modes of ventilation that are most appropriate in patients with neurologic injuries.
- ✓ Describe how various ventilation and blood gas parameters influence ICP and cerebral perfusion.

## **Module 3: Pathology and Disease in Neurocritical Care**

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### **Topics:**

- Subarachnoid Hemorrhage
- Intracerebral Hemorrhage
- Ischemic Stroke
- Traumatic Brain Injury
- Spinal Cord Injury and Compression
- Infectious Disease and Complications
- Seizure and Status Epilepticus
- Pain, Agitation and Delirium
- Neuropharmacology
- Resuscitation Post Cardiac Arrest- TTM
- Coma
- Encephalopathy

- Brain Death
- Neuromuscular Disease (MG, GBS)
- Neuroendocrine Complications (DI/SIADH/CSW)

## Suggested Competencies

- ✓ Identify the role of scores utilized for SAH, including the Hunt and Hess and modified Fisher scores.
- ✓ Describe pharmacological treatment strategies for the management of SAH and prevention of its complications.
- ✓ Summarize management strategies for complications of SAH, including symptomatic vasospasm and delayed cerebral ischemia.
- ✓ Describe pharmacological treatment strategies for the management of ICH, including acute blood pressure management and reversal of antithrombotic medications.
- ✓ Identify appropriate LDL targets for patients with ICH.
- ✓ Summarize the role of antifibrinolytics in patients with neurologic injury.
- ✓ Identify inclusion and exclusion criteria for AIS interventions, including thrombolytics and endovascular therapy.
- ✓ Recognize common issues and complications with thrombolytic agent use in AIS.
- ✓ Describe thrombolytic reversal strategies in patients developing hemorrhagic conversion after receiving thrombolytic therapy for AIS.
- ✓ Identify management strategies for complications of AIS, including malignant cerebral edema.
- ✓ Summarize the pathophysiology and pharmacologic strategies for managing patients with reversible cerebral vasoconstrictive syndrome (RCVS) and posterior reversible encephalopathy syndrome (PRES).
- ✓ Classify the severity of traumatic brain injury (TBI).
- ✓ Compare and contrast the various radiographic findings of TBI (e.g. subdural hematoma, diffuse axonal injury)
- ✓ Describe strategies for the prevention and management of secondary injuries in TBI.
- ✓ Describe the role of antifibrinolytics in acute TBI
- ✓ Discuss strategies and treatment thresholds for management of cerebral perfusion pressure (CPP).
- ✓ Identify potential severe adverse effects, drug interactions and pharmacokinetic/pharmacodynamics considerations of medications and therapeutic strategies commonly used for the treatment of patients with TBI.

- ✓ Summarize the Canadian C-Spine Rule and/or NEXUS Criteria and need for further cervical spine imaging.
- ✓ Summarize the ASIA/ISCoS Exam and Grade on a patient presenting with spinal cord injury, anticipating rehabilitation and recovery needs.
- ✓ Review neuroimaging and multimodality neuromonitoring for diagnosis and prognostication of patients with spinal cord injury
- ✓ Describe management strategies for a patient with spinal cord injury or compression, including those with cancer-associated or infection-related myelopathy.
- ✓ Describe treatment strategies for acute complications after spinal cord injury.
- ✓ Interpret CSF profiles for bacterial meningitis, viral meningitis, herpes encephalitis, and subarachnoid hemorrhage.
- ✓ Select appropriate empiric antimicrobials for suspected meningitis based on patient characteristics.
- ✓ Recommend an appropriate de-escalation of antimicrobial treatment regimen for treatment of meningitis once microbial susceptibilities are finalized.
- ✓ Recognize complications of neuroinfectious diseases and appropriate management.
- ✓ Compare and contrast antiepileptic drugs (AEDs) for the management of seizures and status epilepticus.
- ✓ Recommend appropriate AED therapy for a patient in status epilepticus with respect to AED dosing, drug-disease and drug-drug interactions and adverse effect profiles.
- ✓ Describe the role of continuous electroencephalographic (cEEG) monitoring in a patient presenting with status epilepticus.
- ✓ Describe various scales and scores utilized to assess pain, agitation, and delirium in neurocritically ill patients.
- ✓ Identify common medications utilized for pain, agitation, and delirium in the neurocritical care setting.
- ✓ Recognize the risks and benefits of different medications utilized for pain, agitation, and delirium in the neurocritical care setting.
- ✓ Describe pharmacokinetic and pharmacodynamic alterations in patients with acute neurologic injury.
- ✓ Describe the pharmacology, pharmacokinetics and pharmacodynamic characteristics of common medications used in the neurocritical care setting.
- ✓ Discuss factors related to blood-brain barrier penetration of medications.

