The Neurological Surgery Milestone Project

A Joint Initiative of

The Accreditation Council for Graduate Medical Education

and

The American Board of Neurological Surgery

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

Neurological Surgery Milestones

Chair: Nathan Selden, MD

Working Group

Aviva Abosch, MD

Richard W Byrne, MD

Pamela Derstine, PhD, MHPE

Laura Edgar, EdD, CAE

Robert Harbaugh, MD, FAANS, FACS, FAHA

William Krauss, MD

Timothy B. Mapstone, MD

Oren Sagher, MD

Gregory Zipfel, MD

Advisory Group

Daniel Barrow, MD

Hunt Batjer, MD

Timothy Brigham, PhD, MDiv

Kim Burchiel, MD

Ralph Dacey Jr., MD

Arthur Day, MD

Fredric Meyer, MD

John Potts, MD

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Milestone Reporting

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

For each period, review and reporting will involve selecting milestone levels that best describe a resident's current performance and attributes. Milestones are arranged into numbered levels. Tracking from Level 1 to Level 5 is synonymous with moving from novice to expert. These levels do not correspond with post-graduate year of education.

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

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

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

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

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

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

Additional Notes

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

The Society of Neurological Surgeons (SNS), representing residency program directors and other educational leaders, has developed a detailed curriculum with individual elements linked to relevant milestones goals. The SNS also provides collaborative, hands-on training for certain fundamental skills and attributes at regional courses available to all residents in ACGME-accredited neurological surgery programs. Information about SNS educational programs can be found at www.societyns.org.

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

Answers to Frequently Asked Questions about the NAS and milestones are available on the ACGME's NAS microsite: http://www.acgme-nas.org/assets/pdf/NASFAQs.pdf.

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

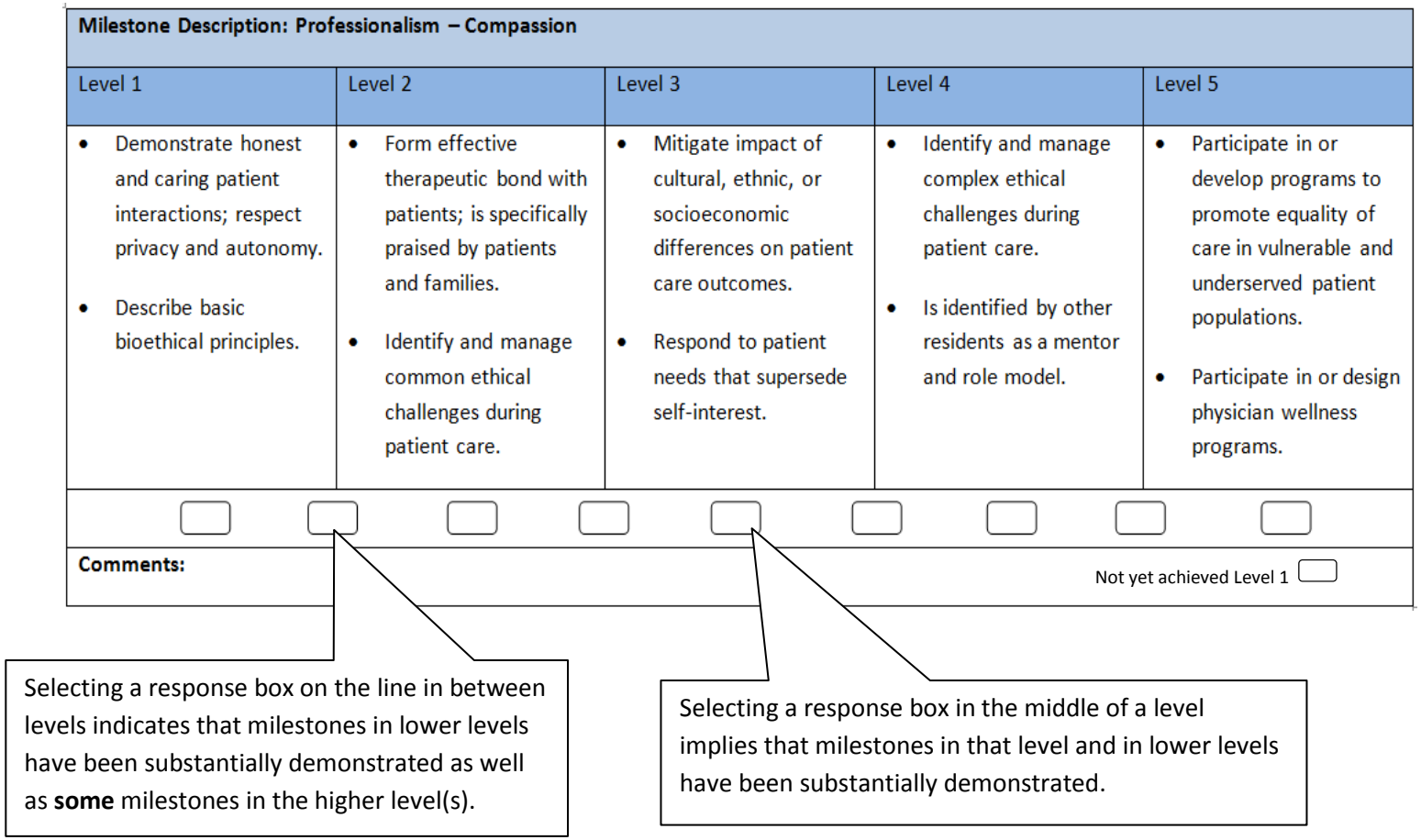
- Selecting the level of milestones that best describes that resident's performance in relation to the milestones

