2013-2014
Resident Handbook

Penn State Department of Neurosurgery
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Update: May 1, 2013
MISSION STATEMENT

The mission of the Penn State Hershey Medical Center Neurosurgery Residency Training Program is:

- to train neurosurgery residents in the core competencies of neurosurgery, providing for them an educational, clinical, operative, and research environment of the highest standard.
- to prepare our residents for the neurosurgical career of their choice.
- to foster an appreciation among our residents and staff for the scholarly values and societal ideals which are the underpinnings of our profession.
- to promote a responsible, productive, and healthy work ethic recognizing the needs of the society and the individual.
- to further the knowledge of basic, translational and clinical neuroscience through neurosurgical research and scholarly review of published literature.
- to be active members in the regional, national, and international neurosurgical community.
- to participate in the broader academic programs of the Penn State College of Medicine, the Penn State Hershey Medical Center, and Pennsylvania State University for the benefit of undergraduate, medical, and graduate students as well as our colleagues and ourselves.
- to ensure that both the Neurosurgery Department's goals and its individuals' needs are met in a working environment that is collegial, collaborative, facilitative, fair and personally rewarding.

NEUROSURGERY FACULTY

The department provides comprehensive neurosurgical expertise from our full-time clinical and research faculty with resident teaching responsibilities. Each has special expertise in particular areas as indicated below:

Robert Harbaugh, MD, FACS, FAHA
University Distinguished Professor
Neurosurgery and Engineering Science & Mechanics Neural Engineering Research
Chairman, Department of Neurosurgery
Vascular Neurosurgery
Neuro-Oncology

Akash Agarwal, MD
Associate Professor of Neurosurgery at Wyoming Valley
Vascular & Endovascular

Kevin Cockroft, MD, MSc, FACS, FAHA
Associate Professor of Neurosurgery
Director, Cerebrovascular & Endovascular Neurosurgery
Co-Director, Stroke Center
Vascular Neurosurgery
Endovascular Neurosurgery
Stereotactic Radiosurgery

James Connor, PhD
University Distinguished Professor of Neurosurgery and Neural & Behavioral Science
Vice Chair, Research
Neuroscience Research

Update: May 1, 2013
Carlo de Luna, MD  
Associate Professor of Neurosurgery at Wyoming Valley  
Spine Surgery

Mark S. Dias, MD, FAANS, FAAP  
Professor of Neurosurgery & Pediatrics  
Vice Chair, Clinical Neurosurgery  
Director, Pediatric Neurosurgery  
Pediatric Neurosurgery

James R. Fick, MD  
Associate Professor of Neurosurgery at University Park  
General Neurosurgery & Neuro-Oncology

Michael Glantz, MD  
Professor, Department of Neurosurgery, Medicine, Neurology  
Co-Director, Neuro-Oncology Program  
Neuro-Oncology

Bruce Gluckman, PhD  
Associate Professor of Engineering  
Science & Mechanics and Neurosurgery  
Neural Engineering Research

Kimberly Harbaugh, MD  
Associate Professor, Neurosurgery and Neural & Behavioral Science  
Chief, Division of Peripheral Nerve Surgery  
Peripheral Nerve Surgery  
Neuroanatomy

Philip Hlavac, MD  
Assistant Professor Penn State Neurosurgery at Wyoming Valley  
General Neurosurgery

Mark Iantosca, MD  
Associate Professor, Neurosurgery  
Medical Director, Neurosurgery Clinics  
Pediatric Neurosurgery  
Neuroendoscopy

Uhnoh Kim, PhD  
Neuroscience Research

Sang Lee, PhD  
Assistant Professor, Neurosurgery  
Neuroscience Research

A.B. Madhankumar, PhD  
Assistant Professor, Neurosurgery  
Neuroscience Research

James McInerney, MD  
Associate Professor, Neurosurgery  
Stereotactic & Functional Neurosurgery  
Deep Brain Stimulation  
Epilepsy Surgery  
Stereotactic Radiosurgery

Mark Meadowcroft, PhD  
Neuroscience Research  
Assistant Professor of Neurosurgery at University Park

Paul Nelson, MD  
Professor of Neurosurgery at University Park  
General Neurosurgery

Stephanie Patton, PhD  
Assistant Professor, Neurosurgery  
Neuroscience Research

G. Timothy Reiter, MD  
Associate Professor, Neurosurgery  
Spine Surgery  
Kyphoplasty

Michael Sather, MD  
Assistant Professor, Neurosurgery  
Director, Epilepsy Surgery  
Epilepsy Surgery  
Spine Surgery

Steven Schiff, MD, PhD, FACS  
Professor of Neurosurgery and Engineering Science & Mechanics  
Director, Center for Neural Engineering  
Pediatric Neurosurgery  
Pediatric Neurosurgery  
Neural Engineering Research

Update: May 1, 2013
Jonas Sheehan, MD, FAANS, FACS
Associate Professor, Neurosurgery
Residency Program Director
Co-Director, Neuro-Oncology Program
Neuro-oncology, Skull Base Surgery
Stereotactic Radiosurgery, Spine Surgery

Nancy Villanueva, PhD, CRNP, CNRN, BC
Associate Professor, Neurosurgery
Director, Neuroscience Nursing
Neurosurgical Quality Improvement

Philip Villanueva, MD
Professor, Neurosurgery
Co-Director, Neuroscience ICU
Neurotrauma

J. Christopher Zacko, MD, MS
Assistant Professor of Neurosurgery
Co-Director, Neuroscience ICU
Neurocritical Care
Neurotrauma

Secondary Faculty Appointments

Jennifer Baccon, MD
Department of Neuropathology

Patrick Drew, PhD

Elana Farace, PhD
Associate Professor, Neurosurgery and Neuroscience Research
Public Health Science
Director of Clinical Research
Clinical Neuropsychology

Xuemei Huang, MD
Department of Neurology

Paul Kalapos, MD, FRCP(C)
Associate Professor, Radiology and Neurosurgery
Interventional Neuroradiology
Neuroradiology

Donald Mackay, MD
Department of Plastic and Reconstructive Surgery

Daniel Nguyen, MD
Associate Professor, Radiology and Neurosurgery
Interventional Neuroradiology
Neuroradiology

Thomas Samson, MD
Department of Plastic and Reconstructive Surgery

Elizabeth Sinz, MD
Professor of Anesthesiology and Neurosurgery
Neuroanesthesia
Neurocritical Care

Semon Slobounov, PhD

Charles Specht, MD
Department of Neuropathology

John Stene, MD, PhD
Professor, Anesthesiology and Neurosurgery
Neuroanesthesia
Neurocritical Care

Qing Yang, PhD
Professor of Radiology and Neurosurgery
Neuroscience Research
OVERVIEW

The Department of Neurosurgery participates in the National Residency Matching Program, (NRMP) and Electronic Residency Application Service ERAS. Currently the program accepts two residents each year. The total length of training currently encompasses seven years.

The clinical program is organized around four distinct services within the parent institution on the Penn State Hershey campus: three adult services; the Red Service (with an emphasis on cerebrovascular, endovascular, skull base and neuro-oncology and peripheral nerve surgery), the Blue Service (with an emphasis on spine, pain management, stereotactic and functional neurosurgery), the White Service (neurotrauma and neurocritical care) and the Pediatric Service. Structured rotations on each of these services provide both an exposure to a breadth of neurosurgical disease while at the same time emphasizing the clinical caseload and expertise of the individual faculty members on each service.

An extensive and comprehensive educational conference schedule on Tuesday, Thursday and Friday expose residents to all disciplines of basic and clinical neuroscience. The various neurosurgery and interdisciplinary conferences for neurosurgery residents are discussed below. Although structured, the Penn State Neurosurgery program is flexible enough to accommodate each trainee's individual educational needs and interests. Residents are advanced to higher levels of responsibility based upon performance evaluations. Elective rotations are determined on an individual basis and are based upon the resident's interests and the recommendations of the faculty. Elective time may be spent at Penn State Hershey or another institution engaged in basic, translational or clinical research or studying a subspecialty of neurosurgery as an enfolded fellowship.

The fundamental goals of the program are to provide residents the opportunity to:

- develop an ethic of self-assessment and quality improvement based on meaningful outcomes assessment and the core competencies of neurosurgical practice.
- develop a thorough, in-depth knowledge of clinical neurosurgery.
- develop excellence in clinical judgment.
- develop excellence in the operative techniques of neurosurgery, including adult and pediatric neurosurgery, stereotactic radiosurgery and endovascular neurosurgery
- obtain a practical working knowledge of neuroradiology, neuropathology and neurology.
- obtain a fundamental knowledge of basic neurosciences including: neuroanatomy, neurophysiology, neurochemistry, neuropharmacology, embryology and neurosciences.
- pass the examinations of the American Board of Neurological Surgery.
• develop an interest in and understanding of fundamental research techniques including statistical analysis and clinical trial design that will allow accurate evaluation of the neurosurgical literature.

• develop an interest in and skills for effective teaching.

• make a contribution to academic and clinical neurosurgery through publications and presentations.

Specifically, the program requires that trainees develop:

• an ability to deliver high quality, patient centered, cost effective neurosurgical care.

• a mastery of the principles of neurosurgery.

• the expertise to obtain detailed and accurate neurological histories.

• the skills to conduct a thorough and accurate neurological examination.

• the ability to formulate a differential diagnosis based on critical evaluation of symptoms and signs.

• the acumen to order appropriate and properly utilized radiographic imaging studies and other laboratory tests to refine the clinical diagnosis.

• the ability to formulate a medical and surgical management program that includes not only specific neurosurgical care but attends holistically to the general medical care of the patient including nutritional support, cardiopulmonary support, fluid management, the appropriate use of neuropharmacology and functional rehabilitation.

• an in-depth understanding of the critical care of patients with neurological disorders.

• the necessary technical skills to safely perform a wide variety of neurosurgical procedures.

• an understanding of the fundamentals of neuroanesthesia.

• a familiarity with basic neuroscience and diseases of the central and peripheral nervous system, including: pathology and pathophysiological mechanisms of neurological disease; neuroendocrinology; metabolism and pharmacology of the brain, spinal cord, peripheral nerve and muscle; and developmental embryology of the brain and spinal cord.

• a thorough understanding of the techniques and interpretation of ancillary aids to the diagnosis of neurological diseases, including current neuroimaging modalities and neuromonitoring techniques.

• effective working relationships with other physician colleagues in medicine and surgery, as well as other health care professionals.
• a keen sense of responsibility and compassion towards all patients and their families that includes counseling and education.

• an understanding of current ethical, socioeconomic and medico legal issues and their implications for the practice of neurosurgery.

• the ability to investigate and evaluate care practices through assimilation of scientific evidence.

• the ability to apply knowledge of study design and statistics to the critical analysis of clinical studies

• the ability to demonstrate an awareness of the larger context of health care and the ability to call upon system resources efficiently.

INSTITUTION

Penn State Hershey is the hub for most of the clinical and academic activities of the neurosurgery residency program. The institution houses the Department of Neurosurgery and has directed the neurosurgical residency program since its inception. The department’s clinical and academic offices are located at 30 Hope Drive on the Penn State Hershey campus. Research offices are located at the Support Services Building and Biomedical Research Building on the Penn State Hershey campus and in the Millennium Science Complex on the Penn State University Park campus. The Penn State Hershey Medical Center is a 491 bed full-service acute care hospital with 7 floors of inpatient and outpatient care activities. All adult clinical services are represented. For adult neurosurgery patients, the institution has a 16 bed Neuroscience ICU, an adjacent 15 bed Neuroscience Intermediate Care Unit and an adjacent 20 bed Neuroscience Acute Care Unit on the fourth floor of the hospital.

The Penn State Children’s Hospital is a pediatric facility physically housed on the 7th floor of the medical center. The Children’s Hospital contains a 12 bed Pediatric Intensive Care Unit, a 31 bed Neonatal Intensive Care Unit, a 16 bed Pediatric Intermediate Care Unit, and 35 bed general pediatric ward beds. Plans are underway for construction of a separate 5 story Children’s Hospital on the Medical Center campus which is scheduled to open in 2012. All pediatric care is rendered in the Children’s Hospital.

The medical center currently contains 21 fully equipped operating rooms in the main operating room facility, three of which are dedicated for neurosurgical use 4 days per week. State-of-the-art neurosurgical operating room equipment is available including operating microscopes, ultrasonic aspirators, neuronavigational tools, neuroendoscopy, and intra-operative ultrasound and angiography. The IMRIS System for intraoperative MRI is available at the Penn State Neurosurgery at Wyoming Valley facility in Wilkes-Barre, Pennsylvania. Appropriate cases for intraoperative MRI are done by Penn State Neurosurgery faculty members at this facility with resident involvement.

Our neuroendovascular suites at the Penn State Hershey and Penn State Neurosurgery at Wyoming Valley are equipped with biplane angiography for neuroendovascular procedures. Three Penn State Neurosurgery faculty members perform neuroendovascular procedures. Neurosurgery residents

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cover the neuroendovascular suite and neuroendovascular cases just as they do the neurosurgical operating rooms and open neurosurgical cases.

The Radiosurgery Center at Penn State Hershey houses both an Elekta Perfexion Gamma Knife and a Varian Trilogy System for intracranial and extracranial radiosurgery. Five Penn State Neurosurgery faculty members perform radiosurgical procedures. Neurosurgery residents cover the radiosurgical suite and radiosurgical cases just as they do the neurosurgical operating rooms and open neurosurgical cases.

Out-patient operating rooms are also available in the Hershey Outpatient Surgery Center (HOSC) located on the East Health Campus. Smaller outpatient neurosurgical procedures are performed at HOSC and are covered by the neurosurgical residents.

Neurosurgery residents operate under the direct supervision of a faculty neurosurgeon at all times. The majority of neurosurgical procedures at Penn State Hershey are performed with neurosurgical resident involvement; however elective case starting after 5:00 PM or conflicting with scheduled conference time may not have resident participation. Neuroradiology services include multiple CT, MRI and PET scanners staffed by full-time neuroradiologists. Angiography and endovascular services are provided jointly by the Radiology and Neurosurgery services. Neuropathology services are provided in the Department of Pathology by dedicated neuropathologists.