- ✓ Explain how medications may lower the seizure threshold and provide examples.
- ✓ Summarize pharmacologic characteristics and compounding considerations required for intraventricular and intrathecal drug delivery.
- ✓ Describe the neurologic benefit of temperature management in the post cardiac arrest patient population.
- ✓ Compile a list of physiologic changes and potential adverse effects/complications associated with TTM.
- ✓ Compare and contrast abortive and prophylactic medication strategies for shivering during TTM.
- ✓ Describe TTM effects on medication pharmacokinetics and pharmacodynamics.
- ✓ Differentiate between coma, persistent vegetative state, and locked-in-syndrome.
- ✓ Identify potentially reversible metabolic, toxic, and neurologic causes of coma.
- ✓ Evaluate the role of various neurostimulants in the neurocritical care patients.
- ✓ Summarize common etiologies of metabolic encephalopathy.
- ✓ Manage one patient with acute metabolic encephalopathy, with a focus on laboratory investigation, interpretation and treatment strategies.
- ✓ Describe components of a brain death examination.
- ✓ Identify medication confounders pertinent to the brain death examination.
- ✓ Evaluate pharmacological options in the management of the brain-dead organ donor.
- ✓ Summarize treatment of MG and/or GBS and what factors contribute to the decision of IVIG versus Plasmapheresis.
- ✓ Compare and contrast IVIG dosing strategies with respect to clinical and cost effectiveness
- ✓ Identify common drug-disease interactions in patients with myasthenia gravis and facilitate prescribing of alternative therapy as clinically appropriate
- ✓ Manage one patient with a Neuromuscular disease:
  - GBS, with a focus on clinical presentation and treatment strategies
  - MG, with a focus on clinical presentation and treatment strategies
- ✓ Differentiate clinical and laboratory diagnostics between syndrome of inappropriate diuretic hormone secretion (SIADH), cerebral salt wasting (CSW), and diabetes insipidus (DI)

- ✓ Describe appropriate treatment algorithms for SIADH, CSW, and DI
- ✓ Identify potential causes of SIADH, CSW, and DI and recommend appropriate pharmacologic interventions for treatment

## Module 4: Recommended Procedures in the Neurocritical Care Environment

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### Topics:

- Immunosuppressive Therapies
- Supportive Care
- Medication Safety
- Ethics & Prognostic Assessment

### Suggested Competencies

- ✓ Identify indications for chimeric antigen receptor T cell (CAR-T) therapy
- ✓ Identify immunosuppressive agents utilized in CAR-T therapy.
- ✓ Recognize complications related to CAR-T therapy, including cytokine release syndrome (CRS) and immune effector cell-associated neurotoxicity syndrome (ICANS).
- ✓ Evaluate management strategies for CRS and ICANS based on grading of each complication.
- ✓ Recognize common supportive care needs for neurocritical care patients.
- ✓ Summarize symptomatology and pharmacologic treatment strategies for the management of PSH.
- ✓ Determine effects of fever on clinical outcomes and identify treatment options for fever in neurocritical care patients.
- ✓ Evaluate the appropriateness of VTE prophylaxis based on timing of neurologic injury/surgery and patient risk factors.
- ✓ Define appropriate indications for seizure prophylaxis in neurocritical care patients.
- ✓ Describe various challenges in managing a patient with Parkinson's disease in the neurocritical care unit.
- ✓ Evaluate blood glucose goals and the importance of glycemic control in neurocritical care patients.
- ✓ Identify common concerns and management strategies of substance withdrawal in the neurocritical care unit.

- ✓ Describe the appropriate utilization of fluid therapy in neurointensive care patients.
- ✓ Determine perioperative supportive care measures in patients with neurological injuries.
- ✓ Describe medication safety issues in the neurocritical care unit
- ✓ Identify prevention and management strategies for medication safety issues in the neurocritical care unit.
- ✓ Identify potential adverse drug effects and drug interactions for medications used in the neurocritical care setting.
- ✓ Describe the shared decision-making process for a family meeting.
- ✓ Describe challenges and pitfalls in neuro-prognostication and self-fulfilling prophecy.