or

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

or

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



Milestone Description: Professionalism – Compassion				
Level 1	Level 2	Level 3	Level 4	Level 5
• Demonstrate honest and caring patient interactions; respect privacy and autonomy. • Describe basic bioethical principles.	• Form effective therapeutic bond with patients; is specifically praised by patients and families. • Identify and manage common ethical challenges during patient care.	• Mitigate impact of cultural, ethnic, or socioeconomic differences on patient care outcomes. • Respond to patient needs that supersede self-interest.	• Identify and manage complex ethical challenges during patient care. • Is identified by other residents as a mentor and role model.	• Participate in or develop programs to promote equality of care in vulnerable and underserved patient populations. • Participate in or design physician wellness programs.
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Comments:				Not yet achieved Level 1 ☐

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

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

Brain Tumor – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
• Performs a history and physical examination in patients with brain or spinal cord tumors • Provides routine peri-operative care for patients with brain or spinal cord tumors • Initiates the work-up of a patient with a brain or spinal cord tumor • Recognizes signs of and initiates work-up for neurological deterioration	• Explains risks and benefits of neurosurgical procedures for brain and spinal cord tumors • Interprets diagnostic studies • Assists with routine procedures (e.g., resection of non-eloquent glioma or metastasis, stereotactic biopsy) • Recognizes and initiates work-up of complications (e.g., hematoma, infection, seizure, hydrocephalus)	• Formulates a work-up and treatment plan for patients with brain, skull base, or spinal cord tumors • Independently performs routine procedures • Performs complex procedures with assistance (e.g., resection of eloquent glioma, ventricular or posterior fossa tumor) • Manages unexpected intra-operative events (e.g., sinus bleeding, cerebral edema) • Manages complications with assistance	• Independently formulates a treatment plan for patients with comorbidities or other complicating factors (e.g., systemic illness, radiation, chemotherapy) • Independently performs complex procedures • Adapts standard treatment plans to special circumstances (e.g., previous surgery, anticipated neurological morbidity) • Independently manages complications	• Systematically reviews treatment outcomes for brain and spinal cord tumors • Participates in quality improvement for brain and spinal cord tumors • Participates in or lead a multidisciplinary brain tumor team or program
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Comments:				Not yet rotated ☐

Brain Tumor – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
• Correlates neurological deficits with tumor location • Correlates radiographic tumor location with ventricular, cranial nerve and vascular anatomy • Describes the pathophysiology of mass lesions and obstructive hydrocephalus • Describes acute symptomatic medical therapy for neoplastic mass lesions (e.g., steroids, ventricular drainage)	• Describes the use of radiation and chemotherapy for brain and spinal cord tumors • Lists indications for biopsy or resection of brain and spinal cord tumors • Categorizes brain and spinal cord tumors by age, histology, and radiographic appearance • Describes the non-neoplastic differential diagnosis of various mass lesions • Describes the natural history of common intrinsic brain tumors	• Describes the genetics of brain tumors and genetic markers that impact prognosis • Describes the use of advanced imaging in tumor evaluation and surgical planning (e.g., magnetic resonance [MR] tractography, functional imaging, spectroscopy) • Describes the use of neuro-navigation and intra-operative imaging for brain tumor surgery • Describes the role of skull-base surgical approaches in tumor resection, attendant complications, and their management	• Describes expected outcomes after surgery for brain and spinal cord tumors • Describes the role of radiosurgery in brain tumor therapy • Describes the role of palliative care for brain tumor patients • Describes personalized medicine approaches for brain tumor treatment	• Contributes to the peer-reviewed literature in brain and spinal cord tumors • Participates in brain tumor research and clinical trials
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Comments: Not yet rotated ☐				