Neurosurgery outpatients are seen in the Neurosurgery Clinic at Penn State Hershey, in the Penn State Neurosurgery at Wyoming Valley Clinic in Wilkes-Barre, PA and at the Nyes Road Clinic in Harrisburg, PA. Neurosurgery residents are required to see clinic patients only at the Penn State Hershey clinic but elective rotations at the Wyoming Valley site can be chosen. Neurosurgery residents see approximately 25% of the outpatients with faculty neurosurgeons, including new patient evaluations and patient follow up evaluations.

The Penn State University College of Medicine is the teaching institution that oversees resident and medical student teaching as well as research. All Neurosurgery Department faculty hold tenured or clinical positions in the College of Medicine. Neurosurgery Department research grants are administered through the College of Medicine. Other services (such as medical photography and graphical arts services, office of research affairs, and the Harrison Library) are housed within the College of Medicine.

Update: May 1, 2013
## ROTATIONS AND SCHEDULES

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### Detailed Rotations Academic Year 2012-2013

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**Key for Block Rotational Diagram**

- **W** = White Service - Neuro Trauma, Neuro-critical care - Villanueva & Zacker
- **B** = Blue Service - Spine, Pain Management, Epilepsy, Stereotactic & Functional - Reiter, Sather, Mcinerney
- **P** = Pediatric Service - Pediatric Neurosurgery - Dias & Iantosco
- **E** = Elective Service - Clinical electives may be on the Red, White, Blue or Pediatric services at Penn State Hershey or Penn State Neurosurgery at Wyoming Valley. Assignment of service will be based on clinical needs of the resident as determined by the resident, his or her faculty advisor and the Program Director. This two month period may also be used for very well defined research projects or manuscript preparation with the
- **D** = Other Disciplines - Neuroanatomy, Neuroradiology[RAD-NEUROIMAGE-HMC], Neuropathology [PATH-NEUROPATH-HMC]

Residents on the Red, White, Blue, Pediatric, Elective and Other Disciplines rotations will continue to take neurosurgery night call during these rotations. If conferences of the other disciplines conflict with the neurosurgery conference schedule, the resident should attend the other disciplines' conferences while assigned to that service.

**ROTATION NAMES**

- Neuroradiology (RAD-NEUROIMAGE-HMC)
- Neuropathology (PATH-NEUROPATH-HMC)
- ENT (NEUROSURG - OFF SERV - OTOLARYNGOLOGY)
- TRACS (SURG TRAUMA/ACUTE CARE SURGERY [TRACS])
- Peds Surg (SURG-PEDS SURG-HMC)
**Key For Block Rotational Diagram**

| Red Service | Endovascular, Peripheral Nerve, Skull Base, Tumor, Vascular |
| White Service | Neurotrauma, Neuro-Critical Care |
| Blue Service | Spine, Pain Management, Stereotactic & Functional |
| Pediatric Service | Pediatric Neurosurgery |
| Elective Service | Clinical electives may be on the Red, White, Blue or Pediatric services at Penn State Hershey or Penn State Neurosurgery at Wyoming Valley. Assignment of service will be based on clinical needs of the resident as determined by the resident, his or her faculty advisor and the Program Director. This two month period may also be used for well defined research projects or manuscript preparation with the approval of the Program Director. |

**Other Disciplines**

- Neuroanatomy, Neuroradiology, Neuropathology

Residents on the Red, White, Blue, Pediatric, Elective and Other Disciplines rotations will continue to take neurosurgery night call during these rotations. If conferences of the other disciplines conflict with the neurosurgery conference schedule, the resident should attend the other disciplines’ conferences while assigned to that service.

**Senior Resident 1**

- May be done at Penn State Neurosurgery Wyoming Valley or at Penn State Hershey. If both Senior Residents stay at Penn State Hershey the Senior Resident 1 will cover the Red and White Services.
- Various faculty members

**Senior Resident 2**

- Must be done at Penn State Hershey. If both Senior Residents stay at Penn State Hershey for this rotation the Senior Resident 2 will cover the Blue and Pediatric Services.
- Various faculty members

**Independent study**

- Basic, translational or clinical research or an enfolded fellowship year - Must be approved by the Program Director and appropriate faculty members - No first call responsibilities under usual circumstances.
- Various faculty members

**Chief Resident 1**

- Will manage the Red and White services from July 1– December 31 and the Blue and Pediatric Services from January 1-June 31.
- All faculty members

**Chief Resident 2**

- Will manage the Blue and Pediatric service from July 1-December 31 and the Red and White Services from January 1-June 31. The C2 chief resident will be in charge of the conference schedule and call schedule.
- All faculty members
Program Narrative

The first year of the program consists of a required three-month rotation in neurology training in the Department of Neurology under the guidance of Dr. David Good, Chairman of Neurology exposing the residents to management of general neurological medical conditions with an inpatient month specifically focused on stroke and ischemic disease. In addition, the first year residents rotate on the pediatric surgery service, the trauma service, and a general surgery service to develop skills in general inpatient management, gain an understanding of the function and daily operations of those services, and to acquire skills in those specific areas that are pertinent to neurosurgical practice. The remaining six months of the year are spent on the neurosurgical service with 1-2 months dedicated to the Neuro ICU team.

Following the PGY1 year, neurosurgery junior residents are assigned to each of four clinical services (Red, White, Blue and Pediatric Services) for two-month rotations during each of the first three years of the residency. The Red Service has an emphasis on cerebrovascular, endovascular, peripheral nerve, skull base and tumor surgery. The White Service focuses on neurotrauma and neurocritical care. The Blue Service has an emphasis on spine care, pain management, stereotactic and functional neurosurgery. The Pediatric Service exposes the resident to the full array of neurosurgical care of pediatric patients. The residents also have a two-month clinical elective during each of the first three years of the residency program. This clinical elective time may be spent on any of the clinical neurosurgery services at PSUHMC. The elective rotations are designed to allow additional exposure to a particular area of interest to the resident or an area in which the faculty would like the resident to have additional exposure. A well thought out and highly focused research or education project or elective rotation on the Penn State Neurosurgery service at Wyoming Valley may also be done during this time with the approval of the program director. During each of these three years, there is also a two-month rotation on either neuroanatomy, neuroradiology or neuropathology.

The fifth year of the program is the Senior Resident year. This year is divided into two six-month blocks, at least one of which must be spent at the Penn State Hershey Medical Center. If both Senior Residents stay at Penn State Hershey the Senior Resident 1 will cover the Red and White Services and the Senior Resident 2 will cover the Blue and Pediatric Services. Senior residents are assigned by the chief residents to work in the operating room, neuroendovascular suite, radiosurgical suite, outpatient surgical center and clinics based on the needs of the services and the particular interests of the senior resident. With the approval of the program director, the Senior Resident may elect to spend up to six months working under the supervision of Drs. Hlavac and de Luna in the Penn State Neurosurgery facilities at Wyoming Valley. While there, they will see patients in the outpatient clinics, in the operating room, in the neuroendovascular suite and in the radiosurgery suite. If the Senior Resident 1 is at Wyoming Valley, the Senior Resident 2 will be available for all clinical services at Penn State Hershey.

The sixth year of the residency is devoted to independent study. The resident must submit a proposal to the program director outlining the objectives and course of study to be pursued. The resident can gain additional experience in a clinical neurosurgery subspecialty area at Penn State through an enfolded fellowship, pursue a clinical elective at another institution or participate in research with a faculty member in another department at the Penn State College of Medicine or at another institution during this year. All requests for elective study outside the Penn State Department of Neurosurgery must be approved by the program director, the department chair, and the American Board of Neurological Surgery. Proposed elective rotations at another institution

Update: May 1, 2013
should provide an educational experience that cannot be obtained at Penn State. The sixth year resident is not on call for the service under ordinary circumstances but may take specialty call for a particular area during an enfolded fellowship. By the end of the 6th year, each resident is expected to pass for credit the primary examination of the American Board of Neurological Surgery. A passing score on the primary examination is required prior to beginning the chief resident year.

The seventh year resident is the Chief Resident and assumes not only the highest clinical, operative, radiosurgical and endovascular duties but also assumes significant administrative duties. Administrative duties include the day-to-day operations of the neurosurgical clinical services, supervision of the junior and senior neurosurgery residents and assignment of residents to the operating rooms, radiosurgical procedures, and endovascular procedures. With the approval of the program director, the chief resident assigns the junior residents to clinics, call, and vacation/meeting schedules, and co-ordinates the academic conferences. Each chief resident will manage the Red and White services for six months and the Blue and Pediatric Services for six months. The chief resident managing the blue and pediatric services will be in charge of the conference schedule.

**Progressive Responsibility**

The first year resident responsibilities are specific to the service to which he/she is assigned. While on the neurosurgical service, the residents’ responsibilities include participation in all aspects of neurosurgical care in support of the more senior residents. The first year residents are expected to participate actively in admission and discharge planning, management of intermediate care and floor patients, and gain a level of facility in basic neurosurgical procedures such as lumbar punctures and ventricular drain placement.

The second year resident spends a majority of his or her time in the operating room, in the clinic, on the wards and in the Neuroscience ICU honing his or her clinical skills in evaluating and managing the medical and perioperative issues of the neurosurgical patient. The resident evaluates patients preoperatively and assists in pre- and post-operative care. He or she should be involved in a significant number of procedures participating in various aspects of surgical cases commensurate with his or her ability. During the Red Service rotation the resident works in the neuroangiography suite as well as the operating room. He or she will assist and perform angiograms and endovascular procedures. The resident is also expected to participate in radiosurgical procedures. The primary focus is on knowledge of positioning, general neurosurgical techniques, handling of surgical, radiosurgical and endovascular instruments, and opening and closing wounds. During the off-service Neuroanatomy rotation, residents perform anatomical dissections, including standard neurosurgical approaches for cranial, spinal and peripheral nerve procedures in the Anatomy Laboratory under the direction of Dr. Kimberly Harbaugh. The general goals of this rotation are to improve the resident’s knowledge base in neuroanatomy and surgical anatomy for application in neurological localization and neurosurgical procedures.

During the third year, the resident becomes increasingly responsible for patient management and assumes increasing responsibility in the operating rooms, radiosurgical suite, and neuroangiography suite. The resident is involved with more complex operations and spends time participating in increasingly difficult dissections and complex procedures. Neuroradiology teaching occurs in numerous clinical conferences regularly throughout the course of the residency program. Neurosurgery residents also participate in angiographic studies throughout the residency when they are assigned to the cerebrovascular/endovascular service. Interpretation of neuroradiological studies is also taught by the neurosurgical faculty by clinical teaching and performance feedback.
throughout the residency program. In addition to this training in Neuroradiology, during the third year of the Neurosurgery residency, residents take a two month off service rotation on the neuroradiology service. During this time they function as radiology residents reviewing radiographic studies with the neuroradiology faculty. This rotation is under the supervision of the neuroradiology faculty and the Neurosurgery Program Director. The goals of this rotation are to improve the skills of the neurosurgery resident in the interpretation of various neuroradiological studies, to refine the neurosurgery resident’s ability to choose appropriate neuroradiological diagnostic studies in a cost-effective fashion and to develop an appreciation of clinical-neuroradiological correlation. Residents are also encouraged to read standard texts in neuroradiology.

The fourth year neurosurgery resident assumes more advanced clinical neurosurgery responsibilities with 6 months on the adult services (2 months each on the Red, White and Blue services) and an additional 2 months on the pediatric neurosurgery service. The resident also has another 2 month elective studying neuropathology. The emphasis during the fourth year is the mastery of microsurgical, radiosurgical, and endovascular techniques pertinent to neurosurgery, and further intra-operative experience with graduated responsibilities. The resident is expected to direct his or her efforts to mastering the senior level Core Curriculum and Core Competencies at this stage. The neuropathology rotation is supervised by the faculty of the Department of Clinical Pathology. During this rotation the resident attends neuropathology and brain cutting conferences and assists the neuropathologists in the clinical laboratory. The resident is also exposed to autopsy and brain dissections. This rotation is designed to expose the junior resident to the basics of neuropathology. Residents are expected to actively participate in the Neuropathology and other teaching conferences during this rotation.

The fifth year of the program is the senior resident year. The senior residents are assigned to cover the Red/White services together, and the Blue/Pediatric services together. Senior residents are assigned by the chief resident to more challenging cases in the operating room, neuroendovascular suite, and radiosurgical suite, and assume a greater degree of involvement in these cases. With the approval of the program director, the senior resident may elect to spend six months working under the supervision of Drs. Hlavac and de Luna in the Penn State Neurosurgery facilities at Wyoming Valley. While there, they will see patients in the outpatient clinics, in the operating room, and in the radiosurgery suite.

The independent study rotations in the sixth year are designed to accommodate the individual needs of each resident. The resident must submit a proposal to the program director outlining the objectives and course of study to be pursued during this rotation. He or she must pass the ABNS primary examination for credit by the end of this year, prior to starting the chief resident year.

The seventh year resident assumes not only the highest clinical, operative, radiosurgical, and endovascular responsibilities but also assumes significant administrative duties. Administrative duties include the day-to-day operation of the neurosurgical services, supervision of the junior and senior neurosurgery residents and allocation of residents to operating rooms, radiosurgical procedures and endovascular procedures. With the approval of the program director, the chief resident assigns the junior residents to clinics, call, and vacation/meeting schedules, and coordinates the academic conferences. He or she is expected to demonstrate competence to safely practice independently by the end of the chief resident year.
**Supervisory Lines of Authority**

The neurosurgery junior residents are assigned to specific clinical services (Red, White, Blue and Pediatric Services). They are under the supervision of the neurosurgery Senior and Chief Residents and the staff neurosurgeons who are assigned to the specific service. In those instances in which the Chief Resident may not be directly or immediately involved, the junior resident is directly supervised by the staff neurosurgeon.

The Chief Resident is under the supervision of the staff neurosurgeon assigned to the patient involved.

There is no time that no faculty member is available for supervision of the residents. There is at all times a responsible faculty member.

In addition, the junior residents, senior residents and the Chief Residents are supervised by the Program Director, who together with the neurosurgical faculty is responsible for the neurosurgery service and the training program.