Critical Care – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
• Performs a history and physical examination in critically-ill patients • Orders positioning, analgesics, sedation, neuromuscular blockade, intravenous (IV) fluids and nutrition in critically-ill patients • Diagnoses and formulates treatment plans for common pulmonary diseases • Use electrocardiogram (EKG) to diagnose cardiac arrhythmia; initiates hemodynamic monitoring • Performs a brain death examination	• Explains risks and benefits of ventilatory support • Interprets diagnostic studies (e.g., chest x-ray [CXR], brain computed tomography [CT], echocardiogram) • Manages intra-cranial hypertension (e.g., hyperosmolar agents, cerebral spinal fluid [CSF] drainage) • Manages airway and performs endotracheal intubation • Inserts arterial and central venous catheters • Diagnoses and manages spinal or hypovolemic shock	• Formulates work-up and treatment plan for a comatose patient • Manages refractory intra-cranial hypertension (e.g., blood pressure, cerebral perfusion pressure [CPP]) • Obtains confirmatory tests and make an accurate diagnosis of brain death • Initiates management of pneumonia or systemic infection	• Independently formulates a treatment plan for complex patients (e.g., failure of cerebral autoregulation, multi-organ failure, non-recoverable central nervous system [CNS] injury) • Diagnoses and initiates management of adult respiratory distress syndrome • Manages difficult and emergency airways • Diagnose and manages CSF leak • Initiates management of cardiac rhythm disturbances	• Systematically reviews outcomes for neurocritical care patients • Participates in quality improvement for a neurocritical care unit • Develops a standard neurocritical care unit management protocol • Leads multidisciplinary neurocritical care team • Manages respiratory failure (e.g., mechanical ventilation, bronchoscopy) • Manages cardiac rhythm disturbances
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Comments: Not yet rotated ☐				

Critical Care – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
• Describes intracranial pressure (ICP), CPP and cerebral blood flow (CBF) physiology • Describes respiratory and ventilator physiology and effects on the CNS • Describes the pathophysiology of myocardial infraction (MI) and congestive heart failure (CHF) • Describes physiology of coagulation and hemostasis • Describes principles of nutritional support • Lists indications for ICP monitoring and hematoma evacuation • Describes cerebral autoregulation	• Describes the pathophysiology and medical management of intra-cranial hypertension and cerebral edema • Describes modes of mechanical ventilation and management of pulmonary shunting and dead space • Describes prophylaxis for deep vein thrombosis (DVT) • Describes the pathophysiology and treatment of diabetic ketoacidosis (DKA) • Describes the etiology and imaging of traumatic intra-cranial hemorrhage and parenchymal injuries	• Describes indications for electroencephalography (EEG) monitoring • Discusses indications for and risks of endotracheal intubation/ventilation • Describes the pathophysiology and treatment of systemic critical illness (e.g., hypertension, coagulopathy, electrolyte imbalance, alcohol withdrawal) • Lists indications and complications for decompressive craniectomy, CSF drainage, and barbiturate coma in traumatic brain injury (TBI)	• Describes expected outcomes after TBI and the impact of intra-cranial hypertension and of surgical intervention • Understands trans-cranial Doppler (TCD) sonography and its role in monitoring • Discusses the risks of CSF drainage, hyperosmolar therapy, and hyperventilation • Describes methods to assess intra-vascular volume and tissue perfusion	• Contributes to the peer-reviewed literature in TBI • Describes advanced intra-cranial monitoring (e.g., brain tissue oxygenation, jugular venous oxygen saturation, microdialysis) • Describes advanced imaging for TBI (e.g., cerebral metabolism, perfusion • Describes indications and risks for various methods of hemodialysis and extracorporeal membrane oxygenation (ECMO)
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Surgical Treatment of Epilepsy and Movement Disorders – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
• Performs a history and physical examination in patients with epilepsy or movement disorders • Evaluates and treat a patient for medical comorbidities affecting functional neurological surgery • Provides routine peri-operative care for functional neurosurgical patients • Initiates the work-up of a patient with an apparent seizure • Recognizes and initiates treatment of status epilepticus	• Explains risks and benefits of neurosurgical procedures for epilepsy and movement disorders • Interprets diagnostic studies • Assists with routine components of functional procedures (e.g., burr hole, craniotomy, generator change) • Recognizes and initiates work-up of complications (e.g., hematoma, seizure, infection, device malfunction) • Places stereotactic head-frame	• Formulates a work-up and treatment plan for patients with epilepsy or a movement disorder (e.g., Parkinson disease, essential tremor) • Independently performs routine functional procedures (e.g., deep brain simulation [DBS] placement, subdural electrode placement, topectomy) • Performs complex functional procedures with assistance (e.g., temporal lobectomy) • Manages complications with assistance • Performs stereotactic targeting using frameless and frame-based systems	• Independently formulates a treatment plan for patients with comorbidities or other complicating factors (e.g., eloquent seizure focus) • Independently performs complex procedures • Adapts standard treatment plans to special circumstances (e.g., previous surgery, neuropsychological limitations) • Independently manages complications	• Systematically reviews treatment outcomes for epilepsy and/or movement disorders • Participates in quality improvement for epilepsy and/or movement disorders
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Surgical Treatment of Epilepsy and Movement Disorders – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
• Describes the embryology and functional anatomy of the basal ganglia, thalamus, and cortex • Describes the physical findings and differential diagnosis of common movement disorders • Describes the semiology and pathophysiology of common seizure disorders • Describes medical therapy for status epilepticus	• Describes medical therapies for epilepsy and movement disorders • Lists surgical indications for patients with epilepsy or movement disorders • Describes imaging findings in common epilepsies and movement disorders (e.g., magnetic resonance imaging [MRI], Single Proton Emission Computerized Tomography [SPECT], and position emission tomography [PET]) • Describes the principle of arc-centered stereotaxy • Describes sources of inaccuracy in stereotaxy (e.g., brain shift, human error)	• Describes the pathophysiology, including genetics, of the common movement disorders • Describes the pathophysiology and pathoanatomy of common epilepsies • Identifies on MRI the structures targeted for movement disorder surgery • Describes the use of surface and invasive EEG in seizure focus localization • Identifies common patterns of EEG abnormality	• Describes expected outcomes after surgery for epilepsy and movement disorders • Describes responses to electrical stimulation around intended DBS targets and in various regions of eloquent cortex • Describes indications for lesional vs. neuromodulatory interventions • Describes the role of radiosurgery for functional lesions • Describes indications for vagus nerve stimulation (VNS), callosotomy, and hemispherectomy	• Contributes to the peer-reviewed literature in epilepsy and/or movement disorder treatment
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Pain and Peripheral Nerves – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
• Performs a history and physical examination in patients with chronic pain or peripheral nerve disorders • Provides routine peri-operative care for patients with chronic pain or peripheral nerve disorders • Initiates the work up of a patient with a peripheral nerve injury • Recognizes and initiates treatment of baclofen withdrawal or morphine overdose	• Explains risks and benefits of neurosurgical procedures for pain and peripheral nerve disorders • Interprets diagnostic studies • Assists with routine procedures (e.g., carpal tunnel release, spinal cord stimulation, intrathecal pump) • Recognizes and initiates work-up of complications (e.g., hematoma, infection, device malfunction)	• Formulates a work-up and treatment plan for patients with chronic pain or peripheral nerve disorders (e.g., trigeminal neuralgia, carpal tunnel syndrome) • Independently performs routine procedures • Performs complex procedures with assistance (e.g., dorsal root entry zone [DREZ] lesions, cordotomy, neuroma in continuity, brachial plexus repair, nerve graft, nerve transfer) • Manages complications with assistance	• Independently formulates a treatment plan for patients with comorbidities or other complicating factors (e.g., recurrent trigeminal neuralgia) • Independently performs complex procedures • Adapts standard treatment plans to special circumstances (e.g., previous surgery, deafferentation pain) • Independently manages complications	• Systematically reviews treatment outcomes for pain and/or peripheral nerve disorders • Participates in quality improvement for pain and/or peripheral nerve disorders
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Pain and Peripheral Nerves – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
• Describes the anatomy of spinal cord and thalamic pathways for pain and pain modulation • Describes the anatomy of the brachial and lumbar plexi and major nerves of the extremities • Describes nerve injury classifications and the prognosis and time course for recovery of each	• Lists medical therapies for chronic pain (e.g., trigeminal neuralgia, brachial plexus neuritis) • Describes the anatomy and physical findings of common upper extremity entrapment neuropathies • Describes the clinical findings and differential diagnosis of trigeminal neuralgia • Lists surgical indications for patients with chronic pain or peripheral nerve disorders	• Describes the pathophysiology of chronic pain disorders • Describes non-operative therapies for nerve entrapment disorders • Describes the anatomy and physical findings of common lower extremity entrapment neuropathies • Describes the findings of electromyography (EMG) and nerve conduction studies in peripheral nerve disorders • Obtains and interprets diagnostic studies for chronic pain and peripheral nerve disorder patients	• Describes expected outcomes after surgery for chronic pain (e.g., microvascular decompression [MVD], DREZ lesions, cordotomy) • Describes expected outcomes after surgery for peripheral nerve disorders (e.g., neurolysis, direct anastomosis, grafting) • Describes the anatomy and physiology of spinal cord lesioning for pain (myelotomy, cordotomy)	• Contributes to the peer-reviewed literature in chronic pain and/or peripheral nerve disorders
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Pediatric Neurological Surgery – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
• Performs an age-appropriate history and physical examination with developmental assessment • Provides routine peri-operative care for pediatric neurosurgical patients • Programs shunt valves and tap shunts • Evaluates CSF shunt function • Recognizes and initiates notification and evaluation of non-accidental trauma	• Explains risks and benefits of neurosurgical procedures to parents and older children • Interprets diagnostic studies with accurate identification of age-related variations • Assists with routine procedures (e.g., CSF shunt, baclofen pump, Chiari decompression) • Recognizes in pre-verbal children, and initiates work-up of, complications (e.g., hematoma, infection, device malfunction, acute mental status decline)	• Formulates a work-up and treatment plan for pediatric patients (e.g., hydrocephalus, synostosis, tethered cord, birth injury) • Independently performs routine procedures • Performs complex procedures with assistance (e.g., brain tumor, synostosis repair, tethered cord, ventricular endoscopy, indirect vascular bypass, craniotomy for epilepsy) • Manages complications with assistance • Diagnoses brain death in infants/children	• Independently formulates a treatment plan for patients with comorbidities or other complicating factors (e.g., other organ system congenital anomalies) • Independently performs complex procedures • Adapts standard treatment plans to special circumstances (e.g., previous surgery, developmental delay, coagulopathy) • Independently manages complications	• Systematically reviews treatment outcomes for pediatric neurosurgical patients • Participates in quality improvement for pediatric neurological surgery • Formulates a diagnostic and management plans for a patient with a functioning CSF shunt and chronic headaches • Counsels expectant parents regarding fetal congenital anomalies • Performs surgical stabilization of the spine in a patient aged less than three years
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Comments: Not yet rotated ☐				