**DEPARTMENTAL AND UNIVERSITY CONFERENCES**

The conference schedule is included in the attachments. A variety of conferences are available to maximize the residents’ exposure to all facets of neurosurgical care and the neurosciences basic to the discipline of neurosurgical practice and to assure instruction based on the core competencies residents must learn to practice independently.

**DEPARTMENTAL ADMINISTRATION**

The Chairman of the Department of Neurosurgery and Program Director are ultimately responsible for assuring that the training program is in compliance with the Special Requirements for Residency Training in Neurological Surgery and the General Requirements of the Essentials of Accredited Residencies.

**Responsibilities of the Program Director**

- Establishes written educational goals and objectives of the residency training program.
- Designs the residency training program to meet the stated goals and objectives.
- Regularly evaluates the residency training program to assess its ability to achieve stated goals and objectives.
- Develops and maintains a written plan of rotation and approves educational conference/activity schedules.
- Monitors resident schedules to assure appropriate mix of patient care and educational activities and to avoid undue stress and fatigue among residents.
- Monitors residents’ emotional well-being and recommends counseling services as required.
• Establishes written policies and procedures for resident selection and monitors the selection process.

• Assures that residents are adequately supervised by the teaching staff to facilitate resident education and to promote quality patient care.

• Develops criteria for evaluating resident performance and monitors the evaluation process. The director meets with each resident at least semiannually to review performance. Recommends and oversees remedial training as necessary.

• Implements procedures for discipline and the adjudication of complaints and grievances as per departmental policies.

• Complies and maintains statistical and narrative descriptions of the program.

• At least annually, convenes a meeting of the Neurosurgery Curriculum Committee, which is composed of neurosurgical faculty and a resident representative, to review the program's success at meeting stated program goals and the effectiveness of the overall program.

• Notifies the Executive Secretary of the Residency Review Committee in writing of any major changes to the residency training program.

• Complies with local, state and federal regulations governing resident and medical student education.

Responsibilities of Attending Faculty

As members of the University faculty, attending physicians are responsible for supervising the educational and clinical activities of the residents in the inpatient wards, the outpatient clinics, and the operating room and for ensuring that such supervision is documented in the patient's medical record. Attending physicians are expected to work closely with the resident assigned to their service for the period specified. Duties include: rounding daily with the resident; supervising the resident's care on the wards, in the operating room, and in the outpatient clinics; teaching the residents in a didactic manner; and evaluating each resident's performance at the completion of each rotation.

Attending faculty should notify the Program Director of observed deficiencies in a resident's performance as soon as possible so that a plan of remedial training may be designed and implemented. Faculty members are also required to attend educational and departmental conferences unless emergency duties prohibit their participation. All faculty are expected to pursue clinical and/or basic neuroscience research endeavors, to publish scholarly peer reviewed research accomplishments, to present at national and/or international meetings, and to provide service to organized Neurosurgery and other professional organizations.

Resident Selection Process

The Department of Neurosurgery participates in the NRMP/ERAS. Two resident matches each year in the training program. All applicants must register with the NRMP and with ERAS in order for their applications will be considered for a first-year program opening.

Update: May 1, 2013
Applicants to the residency training program in neurosurgery are evaluated on a number of criteria. Heavy emphasis is placed on the applicant's cognitive abilities, clinical skills, knowledge and record of achievement. The applicant's ability to adapt to the program, to work as a team member with the faculty, resident colleagues, and nursing and support staff and to develop effective patient/physician relationships are equally important criteria. The following process has been designed to facilitate the search for the 'right match'.

Each application is screened by the Department Chair and Program Director on the basis of the following criteria:

- Quality of undergraduate education.
- Medical school grades, achievements and honors.
- National Board of Medical Examiners scores.
- Research experience.
- Quality of the personal statement, which should indicate effective written communication skills as well as a commitment to a career in neurosurgery.
- Letters of recommendation, which should indicate the applicant's ability to sustain the rigorous training program and to interact effectively with others.

Based on this review applicants are either rejected from further consideration or invited to pursue their application with a personal interview.

Interviews are scheduled for a full day, and applicants are offered several dates from which to choose. Faculty members are provided with complete copies of the applicants' files so that they may review them before the interview date.

During the course of the day, applicants attend, tour the department's facilities, meet and have lunch with the residents, and interview with the faculty. Faculty and resident evaluations are summarized and an initial ranking list is compiled.

After all qualified applicants have been interviewed and the initial ranking list is compiled, faculty members meet to discuss the final ranking list. The final ranking is submitted through the NRMP.

Should an opening occur during the academic year, the Program Director will notify the Neurological Surgery Matching Program Vacancy Hot Line and applications will be accepted from qualified candidates. Each faculty member is provided with copies of the applicants' files and is given the opportunity to interview the applicants. The Program Director solicits the recommendations of the faculty before selecting a candidate and making the offer.

**Resident Evaluation Process – Add milestones and CCC committee**

All residents in their fourth, fifth, and sixth years are required to take the written examination of the American Board of Neurological Surgery, and each resident must pass the examination for credit by the end of the PGY-6 year of training. Residents are expected to pass the exam with a score in the 60th percentile or higher. If a resident passes the exam with a lesser score, he/she may be required to take the exam again. A passing score on the primary examination is a requirement prior to beginning the chief resident year. Failure to obtain a passing score in the written primary
examination prior to the end of the PGY6 year may result in dismissal from the program. The Department of Neurosurgery will assume testing costs for all residents taking the examination.

Residents are evaluated at each monthly faculty meeting and evaluated after each rotation and biannually according to the following criteria: clinical judgment; medical knowledge; clinical skills, including history taking, physical examination and procedural skills; technical skills; humanistic qualities; professional attitudes and behavior; medical care; commitment to scholarship, practice based learning, an understanding of systems based practice; and overall clinical competence. Semi-annually each resident meets with the Program Director to discuss his/her evaluations and educational and career objectives. Advancement to the next year of training is dependent upon satisfactory progress as determined by the evaluations.

Should the evaluations identify deficiencies, the Program Director and resident will develop a course of remediation for the resident. During the period of remediation, the resident will be evaluated on a monthly basis. Again, satisfactory progress must be demonstrated before the resident can advance to the next level of training.

If performance has not improved within six months, the Program Director will call a vote of the full-time faculty to determine the resident's status. The resident may be placed on an additional probationary period, dismissed from the program, or taken off of remediation/probation and returned to normal status. Under no circumstance will the probationary period exceed twelve months during the course of the resident's training. (In case of a tie in voting, the Program Director will cast the deciding vote on all disciplinary actions.)

Consistent with University and Medical Center policies and procedures, residents may be terminated immediately from the program if found guilty of gross infraction of department, hospital or University policies and procedures.

Faculty and Program Evaluation Process

Residents also evaluate the faculty and their educational experience on a semi-annual basis. The evaluation process is strictly confidential, and all residents are encouraged to complete an evaluation in order to provide the Chair information on the effectiveness of the program and faculty as perceived by the residents. The results of the evaluations are summarized and distributed to each faculty member. Identified program deficiencies are discussed at regular meetings of the Neurosurgery Curriculum Committee.

RESIDENT RESPONSIBILITIES

The neurosurgery residents will be expected to perform in an exemplary fashion and exhibit the highest ethical standards and work habits. Each resident should carefully review the enclosed document “Rules We Live By “; these rules form the guiding principles of the department and should be adhered to throughout the resident's training. In addition, residents are encouraged to read the Graduate Medical Education Handbook, published by the Penn State University College of Medicine and available in the Department Office.
Resident General Responsibilities

- Providing safe, effective and compassionate patient care, commensurate with level of advancement, under attending supervision.

- Providing patient care in accordance with the provisions and standards set by the Department of Neurosurgery and the Penn State Hershey Medical Center.

- Arriving to assigned duties promptly; notifying the Chief Resident as soon as possible if unable to report as scheduled (this includes hospital duties as well as on-call duties).

- Maintaining medical records to ensure that they accurately document the quality of care delivered to the patient.

- Completing medical records in compliance with standards of the JCAHO, federal and state standards and the requirements of the affiliated hospitals.

- Participating in mandatory residency clinics by examining patients and formulating treatment plans in consultation with attending faculty.

- Performing a complete history and physical examination on all patients admitted to the neurosurgery service prior to morning rounds. The record must indicate that a physician saw the patient, the physician tried to obtain information from the patient and that the information so solicited permitted the formulation of an opinion concerning the state of the patient's health and the urgency of initiating treatment. The resident must provide complete documentation describing the care rendered.

- Examining patients referred for consultation by the emergency department or other medical services as soon as possible after the referral is made. Documenting the findings on the appropriate consultation forms and, in consultation with the attending physician, formulating a management plan.

- Writing accurate and up-to-date progress notes on patients for whom the resident is responsible at time intervals warranted by the patient's condition. The content of the progress notes must reflect the illness and document the dynamics of the disease process.

- Examining each patient before assuming an operative role. For each case, the resident must be familiar with the rationale for surgery, surgical alternatives and limitations and risks of the surgery and must have the technical skills required for successful completion of the case.

- Dictating operative and procedure reports and ensuring that copies of the reports are forwarded to the attending of record in a timely fashion.

- When required, preparing accurate discharge summaries and completing the medical record face sheet on all patients for whom the resident is responsible. This discharge summary must contain the name and hospital number, the date of admission, the chief complaints on admission, a condensed history of past and present medical illness, the important positive physical and neurological findings on admission, a brief summary of important tests and procedures, the course of the disease condition during hospitalization, the treatment given, the final diagnosis, the condition on discharge and the prognosis for the future. The discharge summary should be dictated on the day the patient is discharged.

Update: May 1, 2013
• Ensuring that all progress notes, operative reports and discharge summaries are reviewed and signed by the attending physician.

• Pronouncing a patient dead when necessary; making appropriate entry as to time of death and final diagnosis; notifying the attending physician; determining whether the patient's death comes under the purview of the medical examiner; and taking appropriate action.

• Notifying the Program Director of any case which falls under Pennsylvania State law as a reportable condition and for reporting all such cases to the appropriate agency when requested to do so by the Program Director.

• Reporting to the Pennsylvania State Department of Health the name, address and other data as may be required of any person under treatment who is a habitual user of narcotic drugs (this is confidential information and is used for statistical, epidemiological and research purposes.)

• Developing a personal program of self-study and professional growth with guidance from the teaching staff.

• Participating in the education of junior residents and medical students.

• Participating in institutional programs and activities involving the medical staff and adhering to established practices, policies and procedures of the Medical Center and the Penn State University College of Medicine.

• Participating in institutional committees and councils, especially those that relate to patient care review activities.

• Following all departmental, hospital and University policies and procedures to ensure that the program is in compliance with ACGME Essentials and Special Requirements of the Resident Review Committee in Neurological Surgery.

• Responding to all pages as quickly as possible.

• Maintaining a neat, safe and orderly work area.

Chief Resident Responsibilities

In addition to these responsibilities, the Chief Resident oversees the clinical neurosurgical service and coordinates resident clinical and academic scheduling. It is recognized that much of daily resident learning comes from the chief and senior residents in a hierarchical fashion.

In particular, the Chief Resident’s responsibilities include:

• Working with junior residents from the Departments of Neurosurgery and Surgery, nursing, and paramedical staff to ensure optimal patient management at all clinical sites.
• Making morning rounds with junior residents and nursing staff prior to making rounds with attending staff. Attends and supervises sign-out rounds at 5 PM each weekday or provides a designee.

• Coordinating resident schedules, including night call, weekend coverage, vacation, seminars and leave with the approval of the Program Director. Delivers schedules to the academic administration office in accordance with the scheduled deadlines of the Department of Medical Education.

• Ensure continuity of care at the institution.

• Arranging coverage for any resident who is absent from a clinical service.

• Notifying residents of any anticipated hospital suspensions before the suspensions become effective.

• Coordinating the monthly conference schedule in conjunction with the Program Director; scheduling at least one appropriate didactic presentation for each morbidity/mortality and quality assurance meeting; delivering the conference schedule to the academic administrative office by the end of the first week of the month prior to that being scheduled.

• Selecting cases to be reviewed at monthly departmental morbidity/mortality and quality assurance meetings; informing the academic administrative office of studies and documentation needed for this meeting within one week of receipt of the case list.

• Coordinating the visiting professorships and scheduling resident presentations.

• Scheduling residents to meet with training program applicants.

• Notifying academic office of any changes to the rotation schedule as they occur.

• Ensuring that sign-in sheets for all required lectures, conferences and seminars are signed by all neurosurgery attendings and residents, in accordance with RRC requirements.

• Assisting in the coordination of educational activities of medical students rotating on the neurosurgical service.

• Maintaining high academic standards and stimulating other residents to produce high-quality publications in the field of neurosurgery.

• Participating fully in the educational activities of the program and, as required, assuming responsibility for teaching and supervising other residents and students.

• In compliance with RRC regulations, each resident is required to enter all procedures into the ACGME Resident Case Log. Residents who are not current with their data entry are not entitled to meeting expense reimbursement and book fund allocations and may be barred from the operating room.

Resident Credentialing Process for Basic Neurosurgical Procedures

Each resident will be credentialed to perform specific non-surgical procedures according to the department's Resident Credentialing Plan and hospital policy. A resident must perform a procedure under

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supervision until he/she is privileged to perform the procedure independently. **RESIDENTS ARE NOT CREDENTIALED TO PERFORM SURGICAL PROCEDURES INDEPENDENTLY; ALL SURGICAL PROCEDURES MUST BE PERFORMED UNDER ATTENDING SUPERVISION.**

Residents are required to keep logs of procedures performed under supervision and to submit them to the Program Director as documentation that they have met the criteria for credentialing and are therefore eligible for privileges to perform the procedure. Please refer to the Resident Credentialing Plan for specifics regarding the credentialing process. This is housed on the New Innovations home page.

### Admission workups and consults

All patients must be seen and worked up on the calendar day of admission. All admission workups and consults must be completed prior to attending rounds. All admission work-ups must include a chief complaint, a concise but thorough history of present illness (HPI) and a pertinent PMH, ROS and PSH (see HCFA rules regarding coding requirements for obtaining histories). A physical examination including HEENT, cardiac, pulmonary, renal, GI, extremities, and a thorough neurological examination should be performed. A review of available laboratory data and radiographic tests should be included, and a summary and plan of action developed. Consults should have a CC, HPI, and a focused PMH, ROS, and PSH. The examination should be focused and include a thorough neurological examination focused on the patient’s condition. Dictated notes and consultations must be placed on the chart by the resident as soon as possible.

All ICU and ER consults must be seen ASAP. If the resident is busy, arrangements should be made with another resident or PA to see the patient.

All consults must be presented to an attending within 24 hours of being seen.

### Documentation and preparation for daily rounds

Every acute patient and perioperative patient, including those undergoing endovascular procedures, must be seen daily by a resident, and a note written. Review and abide by HCFA rules for E and M codes for each patient.

Every patient must have an admission note concisely summarizing the chief complaint and the initial plan for treatment documented within 12 hours of admission.

Preoperative/medical management notes and orders must be written, and operative consents must be obtained. Preparation for rounds includes taking a focused history and examination for each patient; reviewing vital signs; reviewing any consult notes and other progress notes by other providers (including pertinent nurses notes); directly viewing or having knowledge of all pertinent X-ray studies, CT, MRI, angio, and labwork; knowing the medication list; and having a proper plan of assessment and treatment for the day.

If a consult is called to another service, the consultant’s recommendations must be known to the house staff prior to either evening rounds (if obtained during the day) or the following morning rounds (if obtained during the night).
All medical management decisions must be complete and residents must be familiar with details of each patient’s course before rounds with the chief resident and attending. Attending rounds are not ‘work rounds’ but are management, decision and social rounds with patients/families.

Every operative patient should have a pre-operative review by the resident on the service or the resident on call for the night. Any in-patients should have a brief note including the rationale for surgery, the risks and benefits of the surgical procedure, and alternatives. The note should also review pertinent laboratory values and X-ray studies. For patients undergoing same day admissions for surgery, all appropriate lab and radiographic tests should be reviewed to make certain that there are no abnormal lab values, and films should be made available for the following day. Surgical delays secondary to incomplete studies or medical clearance are inexcusable.

Each resident is assigned to a specific service for a specified length of time. These patients are your responsibility first and foremost. However, all patients will be discussed daily with the chief resident and other residents, and each resident should be very familiar with patient care issues on all patients regardless of service, especially when covering at night or on weekends.

**Chief Resident and Attending Rounds**

Among the most important facets of residency education is the physician/patient interaction. Therefore, patient care with supervision is critical to the educational mission of the department. Prior to rounds each morning, the resident is responsible for visiting every patient on his/her service and writing daily notes and orders as appropriate. If an intern or student is on the service and co-managing the patient the resident should supervise the student/intern, discuss their management plan and approve or amend their note and/or orders as needed. All residents participate in morning ‘work rounds’ with the chief resident as a group, each resident presenting a concise and thorough accounting of their patients status including the night’s activities, the patient’s present condition, the status of various lab and radiographic results, and consultant and other allied health professional input as documented in the patient’s chart.

Each resident is responsible for communicating daily with the attendings on their service any updates and/or clinical changes in the service. Each resident will accompany his/her attendings on the service sometime during each day, at which time the patients are revisited. During these rounds, management decisions are discussed and made and teaching points are discussed as time permits consistent with the Core Curriculum and Competencies. The resident on each service is responsible for transmitting the care plan from the attending to the remainder of the team.

The residents, PAs and other physician extenders will round each morning at 0700 and each evening at 1700 PM. These are work rounds that should be succinct, brief, and comprehensive. The goal of these rounds is to review the patients, facilitate communication about patient care issues, generate a work list and establish the OR and clinic work schedule. Rounds will be conducted by either the chief or, in his/her absence, the senior resident. All on duty residents are expected to attend these rounds unless attendance would cause a work hour violation. Residents are excused from the OR for these rounds unless extraordinary circumstances absolutely require their presence in the OR.

**Chart documentation**

An extremely important facet of patient care is the proper documentation of the patient’s condition, care rendered, and outcomes of that care. To this end, residents are expected to pay meticulous
attention to documenting these events in the medical record. “If it isn’t written down, it didn’t happen.” Residents should be aware that the medical record is a legal document and anything that is written is potentially discoverable in any legal proceeding. The medical record is not a forum to air grievances, disputes, or make charges against others on the clinical team. **Residents are not to make caustic, disparaging or argumentative comments or openly criticize the management of any other hospital personnel in the chart.**

All face sheets, discharge orders, and discharge instruction sheets must be completed prior to discharge. All operative summaries must be dictated within 24 hours of the operative procedure. All discharge summaries should be dictated on the day of discharge. All death summaries should be dictated within 24 hours of death.

**All residents are responsible for maintaining current chart notes.** Residents must document all patient care activities, including phone orders, and must sign all progress notes. Residents are responsible for ensuring that all notes are reviewed and signed by the supervising attending physician (See Resident Responsibilities).

A record of delinquency will adversely affect the resident's evaluation. Further, residents who are delinquent in their chart responsibilities may not be allowed to operate until their chart work is completed. **Any resident who is on hospital suspension due to chart delinquency will not be allowed to operate.** The Chief Resident will notify residents at least one day prior to any anticipated hospital suspensions.

Residents with a history of chart delinquency or who are on hospital suspension will not be granted reimbursement for travel expenses.

**If a resident anticipates the absence will exceed one week, he/she must complete all outstanding medical records prior to leaving.**

**Patient Transfers & Chart Documentation**

When a patient is transferred to another hospital, the pertinent medical information *(admission history and physical, lab data, etc.)* should be incorporated into the receiving hospital's medical record. It is the **sending** resident's responsibility to ensure that the pertinent information is transferred with the patient, and it is the **receiving** resident's responsibility to ensure that the information is incorporated into the medical record.

**OR responsibilities**

Operating is a privilege. Our patients completely entrust their lives to us and expect that we will approach their care with the utmost preparation and focus. Residents will have graded responsibility in the OR according to their level and training, their demonstrated skills and attention to details, *and the degree of preparation*. The degree to which the resident is allowed to participate in the OR will be a direct reflection of his/her familiarity and degree of preparation for the case.

Each operation must be approached with the appropriate preparation which includes (but is not limited to) consideration of the following: review of the patient’s presenting complaints, history, and neurological examination; review of pertinent pre-operative radiographic studies; the rationale for surgery; potential alternative treatment regimens including non-operative schemes; various...
potential surgical approaches and the risks and benefits, as well as the advantages and disadvantages of each; review of patient positioning and potential skin incisions; a detailed knowledge of the approach taken, anatomy of structures in the surgical corridor, and the steps involved in performing the procedure; and familiarity with the equipment involved and rationale for its use. Each resident is expected to have familiarity with the relevant reference materials (chapters, journal articles, etc.) before the case begins. The use of handbooks or websites as a sole medical reference is strongly discouraged – these are the equivalent of neurosurgical ‘Cliff Notes’ and should be supplemented by readings from a traditional textbook and/or journals.

Each resident should strive to, whenever possible, see patients for whom they will be responsible, in the Same Day Unit before the patients go to the OR, recognizing that time constraints mean that this is not always possible.

The resident must prepare the OR for the upcoming procedure and assure that equipment is properly set up (e.g. microscope balanced, navigation system registration) and appropriate imaging studies are available and displayed. The resident must be physically present in the OR at the beginning of the case to help position the patient. This is one of the most important (and one of the most overlooked) aspects of neurosurgical training. Anticipate where the incision should be, place the operative field uppermost, determine what means of head fixation are needed, attend to patient padding, etc., and oversee placement of lines, Foley catheters, etc. Make certain all equipment (microscope, CUSA, etc.) is in the OR before beginning the procedure.

It is the resident’s responsibility to obtain, organize, and display pertinent studies prior to the patient’s arrival, especially if they expect to do more than watch the operation.

Residents are responsible for writing post-operative orders and a brief operative note that includes the pre and post-op diagnoses, name of operation, surgeons, assistants, pertinent findings, and the condition of the patient at the end of the case. Blood loss and fluid replacement should be recorded for larger cases.

When requested to do so, the resident is responsible for dictating an operative note. This depends upon the individual resident and attending surgeon. If resident is dictating the note, a clause must be included that clarifies which portions of the procedure for which the attending was physically present in the operating room.

The resident should attend the patient to the recovery room or intensive care unit with the anesthesiology staff unless dictated otherwise by circumstances.

All residents are required to maintain an accurate and complete operative log that details their involvement in OR cases. It is extremely important to document the resident’s involvement in each case both for their graduation and boards as well as for departmental accreditation. Residents who do not maintain accurate and complete logs will be disciplined accordingly including suspension or dismissal.

**Clinic Responsibilities**

We live in an age where inpatient stays are brief, where patients are almost always admitted the day of surgery, where pre-operative work-ups are already done by the time the patient is admitted, and where
there is little time for the residents to interact with patients to get to know them and their diseases prior to surgery. Moreover, there are certain patient diseases that are never treated in an inpatient setting and to which the residents might never be exposed. For these reasons, the out-patient clinic has now become a vital part of resident education. Each resident is expected to participate actively in the out-patient clinics of whichever service to which they are assigned and to work closely with the attending in the evaluation, work-up, and follow-up of patients in the clinic. It is recognized that this out-patient experience will vary by service, and the resident is expected to work out an arrangement with the faculty on his/her service in this regard. A varied experience with all faculty members is encouraged. Although the resident's highest priority should be the operating room whenever possible, the out-patient clinic is the next highest priority. The resident is expected to attend, at a minimum, \( \frac{1}{2} \) day (three hours) of out-patient clinic per week and is encouraged to spend additional time if possible.

Residents’ who are unassigned to a procedure should attend clinic. At no times should residents be unaccounted for by either clinic or a procedure during work hours.

**Resident Supervision**

Residents are expected to assume progressively increased responsibility under appropriate supervision according to their level of training, ability and experience. In all cases, residents work under the supervision of a member of the attending staff or his/her designee, who retains ultimate responsibility for the management of the patient.

Residents are permitted to perform only those specific treatments or procedures authorized by the Program Director and faculty as conferred according to the policies and procedures of the Department. Residents may, when privileges are conferred: take and record histories and perform physical examinations; perform treatments and procedures for which they are specifically privileged; write orders for diagnostic tests, medications and other treatments, devices and immunizing agents; and request consultative services on patients on the neurosurgical service. Decisions on management or changes therein will be under the supervision of the responsible attending staff member or designee. No resident should be compelled to perform a task for which he/she has not received sufficient prior training or which they feel falls outside of his/her level of expertise and/or competency.

Senior residents (those who have completed at least three years of neurosurgical training) may supervise junior residents if the patient's attending physician is readily available in person when needed.

All operative procedures requiring other than local anesthesia or conscious sedation must be supervised by a member of the attending staff. All cases requiring conscious sedation must meet the guidelines established by the institution. Note that nothing in this requirement precludes a responsible member of the attending staff from writing orders on patients under his/her care.

**Role of Physician Assistants and Physician Extenders**

The neurosurgery department employs a variety of physician extenders including Physician’s Assistants, nurse practitioners, nurse coordinators, and others. These extenders have joint responsibilities in managing patients with the residents and faculty within the limits of their practice arrangements. It is recognized that they will have various responsibilities including collecting daily information (labs, radiology reports, consultants’ reports, notes, etc.) upon which residents and staff will make decisions; notifying patients and families with various clinical information; and helping to

Update: May 1, 2013
coordinate care and arrange studies, appointments and other patient care activities. However, they are not to be abused. Their presence is to facilitate the patient care and educational missions of the Neurosurgery Department. The extenders do not work for the residents but rather with the residents to achieve the goals of the department.

**Core Curriculum and Competencies**

The ACGME and Neurosurgery RRC have provided Core Curriculum and Core Competency standards that must be met at each stage of the neurosurgical residency. Each resident is expected to meet these standards on the appropriate schedule; faculty evaluations will include an assessment of each resident’s progress toward these goals. In response to this ACGME requirement for competency in these areas, all residents are expected to participate in core competency training as defined by the program.

**Board Examinations**

All residents are expected to take the American Board of Neurological Surgery's Primary Examination during years 4-6 until a passing score is achieved. Residents are expected to take the examination for credit and have passed before beginning their Chief Resident year. Failure to obtain a passing score on the written primary examination prior to the end of the PGY6 year may result in dismissal from the program. All costs for the examination will be covered by the Department.

**Residency Duty Hours**

The department is committed to upholding the residency work hour regulations. Residents are expected to adhere to these rules and should allocate their work schedules accordingly. It is the responsibility of the residents to track their hours and recognize and avoid any duty-hour violations. Residents are personally responsible for recording their work hours on a WEEKLY basis and meeting these work hour requirements. The call schedule will not be more frequent than every third night. All residents will have at least ten hours of service following call and will not be scheduled for more than 24 hours on continuous first call. All residents will have at least one 24 hour period free from clinical responsibilities each week averaged over 4 weeks.

The work hour restrictions place a heavy burden on each resident to manage patients in an efficient and timely manner and to communicate care plans to the rest of the clinical team. Each resident is ultimately responsible for each and every patient on his or her service. Any care that is rendered by others on the team should be communicated effectively to the service resident so that the delivery of care is not compromised. The gaps that arise when residents are off post-call absolutely require communication with the rest of the clinical team to properly care for their patients. This communication is the responsibility of the “signing-out” resident.

The work hour requirements place an extra burden on the on-call resident to whom will fall all outstanding issues at the end of each day so that the other residents can leave at an appropriate time. The on-call resident is expected to finish all of this clinical work and have all outstanding issues resolved before AM rounds. The following morning, after team rounds, the post-call resident is responsible for communicating and assigning any remaining work on their service to another responsible resident or physician extender and for personally communicating (or arranging communication by another resident or PA) with each faculty member on their service before leaving. The resident is then requested to leave the hospital immediately thereafter and may not return until the following morning.

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The Chief Resident will take second call from home, and will back up the in-house call resident except for one night each week and one 24-hour period each weekend. The chief is not expected to come into the hospital for every clinical change or to oversee every procedure, and is expected to use their time wisely so as to avoid exceeding the work hour restrictions. The Chief Resident is expected to be informed of all operative cases occurring at night but is not required to participate in all cases if this would result in non-compliance with work hour requirements. The Chief Resident should accurately track their time in the hospital. The Chief Resident will have 24 consecutive hours free of clinical responsibilities each week.