Pediatric Neurological Surgery – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
• Describes the embryology of common CNS congenital anomalies • Describes normal CSF physiology • Describes the response of the developing brain to injury • Describes developmental changes in cardio-pulmonary function and vital signs • Describes proper utilization and dosing of narcotics in children • Calculates circulating blood volume in infants and children	• Describes abnormal CSF physiology and anatomy in various forms of hydrocephalus • Describes the radiological and clinical features of CNS tumors in children of various ages • Describes the radiological and clinical features of hydrocephalus, benign macrocephaly, and subdural hygroma • Describes the physical findings and mechanisms of head shape abnormalities	• Describes the natural history of congenital CNS anomalies • Describes the implications of spinal column development for patterns of injury and treatment choice in children • Describes the impact of refractory epilepsy and spastic cerebral palsy on development and function • Describes treatment strategies for CNS tumors in children • Identifies methods to limit radiation exposure in children during imaging	• Describes the effects of surgical diversion on CSF physiology • Describes the risks, screening, incidence, and management of late effects from chemotherapy and radiation for childhood CNS tumors • Describes the natural history of cranial synostosis and tethered cord with or without surgical intervention • Describes expected medical and functional long-term outcomes in patients with myelomeningocele	• Contributes to the peer-reviewed literature in pediatric neurological surgery • Describes molecular abnormalities associated with CNS congenital anomalies and tumors • Describes the differential diagnosis and pathophysiology of acquired and congenital movement disorders
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Comments: Not yet rotated ☐				

Spinal Neurosurgery – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
• Performs a history and physical examination in patients with spinal disorders • Evaluates and treat a patient for medical comorbidities affecting elective spinal surgery • Provides routine peri-operative care for spinal surgery patients • Initiates the work-up of a patient with myelopathy or radiculopathy • Safely positions patients for spinal procedures	• Explains risks and benefits of surgical spine procedures • Interprets diagnostic studies (e.g., imaging, EMG) • Initiates management of a patient with acute spinal cord injury • Performs cervical traction/reduction • Assists with routine procedures (e.g., lumbar or cervical laminectomy, lumbar discectomy) • Recognizes and initiates work-up of complications (e.g., CSF leak, infection, radiculitis)	• Formulates a work-up and treatment plan for patients with lumbar or cervical degenerative disease • Formulates a plan for surgical and adjunctive therapy of a patient with spinal column neoplastic disease • Independently performs routine procedures • Performs complex procedures with assistance (e.g., Anterior Cervical Discectomy and Fusion [ACDF], posterior lumbar fusion, spinal cord tumor resection, fracture stabilization) • Manages complications with assistance	• Independently formulates a treatment plan for patients with comorbidities, previous surgery or other complicating factors (e.g., multiple system trauma, coagulopathy) • Independently performs complex procedures • Performs advanced procedures with assistance (e.g., thoracolumbar or craniocervical reconstruction, reconstruction after infection or vertebral tumor resection) • Independently manages complications	• Systematically reviews treatment outcomes for spinal disorders • Participates in quality improvement for spinal disorders • Leads interdisciplinary team in the management of complex spinal disorders • Independently performs advanced procedures
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Spinal Neurosurgery; Degenerative Disease – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
• Describes vertebral and radicular anatomy by level • Describes the physical findings and differential diagnosis of degenerative spinal disorders (e.g., radiculopathy, neurogenic claudication, spondylotic myelopathy) • Describes basic principles of spinal biomechanics	• Describes medical and physical therapies for degenerative spinal disorders • Lists surgical indications and options for degenerative spinal disorders • Describes imaging findings in degenerative spinal disorders (e.g., x-ray, MRI, myelography) • Describes the natural history of spinal degenerative disorders • Describes EMG findings in spondylotic myeloradiculopathy	• Describes the pathophysiology of degenerative spondylotic myeloradiculopathy • Describes and categorize degenerative spinal deformities by imaging (e.g., scoliosis, lumbar spondylolisthesis) • Describes indications for anterior vs. posterior surgical approaches to the spine • Describes the role of instrumentation and bony fusion in surgery for degenerative spinal disorders	• Describes expected functional and pain outcomes after surgery for spinal degenerative disease • Describes criteria for reoperation for degenerative spinal disease • Lists indications for vertebroplasty and kyphoplasty • Describes the genetics, pathophysiology, and imaging findings of inflammatory spinal disorders	• Contributes to the peer-reviewed literature in spinal degenerative disease • Evaluates and introduce resource efficiencies for surgical spine care
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Comments: Not yet rotated ☐				