**Moonlighting**

*Residents in the Penn State Hershey Neurosurgery Program are not permitted to moonlight.*

**Professional Liability Policy**

The professional liability insurance coverage provided by the University applies only when residents render professional services at the Medical Center and affiliate hospitals and are acting within the scope of the training program. Residents are not covered for professional services rendered at hospitals unaffiliated with the training program. If a resident receives notification that he/she has been named in a malpractice suit, he/she should immediately notify the Program Director and Department Chair. Residents are not to speak to anyone, with the exception of attending staff, about a potential lawsuit until they have discussed the case with a representative of the University's Office of Professional Affairs.

**Dress Code**

All residents are required to dress professionally when engaged in patient care or educational activities. Males should wear slacks, dress shirts and ties, and females dress slacks or skirts/dresses. On weekends residents may don more casual attire. Blue jeans or clothing items made of denim material are not permitted. All residents should wear clean white lab coats with nametags.

**Religious Accommodation Policy**

The residency program will extend reasonable accommodation to a resident requesting schedule changes for religious purposes while assuring patient care is not compromised. Requests must be made in writing and appropriate procedures followed.

**Due Process**

Please refer to the Pennsylvania State University Grievance Policy for further information on due process.

**Travel Policy**

During the course of his/her training, a resident may be authorized by the Program Director to attend appropriate board review course(s). The Department of Neurosurgery will reimburse the resident for course related expenses according to this travel reimbursement policy.

Residents are expected to write papers and manuscripts on original scholarly work throughout their training. A resident who produces a manuscript of publication quality may be eligible to attend a relevant
meeting, course or seminar with the approval of the Chair and Program Director. Similarly, a resident who has an abstract accepted for platform/oral presentation at a national meeting may be eligible for expense reimbursement to attend that meeting. Abstract/Poster acceptance, however, does not in and of itself qualify for travel reimbursement. To be eligible for reimbursement, the resident must also produce a current manuscript of publication quality.

Although residents are encouraged to produce more than one publication-quality manuscript a year, the mere fact that a resident has produced multiple manuscripts does not automatically qualify him/her for travel privileges. **The decision to approve additional seminar/meeting requests is made on a case-by-case basis and at the discretion of the Chair and Program Director.** Typically, residents are not granted permission to attend more than one reimbursable course, meeting or seminar per year.

Residents requesting seminar leave must complete a Seminar Request Form and submit it to the Departmental Residency Coordinator within three months prior to the meeting/course date. **Seminar leave is not officially approved until the Chair and Program Director sign off on the Seminar Request Form.** Reimbursement for travel will not be made unless written authorization is obtained before the meeting date and the required manuscript has been submitted to the Program Director. Residents are encouraged to present their work at departmental conference for critique prior to presenting at a national or international meeting.

Each resident is responsible for abiding by the following travel policies:

1. **Residents make initial payment for all seminar expenses,** with the exception of registration fees, which may be prepaid under certain circumstances (i.e., the manuscript is completed). The Chair must approve amounts exceeding the basic advanced registration rate. Residents are not reimbursed for any meal costs included in the registration fee.

2. The least expensive mode of transportation must be used. Reimbursement will be made only for coach class. Residents are responsible for booking the lowest fare. Tickets should be purchased as soon as possible after the decision to attend a meeting has been made. Residents who pay higher fares as a result of booking delays will be responsible for paying the difference between the ‘supersaver’ fare and the higher fare.

3. Air travel will be reimbursed only for travel greater than 200 miles from the Medical Center. If a resident chooses to travel by air when the distance is less than 200 miles, reimbursement for the travel will be in an amount not to exceed the cost of a bus or train ticket, whichever is higher. Reimbursement for transportation between the resident's home/office and the local transportation terminal (airport, bus station, train station, etc.) and between the transportation terminal and the hotel/meeting site at the destination are provided but require documentation/receipts. When travel is expected to exceed four hours and the resident chooses to park in the terminal parking lot, long-term (not daily) parking areas must be used. Reimbursement for parking expenses will not exceed $8.50/day, and a receipt must be submitted.

4. Automobile travel will be reimbursed at the current hospital reimbursement rate up to the cost of a coach airline ticket.

5. Receipts are required for all reimbursement for expenses.

Update: May 1, 2013
6. The maximum reimbursement for lodging costs incurred while attending conferences and seminars is the least expensive single room rate at one of the designated conference hotels as specified in the conference brochure plus any applicable taxes. If the room rate exceeds $150, the resident may request over-the-maximum rate reimbursement. The Chair must approve amounts over the maximum.

7. Reimbursement for meals while attending a meeting or conference will be made according to the Per Diem Rate Schedule. Reimbursement for meals is dependent upon time of departure and return. Meals will be allowed when the time of departure from home/office at the beginning of the trip occurs before 7:00 a.m. (breakfast), or 6:00 p.m. (dinner). Meals will be allowed when the time of return to home/office at the conclusion of the trip occurs after 8:00 a.m. (breakfast), or 7:00 p.m. (dinner).

8. No reimbursement is provided for auto rental unless approved in advance by either the Program Director or the Academic Administrator.

9. No reimbursement is made for incidental expenses, such as: personal phone calls, in-room movies, room service, etc.

10. All requests for reimbursement must be submitted on a Department of Neurosurgery Travel Reimbursement Form. The following documentation must accompany the reimbursement form:

   - A copy of the brochure or agenda from the conference/seminar;
   - A copy of the completed registration form;
   - A letter of invitation, announcement or memo justifying travel if other than to a conference/seminar
   - Original airplane receipt (passenger coupon of the airline ticket);
   - Original receipt for registration fee;
   - Original itemized hotel receipt and canceled check or credit card voucher;
   - Original receipt for local transportation,
   - Original ITEMIZED meals and other reimbursable expenses.
   - A copy of the Approved Meeting Request form.

During the course of the year, opportunities may arise for residents to attend various industry-sponsored training courses. It is expected that travel and lodging expenses for these courses will be paid for by the course organizer(s). All requests to attend industry-sponsored courses must be submitted to the Program Director in writing in advance along with the course objectives and agenda.
Vacation Leave

Residents are granted vacation in accordance with University policy 3 weeks total. Unless approved in advance by the Program Director, vacation leaves may not exceed 7 consecutive days, including the 2 weekend days either preceding or following 5 week days. If a resident is on a clinical rotation, he/she is responsible for arranging coverage with the Chief Resident before vacation time will be approved. All requests for vacation must be submitted on a Resident Vacation Request Form and given to the Coordinator. Initial requests for vacation for the academic year beginning July 1 must be submitted to the Academic Office prior to June 1st. In the event that a duplicate request is made for the same week, vacation time will be granted to the resident with seniority. Unless approved by the Program Director more than 2 residents may not be absent from the program at the same time.

Residents may not schedule vacation or leave without the Program Director's prior approval during the following: The month of July, the month of February, the Christmas/New Year holidays, the week of the CNS or AANS national meetings, or the week before the ABNS written examination.

Leave of Absence

Should a resident require more time than is allotted, he/she may request a Leave of Absence. The Program Director must approve such requests in writing.

The total number of leave days (including vacation, holiday, sick and unpaid leave) a resident may take during any one academic year (July 1 through July 30) cannot exceed 45.

Authorization of Expenditures

Residents are not authorized to commit departmental funds without administrative approval. Any expenses that have not been pre-approved will become the responsibility of the resident. Residents requiring funds to subsidize clinical or research projects must complete an Expenditure Authorization Form and submit it to the Chair for approval.

Photocopying services are provided in the Department. Residents may use the Department's photocopying allotment in the library without prior approval. However, residents should inform the Residency Coordinator of the number of pages copied and the date on which they were copied for record keeping purposes. The residents are expected to be reasonable; excessive photocopying is discouraged.

Accepting Donations from Private Sources

The Department of Neurosurgery may, on occasion accept, from equipment manufacturers and pharmaceutical companies, donations to the Education Fund. These agreements will be made on behalf of the residency training program and departmental goals and will be for the benefit of the total program. Residents are not permitted to accept gifts of money or goods from private sources, as this practice is not consistent with the objectives of the department or residency training program.

Update: May 1, 2013
Miscellaneous Rules

Pages must be answered in a timely fashion – most pages should be answered within 3-5 minutes. If unable to do so, (i.e. if scrubbed or doing a procedure), please ask a nurse to answer the page for you. Persistent failure to answer pages in a timely manner will be cause for disciplinary action.

Phone calls should be answered politely and professionally, especially when coming from an outside facility or referring physician. Do not demean, speak harshly, argue with, criticize, or hang up on the referring physician or caller. Remember that however comfortable you may be with a particular patient circumstance, the referring physician (a non-neurosurgeon) may be acutely uncomfortable with the situation and may simply need somebody with greater experience to manage this patient. In general, requests for transfer of patients should be passed along to the faculty.

All outside radiographic studies should be maintained in the department until requested or required by the OR. All films should be signed out with the office staff before removing them.

Residents are responsible for maintaining compliance with all mandatory in-services, adhere to specific hospital regulations and standards of practice, and maintain their annual physical examinations and tuberculosis testing as required by hospital regulations. Please refer to the Graduate Medical Education Handbook published by the Graduate Medical Education Office of the Penn State Hershey Medical Center for additional hospital policies.

DEPARTMENTAL RESEARCH

All residents are expected to participate in a research activity during their residency; time has been set aside during the rotations for this purpose and residents are expected to use this time wisely to work with a faculty mentor within the department, within the institution, or outside of the institution with prior approval. Residents should be planning their research time during the year preceding their actual research year to make optimum use of their time in the laboratory. Residents should discuss their plans with the Program Director and the appropriate faculty members in advance, and obtain approval for their research project. The resident is responsible for contacting an appropriate faculty mentor and setting up a research program consistent with their area of interest and experience. At the completion the research time each resident is expected to present a manuscript, suitable for publication, on some aspect of his or her research activities.

Resident Research Requirements

1) Each resident should submit an abstract to a national meeting each year.
2) Each resident should prepare a manuscript for submission to a journal each year.

Failure to accomplish either (1) or (2) will result in the resident being placed on probation. During the probation year, the resident is expected to make up for the failure as well as complete the requirement for that year. (For example, a resident submitting an abstract but not a manuscript for his/her PGY2 year will be required to submit one abstract and two manuscripts during his PGY3 year.) Failure to accomplish this during the probationary year will result in dismissal from the program.

Update: May 1, 2013
**SUPPORT SERVICES**

**Professional Support Staff**

Penn State Hershey provides a full range of support services including, IV teams, phlebotomy services, unit clerks, centralized dictation, EKG technicians, 24 hour laboratory services, transport services, and on-line pathology and radiology information systems. The medical records process is entirely on-line. All residents have access to view the patient medical record on computers via mobile carts, on the hospital units, in call rooms, or from home with an internet connection.

The Neurosurgery Department also employs Physicians Assistants, Nurse Practitioners, a Patient Liaison Nurse for patient education and telephone triage activities, a Nurse Specialist for Gamma Knife patients, Clinical Trials Coordinators, Medical Assistants, a Residency Program Coordinator and the secretarial support staff in the Department of Neurosurgery Academic Offices and Laboratories.

The Residency Program Coordinator provides administrative and secretarial services in support of the resident training program. The Residency Program Coordinator works closely with the Department Chair, the Program Director and the Chief Residents to develop the calendar of events, arrange visiting professorships and coordinate a host of educational activities. The Residency Program Coordinator is available to assist residents with program related activities.

The University’s Audiovisual Services Department is available to consult with residents about their audiovisual needs and to prepare necessary illustrations, slides, posters, photos, etc. Residents are expected to inform the Residency Coordinator before submitting a project to the Audiovisual Department.

The neurosurgery residents have two designated call rooms with beds, phones, computers, a refrigerator and private shower and bathroom. Residents are provided with meal money in the hospital cafeteria. Meal money is credited to each resident at the beginning of each month. The money may be spent for food in the hospital cafeteria when it is open between the hours of 6:00 am and 9:00 pm. During the hours in which the hospital cafeteria is not open, a resident refrigerator is available in the hospital cafeteria. Pre-packaged meals are prepared during the day and stored in the resident refrigerator. All items in the resident refrigerator are free and may be heated in the adjacent microwave, when needed.

In addition Penn State Hershey offers the following services for all resident physicians:
- An on-campus fitness center
- Psychological counseling services
- Free access to financial consultants
- 403(b) tax sheltered annuity (401K????)
- Professional liability insurance

Update: May 1, 2013
ATTACHMENT 1:

CORE COMPENCIENCIES

Patient Care
Medical Knowledge
Practice-based Learning and Improvement
Interpersonal and Communication Skills
Professionalism
Systems-based Practice

The Penn State Neurosurgery residency program requires its residents to develop the competencies in the 6 areas below to the level expected of a new practitioner. Toward this end, we will define the specific knowledge, skills, and attitudes required and provide educational experiences as needed in order for their residents to demonstrate the competencies.

PATIENT CARE

Residents must be able to provide patient care that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health. Residents are expected to:

• communicate effectively and demonstrate caring and respectful behaviors when interacting with patients and their families

• gather essential and accurate information about their patients

• make informed decisions about diagnostic and therapeutic interventions based on patient information and preferences, up-to-date scientific evidence and clinical judgment

• develop and carry out patient management plans

• counsel and educate patients and their families

• use information technology to support patient care decisions and patient education

• perform competently all medical and invasive procedures considered essential for neurosurgical practice

• provide health care services aimed at preventing health problems or maintaining health

• work with health care professionals, including those from other disciplines, to provide patient-focused care
MEDICAL KNOWLEDGE

Residents must demonstrate knowledge about established and evolving biomedical, clinical, and cognate (e.g., epidemiological and social-behavioral) sciences and the application of this knowledge to patient care. Residents are expected to:

- demonstrate an investigatory and analytic thinking approach to clinical situations
- know and apply the basic and clinically supportive sciences which are appropriate to their discipline

PRACTICE-BASED LEARNING AND IMPROVEMENT

Residents must be able to investigate and evaluate their patient care practices, appraise and assimilate scientific evidence, and improve their patient care practices. Residents are expected to:

- analyze practice experience and perform practice-based improvement activities using a systematic methodology
- locate, appraise, and assimilate evidence from scientific studies related to their patients' health problems
- obtain and use information about their own population of patients and the larger population from which their patients are drawn
- apply knowledge of study designs and statistical methods to the appraisal of clinical studies and other information on diagnostic and therapeutic effectiveness
- use information technology to manage information, access on-line medical information; and support their own education
- facilitate the learning of students and other health care professionals

INTERPERSONAL AND COMMUNICATION SKILLS

Residents must be able to demonstrate interpersonal and communication skills that result in effective information exchange and teaming with patients, their patients families, and professional associates. Residents are expected to:

- create and sustain a therapeutic and ethically sound relationship with patients
- use effective listening skills and elicit and provide information using effective nonverbal, explanatory, questioning, and writing skills
• work effectively with others as a member or leader of a health care team or other professional group

PROFESSIONALISM

Residents must demonstrate a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to a diverse patient population. Residents are expected to:

• demonstrate respect, compassion, and integrity; a responsiveness to the needs of patients and society that supersedes self-interest; accountability to patients, society, and the profession; and a commitment to excellence and on-going professional development

• demonstrate a commitment to ethical principles pertaining to provision or withholding of clinical care, confidentiality of patient information, informed consent, and business practices

• demonstrate sensitivity and responsiveness to patients’ culture, age, gender, and disabilities

SYSTEMS-BASED PRACTICE

Residents must demonstrate an awareness of and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide care that is of optimal value. Residents are expected to:

• understand how their patient care and other professional practices affect other health care professionals, the health care organization, and the larger society and how these elements of the system affect their own practice

• know how types of medical practice and delivery systems differ from one another, including methods of controlling health care costs and allocating resources

• practice cost-effective health care and resource allocation that does not compromise equality of care

• advocate for quality patient care and assist patients in dealing with system complexities

• know how to partner with health care managers and health care providers to assess, coordinate, and improve health care and know how these activities can affect system performance
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Mandatory Attendance Conferences

Residents are expected to be available for conferences. There is no neurosurgery operating room block time that conflicts with the conference schedule. Neurosurgical faculty are informed that operative cases, patient care rounds and other clinical responsibilities need to be done without resident participation if they conflict with scheduled conferences. If an operating room case that is judged to be of great educational value occurs during scheduled conference time one resident may be assigned to the case at the discretion of the Chief Resident and Program Director.

Resident Course in Evidence-based Medicine

This conference is under the direction of Dr. Michael Glantz but all faculty are encouraged to attend whenever possible. This conference is held from 12:00 to 2:00 pm on Fridays. The first three months of each academic year are devoted to a series of lectures on the scientific method, clinical trial design and statistical analysis. The next three months are devoted to a review and critical analysis of classic neurosurgery papers. The last six months of the academic year residents are expected to demonstrate their ability to critically evaluate the contemporary neurosurgical literature. Each resident is responsible for, and should be ready to present and critique, one article from a recent journal (within the last calendar year). Discussion should include a brief review of the paper’s rationale, methodology, results, and conclusions, and a critique of the paper’s strengths and weaknesses.

Pre-op Conference

This multidisciplinary conference with Neuroanesthesiology and Neuroscience Nursing is directed by the Chief Residents. The Pre-op Conference is designed to review the upcoming week’s operative cases in order to bring all department members up to speed on the upcoming cases, to encourage better communication between residents and staff about each case and to provide an educational opportunity for residents to present and discuss management options, alternative operative approaches, surgical anatomy, radiographic evaluation, surgical planning, and patient management issues. Residents are assigned specific cases to discuss and are required to come prepared to discuss these cases and the various aspects of management that will arise in the discussion. The faculty members formally evaluate each resident’s presentations.

Oral Board Format Conference

Once a month, under the direction of various faculty members, residents are presented unknown clinical cases in the format of the ABNS Oral Examinations. They are expected to request and interpret patient’s history, physical and neurological examination findings and diagnostic studies, to determine a diagnosis, develop and carry out a treatment plan. They are asked to demonstrate and describe operative approaches and to discuss and manage possible complications.

Morbidity and Mortality / Quality Improvement Conference

This multidisciplinary conference with Neuroanesthesiology and Neurocritical Care is under the direction of Dr. Zacko. The M&M/QI Conference is an opportunity to instill in the Neurosurgery residents and faculty an ethic and culture of continuous self-assessment and quality improvement and to instruct the residents in the principles of systems based practice and practice based learning by discussing complications of patient management and opportunities for improvement in care. The role of the M&M/QI Conference is not to assign blame or to be punitive. Rather, it is a conference designed to instill a culture of self-assessment in all members of the Department of Neurosurgery and to stress the importance of self-assessment and quality improvement as a requirement of all core.

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competencies of neurosurgical education and practice. Residents are assigned a specific case to review and discuss. They are to identify individual and systems issues that contributed to a suboptimal outcome and recommend methods for improvement. The list of cases to be discussed is made available at least one day prior to conference. The resident responsible for presenting each case is also responsible for obtaining pertinent studies for presentation at the conference. A comprehensive tracking system based on our electronic medical record is being developed that will allow us to record and analyze patient characteristics, processes of care, complication rates and functional outcomes for all patients on a procedure and surgeon specific basis. Such a system will allow true continuous quality improvement for the Department of Neurosurgery.

**Basic Science Conference / Resident-Faculty Presentations**

These conferences are under the direction of Dr. Dias. The Basic Science conference is a forum for presentation of structured lectures. Most of these lectures will be presented by the neurosurgery faculty on topics about which they have particular expertise. However, it is also important for each resident to learn to present to a public audience. This affords the resident the opportunity to learn public speaking, to research and critically analyze the medical literature, to increase the resident’s appreciation for clinical research and increase knowledge about each topic presented, to work with a faculty member on a particular area of mutual clinical interest, to learn how to write a manuscript, to provide an opportunity for the resident to perform, present, and publish clinical science research on a national or international level, and to provide an opportunity for the faculty to evaluate the resident’s abilities in each of these areas. Each resident is required to present two conferences per year. The conferences will provide a clinically based topic review, based upon a clinical case scenario (preferably a patient for whom the resident has cared) and including a comprehensive review of the medical literature on a topic relevant to the subject of the presentation. A 45-50 minute audiovisual presentation leaving 10-15 minutes for a question/answer period is required. When the presentation reflects appropriate and original research, residents are encouraged to submit these presentations to national or international meetings and manuscripts to peer reviewed journals. Presentations and manuscripts may be maintained on the department web site as a library of clinical reviews for other residents and staff, and for other professionals and the public at large.

**Tumor Board and Tumor Quality Improvement Conference**

These multidisciplinary conferences with our colleagues in Medical Oncology, Radiation Oncology, Neuroscience Nursing and Neuroradiology are under the direction of Dr. Sheehan. Tumor Board is a case based conference with review of the history, physical findings, diagnostic studies and management options for patients with central nervous system tumors. Recommendations are made for medical management, radiotherapy, radiosurgical and open surgical treatment. Residents are expected to present a concise clinical history of their patients who are presented.

In those months with a fifth Friday, a Tumor Quality Improvement Conference is held. This is working conference to review quality metrics for the neuro-oncology services and to discuss methods for quality improvement for these patients.

**Neuropathology Conference**

Twice a month our colleagues in Neuropathology present a resident teaching conference. These conferences may review the neuropathology from an interesting case from the Neurology or Neurosurgery service. The residents who participated in the care of the patient being discussed are expected to present a brief clinical history to allow

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clinico-pathological correlation. Alternatively, these conferences may be dedicated to a didactic presentation from the Neuropathology faculty with slide review.

**Spine Conference and Spine Case Conference**

The multidisciplinary Spine Conference is facilitated by Dr. Sheehan and Spine Case Conference is under the direction of Dr. Reiter. Twice a month we meet with our colleagues in Orthopedics, Pain Management, Physiatry, Neuroradiology and Rehabilitation Medicine for discussion of interesting topics or cases relating to patients with spinal diseases. For the Spine Conference residents are required to read a specific article or articles on a specific topic. For the Spine Case Conference residents will be assigned to present a case and discuss management options based on a review of the literature.

**Cerebrovascular Conferences**

This multidisciplinary conference with our colleagues in Neurology and Neuroradiology occurs is under the direction of Drs. Cockcroft and Kalapos. It is a case-based conference with review of the history, physical findings, diagnostic studies and management options for patients with cerebrovascular disease. Residents are expected to present a concise clinical history of their patients who are presented.

In those months with a fifth Friday, a Cerebrovascular Quality Improvement Conference is held. This is working conference to review quality metrics for the cerebrovascular services and to discuss methods for quality improvement for these patients.

**Core Competencies Lectures**

Once a month the Department of Graduate Medical Education sponsors a Core Competencies Lecture on various topics. **It is required that neurosurgery residents attend. If residents cannot attend in person they are required to view the lectures online at [http://www.hmc.psu.edu/competencies/lectures/index.htm](http://www.hmc.psu.edu/competencies/lectures/index.htm).** Residents are required to fill out the evaluation of the lecture and submit it to the GME office. The GME office will then give credit for the conference. All conferences must be attended in person or reviewed online and be up-to-date on a quarterly basis. The Penn State College of Medicine Core Competency lectures have been chosen by the American Association of Neurological Surgeons (AANS) for posting on the AANS website for use by neurosurgical program directors across the United States and abroad.

**Neuroradiology Conference and Neuroradiology Case Conference**

These multidisciplinary conferences with our colleagues in Neuroradiology and Neurology are under the direction of Dr. Nguyen, Chief of Neuroradiology and Dr. Kalapos. They consist of both case based reviews and topic specific didactic lectures. Residents are required to give a concise clinical history of patients they cared for who are presented at neuroradiology case conference and to interpret imaging studies presented at the conferences.

**Research Conference**

This conference occurs once a month under the direction of Dr. James Connor, PhD, Vice Chair for Research. The Research Conference is designed to report on the research work being done in the Penn State Department of Neurosurgery in the basic science laboratory, in clinical research and in the Center for neural Engineering. Presentations are made by the investigators involved in the research activity.

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**Neurotrauma Conference**

The goal of this conference is to review and discuss the most current trends in the evaluation, diagnosis and management of traumatic brain injury and spinal cord injury.

**Epilepsy Conference**

The Epilepsy Conference is a multidisciplinary conference with our colleagues from Neurology and is facilitated by Dr. Sather. Patients with difficult to control seizures are reviewed. The patients’ history, examination, diagnostic imaging and video EEG findings are discussed and recommendations made for medical and surgical treatment.

**Attending Rounds**

Each Saturday and Sunday morning the resident who was on first call the night before, the resident who will be on first call that day, the senior or chief resident on back up call and the attending faculty member on first call for the weekend meet at 7:00 am in the Neurosurgery Conference Room (H4151) adjacent to the NSICU to review patients on the inpatient Neurosurgery and inpatient consult service. A brief synopsis of new admissions with, review of the history, examination findings and diagnostic studies is carried out by the admitting resident. All residents then make walk rounds with the faculty member and see all neurosurgical inpatients and inpatient consults. This is an opportunity for the faculty member to observe the residents as they interact with and examine patients. It is also an opportunity for the faculty member to observe the interactions of the residents with patients’ families and other health care providers. Finally, it is an opportunity for the residents to observe the faculty member in the same roles. Residents are excused from walk rounds if continuing to the end of rounds would cause a work hours violation.

**Departmental Meeting**

In those months with a fifth Friday, a departmental meeting under the direction of the Department Chair is held from 10:00 – 12:00. This meeting allows the clinical and research faculty, neurosurgery residents, post-doctoral students and fellows, physician assistants, neuroscience nurses, administrative and office support staff in the Department of Neurosurgery to discuss issues of importance to the entire department.

**NEUROSURGERY ELECTIVE ATTENDANCE CONFERENCE SCHEDULE**

**Elective Conferences**

In addition to the mandatory attendance conferences, neurosurgery residents may attend the numerous research conferences conducted by the Department of Neurosurgery. These include: Basic science research conferences (Neurosurgery Basic Science Laboratory Meeting, which occurs each Monday, the Brain Tumor Laboratory Meeting, which occurs the second and fourth Mondays of each month and the Laboratory Journal Club which occurs each Wednesday); Clinical research conferences (Clinical Research Laboratory Meeting, which occurs each Monday) and Neural Engineering research conferences (Integrated Systems Journal Club which occurs each Monday, the Dynamical Neuroscience and Brain-Machine Interface Laboratory Meetings, which occur each Tuesday and the Controls Group Seminar, which occurs each Wednesday). The Neural Engineering conferences are teleconferenced between Penn State Hershey and the Penn State University Park campus. Residents doing research during their independent study year are encouraged to attend these elective conferences. It is understood that the...
The educational mission of the Department of Neurosurgery is founded upon the following guiding principles:

The primary duty of the resident is patient care, both for educational and service purposes. The patient is your best teacher; performing a thorough work-up, developing and implementing a coherent diagnostic and treatment plan and executing this plan are the best ways to cement your textbook learning.

Although the week is structured so as to maximize time for resident teaching and other activities, patient care is of necessity relatively unstructured and often unpredictable. When called upon - even when unscheduled - devotion to patient care will take precedence before any other resident duties including conferences, research activities, administrative work, or any other resident activities.
We are all in the same boat and are rowing in the same direction. We should be supportive of one another, look for ways to assist each other, and go out of our way to lessen the burden when another member is overwhelmed with responsibilities. Ask yourself what you would want from your fellow residents if you were in the same circumstance.

As far as possible and within the duty work hour restrictions, each resident must finish their daily tasks or, if on call, the on-call tasks, before leaving for home each day. Any unresolved or unfinished business must be signed out to another resident clearly and unambiguously in a timely fashion. Dumping is not allowed!

Members of the Department will at all times treat each other with dignity, respect and professionalism. Praise should be delivered publicly, and criticisms whenever possible in private. Public flogging, shouting matches or other demeaning, highly critical, personally debasing or outright public attacks will not be tolerated by any member of the department.

Discussions and disagreements about patient care issues should be handled respectful and collegially. Whenever possible, differences of opinion and conflicts should be aired directly, discreetly, and in person with the person or people involved. Unresolved conflicts should be addressed to the attending involved or the Department Chair as required. Email as a means of airing grievances, petty disagreements or conflicts is not encouraged.