Spinal Neurosurgery; Trauma, Tumor, Infection – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
• Describes spinal cord and cauda equina anatomy • Describes dermatomal sensory and motor levels and patterns of spinal cord injury • Defines spinal stability and instability • Describes the pathophysiology of spine and spinal cord injuries	• Describes the medical treatment of spinal infections • Describes the use and types of external bracing in spinal trauma, tumor, or infection • Classifies spinal fractures by mechanism and imaging appearance • Lists surgical indications, contra-indications, and options for spinal trauma, tumor, and infection • Describes the natural history of primary spinal tumors	• Describes the pathophysiology and imaging findings of spinal tumors (e.g., intradural tumor, vertebral metastasis) • Describes the pathophysiology and imaging findings in spinal infection (e.g., discitis, epidural abscess, tuberculosis, osteomyelitis) • Describes the role of instrumentation and bony fusion in surgery for spinal trauma, tumor, or infection	• Describes expected short- and long-term outcomes and complications after surgery for spinal trauma, tumor, or infection • Describes factors affecting outcome in spinal tumor surgery (e.g., extent of resection) • Describes the use of adjuncts during spinal trauma and tumor surgery (e.g., image guidance, ultrasound, monitoring) • Describes the role of radiotherapy for treatment of spinal tumors	• Contributes to the peer-reviewed literature in spinal trauma, tumor, or infection • Designs a clinical trial in spinal trauma, tumor, or infection
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Comments: Not yet rotated ☐				

Vascular Neurosurgery – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
• Performs a history and physical examination in patients with ischemic or hemorrhagic stroke • Provides routine peri-operative care for patients undergoing extracranial and intracranial vascular surgery • Initiates the work-up of a patient with ischemic or hemorrhagic stroke • Explains risks and benefits of diagnostic catheter angiography	• Explains risks and benefits of surgery and endovascular therapy for aneurysms, vascular malformations, and ischemic stroke • Interprets CT, MR, and angiographic studies • Assists with routine components of procedures (e.g., pterional craniotomy, diagnostic catheter angiography) • Recognizes and initiates work-up of complications after surgery or endovascular therapy (e.g., hemorrhage, ischemic stroke, cardiovascular compromise	• Formulates a work-up and treatment plan for patients with aneurysms, vascular malformations, or ischemic stroke • Independently performs routine components of procedures • Performs complex procedures with assistance (e.g., carotid endarterectomy, aneurysm clipping, arteriovenous malformation resection) • Manages complications with assistance	• Independently Formulates a treatment plan for patients with comorbidities or other complicating factors (e.g., previous stroke, coronary artery disease, anti-coagulation) • Independently performs complex procedures • Performs advanced procedures with assistance (e.g., aneurysm coiling, vascular malformation embolization, extracranial-intracranial bypass) • Independently manages complications	• Systematically reviews treatment outcomes for neurovascular disease • Participates in quality improvement for neurovascular disease • Independently performs advanced procedures
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Comments: Not yet rotated ☐				

Vascular Neurosurgery – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
• Describes intracranial and extracranial vascular anatomy, including vascular territories • Describes mechanisms of cerebral autoregulation • Describes clinical presentations and imaging characteristics of ischemic and hemorrhagic stroke • Describes the embryology and anatomy of vascular lesions (e.g., aneurysms and vascular malformations) • Describes the pathophysiology of intracranial and extracranial atherosclerotic disease	• Lists indications for intravenous thrombolytic therapy in ischemic stroke • Lists indications for carotid endarterectomy and carotid angioplasty/stent • Describes the natural history of aneurysms and vascular malformations • Lists indications for surgical and endovascular treatment of aneurysms and vascular malformations • Describes the clinical and imaging characteristics of delayed cerebral ischemia after subarachnoid hemorrhage • Describes imaging findings in common cerebrovascular conditions	• Describes the pathophysiology of ischemic stroke (e.g., necrotic and apoptotic cell death) • Describes methods for evaluating cerebral perfusion and blood flow • Lists indications for surgical and endovascular treatment of complex aneurysms and vascular malformations • Describes the imaging and angiographic characteristics of cerebral vasculopathies (e.g., atherosclerotic disease, dissection, vasculitis)	• Describes expected outcomes after surgery or endovascular therapy for intracranial and extracranial vascular disease • Describes the indications for medical vs. endovascular treatment of intracranial arterial stenosis • Describes the molecular mechanisms of ischemic protection strategies • Describes the genetics and inheritance of familial cavernous malformations and hereditary hemorrhagic telangiectasia	• Contributes to the peer-reviewed literature in cerebrovascular disease
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Comments: Not yet rotated ☐				