Communication among residents and between residents and faculty is of paramount importance for the best patient care. The current climate of reduced resident work hours mandates that information will be inevitably passed from resident to resident more frequently and maintaining the fidelity of this information is mission critical. Communication should be thorough but succinct, and as frequently as possible. Any significant change in patient status that might require surgery should be reported to the appropriate attending in a timely fashion.
ATTACHMENT 4: WORK HOURS POLICY

PURPOSE: To provide an appropriate leaning environment for residents and maintain patient safety

POLICY STATEMENT: The Duty Hour Policy for the Penn State Hershey Medical Center places appropriate limits on duty hours, fosters high-quality education and safe patient care and promotes institutional oversight.

Duty Hours:

- Residents must not be scheduled for more than 80 hours per week, averaged over a four week period. Residents are closely monitored by faculty on a daily basis for evidence of fatigue and are relieved of their clinical or academic duties for the day if such evidence is noted.
- Residents must have at least one full (24-hour) day out of seven free of patient care duties, averaged over four weeks.
- Residents must not be assigned in-house call more often than every third night, averaged over four weeks.
- Scheduled, continuous on-site duty, including in-house call, must not exceed 24 consecutive hours. Residents may remain on duty up to four additional hours to participate in didactic activities, maintain continuity of medical and surgical care, transfer care of patients, or conduct outpatient continuity clinics. Residents may not assume responsibility for new patients after 24 hours of continuous duty, except in outpatient continuity clinics.
- Residents should have a minimum rest period of 10 hours between duty periods after in-house call.
- When residents take call from home and are called into the hospital, the time spent in the hospital must be counted toward the weekly duty hour limit and must be logged at Pager Call – Called In.

High-Quality Education and Safe and Effective Patient Care:

- Didactic and clinical education must have priority in the allotment of residents' time and energies;
- On-call schedules for attending/teaching staff must be structured to provide that supervision and faculty support/consultation is readily available to residents on duty;
- Duty hour assignments in teaching settings must recognize that faculty and residents collectively have responsibility for the safety and welfare of patients;
- Faculty and residents must be educated to recognize the signs of fatigue and to apply preventive and operational countermeasures. The program director and teaching faculty must monitor residents for the effects of sleep loss and fatigue, and respond in instances when fatigue may be detrimental to resident performance and well-being;
- The Neurosurgery Program provides residents appropriate backup support when patient care responsibilities are especially difficult and prolonged, and if unexpected needs create resident fatigue sufficient to jeopardize patient care during or following on-call periods.

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Institutional Oversight:

- The Penn State Hershey will promote patient safety and education through duty hour assignments and faculty availability;

- Each residency program must establish written policies governing resident duty hours that foster education and the safe care of patients. Duty hours must be consistent with the ACGME requirements, all applicable RRC Program Requirements, and must apply to all institutions to which residents rotate;

- When an increase to duty hours is granted, up to 10 percent above the 80-hour weekly limit, the program must develop written protocols to be approved by the Graduate Medical Education Committee that detail the process for providing an educational rationale for the increase;

- A report will be presented annually to the Board of Directors on program and institutional compliance with the duty hour standards;

- Policies on patient care activities outside the educational program (moonlighting) will be provided to residents. Because residency education is a full-time endeavor, the program director must ensure that moonlighting does not interfere with the ability of the resident to achieve the goals and objectives of the educational program;

- Programs must have procedures and policies in place to monitor and support the physical and emotional well-being of residents to promote an educational environment and safe patient care;

- Demands of home call must be monitored in the programs, and scheduling adjustments made as necessary to address excessive service demands and/or fatigue;

- Patient care support services for IV, phlebotomy, and transport activities must be available to reduce resident time spent on these routine activities.
ATTACHMENT 5: CORE CURRICULUM

CORE COMPETENCIES

The Penn State Neurosurgery residency program requires its residents to obtain competencies in the 6 areas below to the level expected of a new neurosurgical practitioner. We will define the specific knowledge, skills, and attitudes required and provide educational experiences as needed in order for our residents to demonstrate:

Patient Care that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health

Medical Knowledge about established and evolving biomedical, clinical, and cognate (e.g. epidemiological and social-behavioral) sciences and the application of this knowledge to patient care

Practice-Based Learning and Improvement that involves investigation and evaluation of their own patient care, appraisal and assimilation of scientific evidence, and improvements in patient care

Interpersonal and Communication Skills that result in effective information exchange and teaming with patients, their families, and other health professionals

Professionalism, as manifested through a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to a diverse patient population

Systems-Based Practice, as manifested by actions that demonstrate an awareness of and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide care that is of optimal value

PATIENT CARE AND MEDICAL KNOWLEDGE

PGY1 OFF SERVICE ROTATIONS

NEUROLOGY

UNIT OBJECTIVES

Residents are expected to develop an increasing understanding of neurology over the course of their residency. This will occur during clinical rotations with didactic and practical teaching from the neurosurgery and neurology faculty. Neurosurgery residents must take at least a three-month Neurology rotation. A minimum of three months of training in neurology is a requirement of the American Board of Neurological Surgery for board certification. This training is usually done during the PGY1 year but clinical neurology is also one of the options for the three-month off service elective time in the PGY2-4 years of residency training. Graduating neurosurgery residents are expected to demonstrate an understanding of the neurological examination, diagnostic neurological testing, neurological diseases and their treatment as outlined below.

A. Competency-Based Knowledge Objectives:
1. Discuss electroencephalography (EEG). Recognize normal and abnormal EEG patterns. Identify specific epileptic conditions by EEG findings.
2. Describe the principles of sensory evoked potential testing (SEPs). Discuss how SEPs may be useful diagnostically.
3. List the indications for using intraoperative SEP monitoring and describe in detail how the procedure may be performed.
4. Describe the principles of visual evoked potential testing (VEPs). Discuss how VEPs may be useful diagnostically.
5. Describe the principles of motor evoked potential testing (MEPs). Discuss how MEPs may be useful diagnostically.
6. List the indications for using intraoperative MEP monitoring and describe in detail how the procedure may be performed.
7. Discuss electromyographic (EMG) testing in detail. Describe how the testing is performed and review the diagnostic capabilities of EMG testing. Describe the EMG changes associated with neuromuscular pathology.
8. List the indications for using intraoperative EMG testing and describe in detail how the procedure may be performed.
9. Discuss nerve conduction velocity (NCV) testing in detail. Describe how the testing is performed and review its diagnostic capabilities. List the transmission velocities of the major nerves. Describe NCV changes observed in neuropathy.
10. Define delirium and dementia. List the differential diagnoses for each.
11. Define and discuss coma and altered states of consciousness.
12. Describe the evaluation of a patient with syncope.
13. Describe the etiology and pathogenesis of cerebrovascular disease.
14. Review the clinical presentation and discuss the radiographic evaluation, clinical evaluation, and management of the following:
   a. transient ischemic attacks
   b. cerebral infarction
   c. cerebral and cerebellar hemorrhage
   d. subarachnoid hemorrhage
   e. venous infarction
15. Identify the primary causes of stroke in the pediatric population.
16. Comprehensively discuss the etiology, clinical presentation, diagnostic evaluation, and management of cerebral vasculitis.
17. Differentiate between basal occlusive disease with and without telangiectasia. Review the prognosis and treatment options for each.
18. Describe the acute and chronic effects of ionizing radiation on the central nervous system.
19. Review the diagnosis and management of pseudotumor cerebri.
20. Discuss the diagnosis and management of normal pressure hydrocephalus.
21. Discuss the management of hyperosmolar hyperglycemic nonketotic diabetic coma.
22. Review the neurological manifestations of altitude sickness.
23. List the neurological manifestations of decompression sickness.
25. Review the general topic of chromosomal abnormalities as they may relate to the central nervous system including etiology, inheritance patterns, penetrance, and laboratory diagnosis.
26. List the major syndromes characterized by obesity and hypogonadism, including Prader-Willi syndrome.

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27. Discuss agenesis of the corpus callosum.
28. Discuss anencephaly, microencephaly, and megalencephaly.
29. List the major disorders of amino acid and purine metabolism. Discuss the neurological manifestations of each.
30. Review each of the major storage diseases including:
   a. GM1-Gangliosidoses
   b. GM2-Gangliosidoses
   c. Fabry disease
   d. Gaucher disease
   e. Niemann-Pick disease
   f. Farber disease
   g. Wolman disease
   h. Refsum disease
   i. Cerebrotendinous Xanthomatosis
   j. Neuronal ceroid lipofuscinoses
31. Review each of the major leukodystrophies including:
   a. Krabbe leukodystrophy
   b. Metachromatic leukodystrophy
   c. X-linked leukodystrophies with and without adrenal involvement.
32. Review each of the major mucopolysaccharidoses including:
   a. Hurler syndrome (MPS IH)
   b. Hunter syndrome (MPS II)
   c. Sanfilippo syndrome (MPS III)
   d. Morquio syndrome (WS IV)
   e. Maroteaux-Lamy syndrome (MPS VI)
33. Review the disorders of carbohydrate metabolism including:
   a. glycogen storage diseases
   b. Lafora disease and other polyglucosan storage diseases
34. Discuss hyperammonemia as it relates to neurological dysfunction.
35. Discuss adrenoleukodystrophy as it relates to neurological dysfunction including Reye's syndrome.
36. Review the major syndromes of dysfunctional copper metabolism including:
   a. hepatolenticular degeneration (Wilson disease)
   b. Trichopoliodystrophy (Menkes' syndrome)
37. Review the pathogenesis, clinical presentation, diagnosis, and treatment of acute intermittent porphyria. List drugs to avoid in patients with porphyria (i.e., sulfa drugs, etc.).
38. Review the pathogenesis, clinical presentation, diagnosis, and treatment of abetalipoproteinemia.
39. List the neurological disorders associated with xeroderma pigmentosum.
40. List the major cerebral degenerative disorders of childhood including:
   a. progressive sclerosing poliodystrophy
   b. spongy degeneration
   c. infantile neuraxonal dystrophy
   d. Hallervorden-Spatz disease
   e. Pelizaeus-Merzbacher disease
   f. Alexander disease
   g. Cockayne syndrome
   h. peroxisomal diseases

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i. Leigh disease
41. Review in detail the major neurocutaneous disorders including:
   a. neurofibromatosis, Type 1 and Type 2
   b. encephalotrigeminal angiomatosis
   c. incontinentia pigmenti
   d. tuberous sclerosis
42. Discuss Leber Hereditary Optic Atrophy.
43. Review the salient features of progressive external ophthalmoplegia.
44. Define peripheral neuropathy, polyneuropathy, mononeuropathy, mononeuropathy multiplex, and neuritis.
45. Review the major inherited neuropathies including:
   a. peroneal muscle atrophy
   b. Dejerine-Sottas disease
   c. Refsum disease
   d. hereditary sensory neuropathy
   e. porphyric neuropathy
46. Discuss the etiology, clinical presentation, diagnosis, treatment, and prognosis of Guillain-Barre syndrome.
47. List the major acquired neuropathies other than Guillain-Barre syndrome including:
   a. chronic demyelinating polyneuritis
   b. acute and chronic idiopathic sensory neuropathy
   c. acute pandysautonomia
   d. tick paralysis
   e. brachial neuropathy (neuralgic amyotrophy)
   f. radiation neuropathy
   g. cold neuropathy
   h. cryoglobulin neuropathy
   i. diabetic neuropathy
   j. hypothyroid neuropathy
   k. acromegalic neuropathy
   l. vasculitic neuropathy
   m. uremic neuropathy
   n. hepatic neuropathy
   o. infectious neuropathies
      i. leprosy
      ii. acquired immunodeficiency virus
         iii. Lyme
      iv. herpes zoster
   p. sarcoid neuropathy
   q. paraneoplastic neuropathy
   r. amyloid neuropathy
   s. polyneuropathy associated with plasma cell dyscrasia
   t. polyneuropathy associated with dietary deficiencies
   u. neuropathy induced by metals
      i. arsenic
      ii. lead
      iii. mercury
      iv. thallium
v. drug-induced neuropathy
w. neuropathy produced by aliphatic chemicals

48. Discuss the major hereditary ataxias including:
   a. Friedreich ataxia
   b. Levy-Roussy syndrome
   c. hereditary cerebellar ataxia

49. Review the major non-inherited forms of cerebellar ataxia including
   a. acute cerebellar ataxia in children
   b. ataxia telangiectasia
   c. Marinesco-Sjogren syndrome
   d. Ramsay-Hunt syndrome
   e. Joseph disease

50. Discuss the pathophysiology, clinical presentation, treatment, and prognosis of Alzheimer's disease, Pick disease, and diffuse Lewy body disease.

51. Define hemichorea and hemiballismus.

52. Review the pathophysiology, clinical presentation, treatment, and prognosis of Syndenham chorea, Huntington's disease, and senile chorea.

53. Define myoclonus.

54. Review Tourette's syndrome.

55. Review the major general and focal dystonic conditions.

56. Define benign essential tremor.

57. Discuss the pathophysiology, clinical presentation, diagnosis, treatments and prognosis of Parkinsonism in detail.

58. Define progressive supranuclear palsy.

59. Review the pathophysiology, clinical presentation, diagnosis, and treatment of tardive dyskinesia.

60. Discuss hereditary spastic paraplegia.

61. List the major generalized and focal forms of spinal muscular atrophy including:
   a. Wernig-Hoffmann disease
   b. Kugelberg-Welander syndrome
   c. benign focal amyotrophy

62. Describe the pathophysiology and neurological manifestations of poliomyelitis.

63. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of amyotrophic lateral sclerosis.

64. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of subacute combined degeneration of the spinal cord.

65. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of juvenile and adult myasthenia gravis.

66. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of botulism.