Traumatic Brain Injury – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
• Performs a history and physical examination of a comatose patient and assign Glasgow Coma Scale (GCS) score • Evaluates a polytrauma patient and assign Injury Severity Score • Provides initial management of a polytrauma patient • Provides routine peri-operative care for patients with TBI • Detects an altered neurological examination • Places an ICP monitor and external ventricular drain	• Explains risks and benefits of neurosurgical procedures for TBI • Interprets diagnostic imaging for a neurotrauma patient • Organize emergency surgical team; position for craniotomy with cervical precautions • Assist with routine procedures (e.g., burr hole, craniotomy for hematoma or penetrating injury) • Recognizes and initiates work-up of complications (e.g., hematoma, seizure, sepsis, monitor drift)	• Formulates an interdisciplinary treatment plan for patients with polytrauma • Selects patients for operative intervention • Independently performs routine procedures • Performs complex procedures with assistance (e.g., repair of vascular injury or CSF fistula, posterior fossa hematoma) • Manages complications with assistance • Manages ventricular drain	• Prioritizes the management of injuries in a polytrauma patient • Independently performs complex procedures • Manages unexpected intra-operative events (e.g., cerebral edema, hemorrhage, air embolus) • Adapts standard treatment plans to special circumstances (e.g., medical comorbidity, coagulopathy) • Independently manages CNS complications	• Systematically reviews treatment outcomes for TBI • Participates in quality improvement for TBI care • Participates in developing a plan for triage in a disaster management scenario • Reconstructs complex craniofacial injuries
☐	☐	☐	☐	☐	☐	☐	☐	☐
Comments: Not yet rotated ☐				

Economics – Systems-based Practice				
Level 1	Level 2	Level 3	Level 4	Level 5
• Identifies the range of practice variation (e.g., medication, laboratory tests, imaging, and procedures) • Describes U.S. health payment systems	• Describes the cost impact of practice variation in the context of system and national health resource utilization • Describes principles of ethical coding (e.g., diagnostic, E&M, and procedural)	• Use health care resources responsibly (e.g., test ordering, OR efficiency, timely discharges/transfers) • Accurately codes diagnoses and procedures in the ACGME Case Log System	• Cites peer-reviewed cost and outcomes data to support resource utilization decisions	• Designs and implements cost-effective patient care pathways with monitoring and feedback mechanisms
☐	☐	☐	☐	☐ ☐ ☐ ☐ ☐
Comments:				Not yet achieved Level 1 ☐

Safety and Systems – Systems-based Practice				
Level 1	Level 2	Level 3	Level 4	Level 5
• Defines medical errors, near misses, and sentinel events; provides system-based examples of each • Assists care coordinator with discharge and outpatient services arrangements • Works in interdisciplinary teams to enhance safety and quality	• Uses protocols and checklists for patient hand-offs, medication orders, and emergencies • Effects inter-facility transfer, including records and physician communication	• Reports problematic behaviors, processes, and devices, including errors and near misses • Coordinates interdisciplinary inpatient care	• Conducts root cause or failure mode analysis of systems-based errors and effect prophylaxis • Coordinates team for interdisciplinary procedure • Establishes timeline and Identifies resources for transition to practice • Improves care systems to achieve optimal patient care • Works effectively in various health care delivery settings and systems	• Leads multi-disciplinary patient safety team or initiative • Leads interdisciplinary care team or clinic • Mentors colleagues in practice building and administration
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Comments:				Not yet achieved Level 1 ☐

Lifelong Learning – Practice-based Learning and Improvement				
Level 1	Level 2	Level 3	Level 4	Level 5
• Identifies limitations in knowledge, skills, and experience; incorporate feedback • Demonstrates information technology skills for evidence gathering	• Sets learning and improvement goals; identifies resources, and performs appropriate learning activities • Participates in informal patient, medical student, and resident teaching	• Utilizes data for practice improvement (e.g., systematic reviews, meta-analyses, practice guidelines, clinical outcomes data) • Teaches colleagues and other health professionals in both formal and informal settings	• Participates in evidence-based practice improvement • Organizes educational activities at the program level	• Develops educational curriculum and/or assessment tools
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐				
Comments: Not yet achieved Level 1 ☐				

Research – Practice-based Learning and Improvement				
Level 1	Level 2	Level 3	Level 4	Level 5
• Describes basic concepts in clinical epidemiology, biostatistics, and clinical reasoning • Describes the design and use of clinical registry outcomes data in practice improvement	• Categorizes research study designs; evaluates quality and relevance • Contributes to the peer-reviewed neurological surgery literature • Incorporates evidence into routine clinical care decisions	• Contributes systematic clinical or scientific information to the peer-reviewed literature • Participates in clinical outcomes data gathering and analysis	• Formulates question or hypothesis, design investigation, execute project, and report results • Utilizes morbidity and mortality and program-level outcome data to institute systematic clinical practice changes	• Independently plans, fund and execute a research program • Leads or participates in a clinical research trial • Participates in the peer-review and/or research funding review processes • Leads or participates in a clinical outcomes registry
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐				
Comments: Not yet achieved Level 1 ☐				

Compassion – Professionalism				
Level 1	Level 2	Level 3	Level 4	Level 5
• Demonstrates honest and caring patient interactions; respect privacy and autonomy • Describes basic bioethical principles	• Forms effective therapeutic bond with patients; receives praise from patients and families • Identifies and manages common ethical challenges during patient care	• Mitigates impact of cultural, ethnic, or socioeconomic differences on patient care outcomes • Responds to patient needs that supersede self-interest	• Identifies and manages complex ethical challenges during patient care • Acts as a mentor and role model to other residents	• Participates in or develop programs to promote equality of care in vulnerable and underserved patient populations • Participates in or design physician wellness programs
☐	☐	☐	☐	☐ ☐ ☐ ☐ ☐
Comments:				Not yet achieved Level 1 ☐

Accountability – Professionalism				
Level 1	Level 2	Level 3	Level 4	Level 5
• Is punctual for conferences, rounds, pages, and operating room (OR) • Manages fatigue and sleep deprivation • Reports duty hours in a timely and accurate manner • Presents appropriate attire and respectful demeanor • Seeks patient information with reliability, industry, and confidentiality	• Recognizes individual limits in clinical situations and ask for assistance when needed • Manages personal emotional, physical, and mental health • Seeks and accepts professional criticism	• Demonstrates personal ownership of complications and patient outcomes • Acts as effective team leader for physicians and other health care personnel • Leads accurate and effective discussions at morbidity and mortality conference	• Assumes leadership responsibility for clinical care team decisions and outcomes • Mediates conflict amongst members of the health care team • Recognizes and responds to physician impairment in self or others	• Serves as a role model for other practicing and resident physicians for standards of ethical behavior and professionalism • Participates in or lead institutional ethics board or program, or IRB
☐	☐	☐	☐	☐ ☐ ☐ ☐ ☐
Comments:				Not yet achieved Level 1 ☐

Relational – Interpersonal and Communication Skills				
Level 1	Level 2	Level 3	Level 4	Level 5
• Describes the ethical principles of informed consent • Describes methods to compassionately break bad news • Identifies elements of safe patient hand-offs and procedural pause • Prioritizes and conveys simultaneous critical clinical events	• Obtains and documents informed consent • Participates in breaking bad news to a patient or family • Participates in an advanced directive discussion • Leads procedural pause • Uses checklists and informatics to support patient hand-offs • Communicates effectively with patients and families from varied cultural and socioeconomic backgrounds • Prioritizes, conveys, and manages simultaneous critical clinical events	• Obtains and documents informed consent in challenging circumstances (e.g., language or cultural barrier) • Breaks bad news to a patient or family member • Leads and documents an advanced directive discussion • Supervises patient hand-offs • Communicates effectively with physicians, health professionals, and health agencies	• Quantifies evidence for risk-benefit analysis during informed consent for a complex, elective neurosurgical procedure • Manages and documents an unexpected outcome (e.g., patient, care team and risk management communication) • Leads response to an intra-operative or critical care emergency • Acts in a consultative role to other physicians	• Designs consent instrument for a human subject research study; files an Institution Review Board (IRB) application • Designs and implements a procedural safety or sign-out exercise • Designs and implements a team building and communications exercise
☐	☐	☐	☐	☐	☐	☐	☐	☐
Comments:				Not yet achieved Level 1 ☐

Technology – Interpersonal and Communication Skills				
Level 1	Level 2	Level 3	Level 4	Level 5
• Uses Electronic Medical Record (EMR) and radiology access systems for timely reporting of clinical information • Creates accurate patient orders and demonstrate use of EMR dosing and drug interaction safety mechanisms	• Completes timely and accurate operative notes and ACGME Case Log entries • Lists the elements necessary for evaluation and management (E&M) coding at each encounter type/level	• Utilizes Health Insurance Portability and Accountability Act (HIPPA) protection safeguards for Protected Health Information (PHI) and EMR • Designs and implements an EMR template	• Creates or updates a neurosurgical care pathway and order set; implements use	• Utilizes EMR with IRB approval to conduct formal clinical research and/or quality improvement (QI); reports results
☐	☐	☐	☐	☐ ☐ ☐ ☐ ☐
Comments:				Not yet achieved Level 1 ☐