67. Review the common muscular dystrophies including:
   a. Duchenne muscular dystrophy
   b. fascioscapulohumeral muscular dystrophy
   c. myotonic muscular dystrophy
   d. myotonia congenita
   e. congenital muscular dystrophy

68. Review the major periodic paralysis syndromes including:
   a. familial periodic paralysis
b. hypokalemic periodic paralysis
c. hyperkalemic periodic paralysis
d. paramyotonia congenita

69. Discuss polymyositis.
70. Review the epidemiology, pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of multiple sclerosis.
71. Define Marchiafava-Bignami disease.
72. Review central pontine myelinolysis in detail.
73. Discuss multiple system atrophy.
74. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of migraines.
75. Discuss the diagnosis and management of non-migrainous headache syndromes.
76. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of the common epileptic disorders in detail.
77. Define status epilepticus and discuss the medical treatment of same.
78. Describe the neurological implications of the common collagen-vascular diseases.
79. Describe the neurological implications of alcoholism.
80. Discuss the neurological aspects of pregnancy.
81. Review malignant hyperthermia.

NEUROANATOMY

UNIT OBJECTIVE

Residents are expected to develop an increasing understanding of the anatomy pertinent to neurosurgical practice over the course of their residency. This will occur during clinical rotations with didactic and practical teaching from the neurosurgical faculty. A two month off-service rotation in Neuroanatomy is also offered in the PGY-2 year. Graduating residents will be expected to demonstrate knowledge of anatomy that is pertinent to the diagnosis of diseases of the nervous system and the practice of neurological surgery as outlined below.

A. Competency-Based Knowledge Objectives:

General:
1. Review the embryological development of the brain, cerebellum, brain stem, glial elements, spinal cord, conus medullaris, cauda equina, sympathetic and parasympathetic systems and the peripheral nervous system.
2. Review the embryologic development of the skull, craniovertebral junction, and spine.
3. Describe and differentiate types of neurons.
4. Discuss the microanatomy of the neuron including the:
   a. cell body
   b. dendritic process
   c. axonal process
5. Diagram and describe the microanatomy of the synapse.
6. List the microglial elements and review their microanatomy:
   a. astrocytes
   b. oligodendrocytes
   c. microglia
   d. ependyma
7. Diagram and describe in detail the carotid and vertebral arteries and their branches which provide blood supply to the face, scalp, skull, meninges, brain, brain stem, cerebellum, and rostral spinal cord.
8. Discuss the arterial blood supply to the spinal cord. Include in the discussion the spinal and radicular arteries.
9. Identify and review the venous drainage of the central nervous system.
10. List and identify the bones of the skull.
11. Describe the sutures of the skull.
12. Identify the foramen of the skull and their contents.
13. Describe the anatomy of the meninges including the:
   a. dura mater
   b. arachnoid mater
   c. pia mater
14. Describe the anatomy of the dura including the falx cerebri and tentorium.
15. Review the layers of the scalp and discuss its innervation.
16. Diagram the cerebral ventricles.
17. Discuss the major arachnoid cisterns.
18. Review the anatomy of the arachnoid villi.
19. Discuss the anatomic correlates pertinent to the production, flow, and reabsorption of cerebrospinal fluid.
20. Identify and describe the gross anatomy of the spine including:
   a. atlas
   b. axis
   c. subaxial cervical vertebrae
   d. thoracic vertebrae
   e. lumbar vertebrae
   f. sacrum
   g. coccyx
   h. intervertebral disc complex
   i. supporting ligaments of the spine
21. List the muscles related to the skull and spine.
22. Describe the gross anatomy of the neck.
23. Discuss the anatomical basis for the blood-brain barrier in detail.
24. Discuss the clinical presentation in anatomical terms of syndromes of the brain and its coverings including:
   a. epidural hematoma
   b. acute subdural hematoma
   c. chronic subdural hematoma
   d. subgaleal hematoma
   e. injury to innervation of the scalp
25. Discuss the syndromes produced by mass lesions affecting the cranial nerves including:
   a. suprasellar lesions
   b. lesion of jugular foramen
   c. lesion of internal auditory canal
   d. lesions or distortion at the incisura
26. List the expected effects of destructive lesions in the basal ganglia and cerebellum.
27. Discuss the relationship of the spinal nerves to the vertebral level of exit.
28. Diagram the structures comprising the boundaries of the spinal neural foramina.
29. Describe the anatomy of common entrapment syndromes of peripheral nerve entrapments including:
   a. carpal tunnel
   b. ulnar nerve at elbow
   c. ulnar nerve at wrist
   d. lateral femoral cutaneous nerve
   e. peroneal nerve

Central Nervous System
1. Describe the gross anatomy of the brain, brain stem, cerebellum, cranial nerves, and spinal cord.
2. Describe the anatomy of the cerebral cortex including:
   a. cortical layers
   b. sensory areas
   c. motor areas
   d. prefrontal cortex
   e. fiber tracts
   f. calcarine cortex
3. Describe the anatomy of the olfactory pathways, hippocampal formation and amygdala including:
   a. rhinencephalon
   b. olfactory pathways
   c. anterior commissure
   d. hippocampal formation (including cytoarchitecture)
   e. amygdala
   f. limbic system
4. Describe the anatomy of the corpus striatum including:
   a. striatum
   b. globus pallidus
   c. claustrum
   d. subthalamic region
   e. striatal afferent and efferent connections
   f. pallidal afferent and efferent connections
   g. pallidofugal fiber systems
5. Describe the anatomy of the hypothalamus and pituitary including:
   a. cytoarchitecture of the hypothalamus
   b. afferent and efferent connections of the hypothalamus
   c. supraoptic nuclei and tracts
   d. hypophysial portal system
   e. anatomy of the pituitary stalk
   f. anterior and posterior pituitary
   g. cellular organization of the anterior pituitary
   h. hormonally active cells of the hypothalamus and pituitary
6. Describe the anatomy of the diencephalon including:
   a. midbrain-diencephalon junction
   b. caudal diencephalon

Update: May 1, 2013
c. epithalamus
d. thalamus (including nuclei)
e. thalamic radiations
f. internal capsule
g. visual pathways

7. Describe the anatomy of the cerebellum including:
   a. cerebellar cortex including organization
   b. deep cerebellar nuclei
c. cerebellar connections
d. cerebellar peduncles

8. Describe the anatomy of the mesencephalon including:
   a. superior colliculus
   b. inferior colliculus
c. pretectal region
d. posterior commissure
e. mesencephalic nuclei
f. oculomotor nerve
g. tegmentum
h. mesencephalic reticular formation
i. substantia nigra
j. crus cerebri
k. ascending and descending tracts

9. Describe the anatomy of the pons including:
   a. vestibulocochlear nerve
   b. facial nerve
c. abducens nerve
d. trigeminal nerve
e. ascending and descending tracts

10. Describe the anatomy of the medulla including:
   a. olivary nucleus
   b. medullary reticular formation
c. cranial nerves of the medulla
d. ascending and descending tracts

11. Review the location and connections of each cranial nerve nuclei. Trace the course of each cranial nerve from nucleus to end organ termination.

12. Describe the external topography and landmarks of the fourth ventricle.

13. Describe the anatomy of the spinal cord including:
   a. nuclei and cell groups
   b. cytoarchitectural lamination (Rexed laminae)
c. somatic and visceral efferent neurons
d. posterior horn neurons
e. descending tracts
f. ascending tracts
g. upper and lower motor neurons
h. somatotopic organization

**Autonomic Nervous System**

1. Distinguish pre- and postganglionic neurons.
2. Describe the sympathetic nervous system.
3. Describe the parasympathetic nervous system.
4. Review the visceral afferent fibers.
5. Describe the structure of the autonomic ganglia.
6. Discuss the central autonomic pathways.

Peripheral Nervous System
1. Differentiate between segmental and peripheral innervation.
2. Diagram the anatomy of the spinal nerve root.
3. Diagram and discuss the cervical, brachial, and lumbosacral plexi.
4. Outline the anatomy of the major peripheral nerves of the upper and lower extremity including:
   a. axillary
   b. suprascapular
   c. median
   d. ulnar
   e. radial
   f. long thoracic
   g. musculocutaneous
   h. lateral femoral cutaneous
   i. femoral
   j. obturator
   k. sciatic
   l. saphenous
   m. peroneal
   n. tibial
5. Describe the microanatomy of peripheral nerves.
6. Explain the difference between myelinated and unmyelinated nerves.
7. Review the anatomy of the Schwann cell.
8. List the peripheral afferent receptors and describe the anatomy of each.
9. Segregate peripheral neurons by size and explain the rationale for such a classification scheme.

Muscle
1. Explain the concept of the motor unit.
2. Describe the anatomy of the motor end plate.
3. Describe the microscopic anatomy of striated and smooth muscle.
4. Discuss the subcellular components of muscle.

B. Competency-Based Performance Objectives:

1. Identify at the time of surgery:
   a. occipital artery
   b. superficial temporal artery
   c. frontalis muscle
   d. pterion
   e. inion
2. Identify at the time of surgery structures visible in the lateral ventricles including:
   a. Foramen of Monro
   b. fornix
   c. caudate
   d. thalamus
   e. choroidal fissure
   f. named veins
   g. glomus of the choroid plexus
   h. hippocampus

3. Identify the parts of the vertebral column, spinal cord, and nerve roots at the time of surgery including:
   a. spinous process
   b. lamina
   c. ligamentous structures of the spinal column including:
      i. intraspinosus ligament
      ii. ligament
      iii. post-longitudinal ligament annulus
      iv. anterior longitudinal ligament
NEURORADIOLOGY

UNIT OBJECTIVES

Residents are expected to develop an increasing understanding of the radiology pertinent to neurosurgical practice over the course of their residency. This will occur during clinical rotations with didactic and practical teaching from the neurosurgical and neuroradiology faculty. A two-month off service rotation in Neuroradiology is also offered in the PGY3 year. Graduating residents will be expected to demonstrate knowledge of radiology that is pertinent to the diagnosis of diseases of the nervous system and the practice of neurological surgery as outlined below.

A. Competency-Based Knowledge Objectives:
   1. Describe precautions to be taken when performing radiation examinations.
   2. Identify the normal anatomical structures of the skull on antero-posterior, lateral, Towne, and submental vertex radiographs.
   3. List the indications for carotid and cerebral angiography.
   4. Review the potential complications to intravenous contrast agents and discuss the management of same.
   5. Identify the major arteries and veins of the neck and brain on angiograms.
   6. Describe the concepts of computerized tomographic (CT) scanning.
   7. Identify the normal anatomical structures of the scalp, skull, dura, brain, and cranial vasculature on CT scans.
   8. Describe the concepts of magnetic resonance (MR) scanning. Review the various imaging sequences which may be obtained.
   9. Identify the normal anatomical structures of the scalp, skull, dura, brain, and cranial vasculature on MR scans.
  10. Recognize common traumatic injuries which may be detected by skull radiographs including:
      a. fractures: linear, elevated, depressed, diastatic, ping pong
      b. pneumocephalus
      c. foreign bodies
  11. Recognize common pathologic conditions which may be detected by skull radiographs including:
      a. neoplasms
      b. fibrous dysplasia
      c. congenital bone diseases
      d. metabolic bone disorders
12. Recognize common traumatic injuries which may be detected by head CT including:
   a. skull fractures
   b. pneumocephalus
   c. intracranial hematomas
      i. epidural
      ii. acute subdural
      iii. chronic subdural
      vi. intraparenchymal
      v. intraventricular
   d. cerebral contusions
   e. subarachnoid hemorrhage
   f. foreign bodies

13. Recognize common pathologic conditions which may be detected by head CT including:
   a. ischemic infarction
   b. venous infarction
   c. hydrocephalus
   d. cysts
   e. tumors
   f. cerebral edema
   g. infections
   h. congenital abnormalities
   i. infections

14. Recognize common traumatic injuries which may be detected by head MR scans including:
   a. pneumocephalus
   b. intracranial hematomas
      i. epidural
      ii. acute subdural
      iii. chronic subdural
      iv. intraparenchymal
      v. intraventricular
   c. cerebral contusions
   d. diffuse axonal injury

15. Recognize common pathologic conditions which may be detected by head MR scans including:
   a. ischemic infarction
   b. venous infarction
   c. hydrocephalus
   d. cysts
   e. tumors
   f. cerebral edema
   g. vascular occlusions
   h. infections
   i. congenital abnormalities

16. Identify the normal anatomical structures of the craniovertebral junction on plain radiographs.

17. Review the radiographic diagnoses of platybasia and cranial settling.
18. Describe the plain radiographic findings of common traumatic injuries to the craniovertebral junction including:
   a. occipital condyle fractures
   b. atlanto-occipital dislocation
   c. Jefferson fractures
   d. posterior atlas fractures
   e. dens fractures
   f. axis body fractures
   g. hangman's fracture
   h. atlas and axis facet fractures
   i. atlanto-axial rotatory dislocation
19. Distinguish between orthotropic and dystropic os odontoideum.
20. Describe the common congenital abnormalities of the craniovertebral junction
21. Recognize common spinal congenital abnormalities on plain radiographs.
22. Recognize common spinal traumatic injuries which may be detected by plain radiographs including:
   a. vertebral body fractures
   b. facet fractures and dislocations
   c. posterior element fractures
   d. transverse process fractures
   e. vertebral subluxation/dislocation
23. Recognize common spinal degenerative conditions which may be detected by plain radiographs.
24. Discuss the indications for CT and MR scanning of the spine in the setting of trauma.
25. Describe the CT scan appearance of each of the traumatic spinal lesions previously listed.
26. Describe the MR scan appearance of:
   a. spinal ligament injury
   b. traumatic disc herniation
   c. spinal cord contusion
   d. spinal epidural hematoma
27. Recognize common spinal degenerative conditions which may be detected by MR including:
   a. disc degeneration
   b. disc herniation
   c. degenerative spinal stenosis
   d. facet hypertrophy
   e. osteophyte formation
   f. foraminal stenosis
   g. degenerative spondylolisthesis
   h. degenerative scoliosis
   i. ossification of the posterior longitudinal ligament
28. Identify spinal and spinal cord tumors on CT and MR scans.
29. Discuss the indications for spinal myelography.
30. Review the indications for spinal angiography.
31. Discuss the use of both the radiographic contrast and radionuclide shuntogram in evaluating neurosurgical patients.
32. Identify the common carotid and vertebral circulation congenital variants on angiograms.
33. Recognize intracranial aneurysms on angiograms.
34. Identify and characterize intracranial vascular malformations on angiograms. Recognize:
a. arteriovenous malformations  
b. venous angiomas  
c. arteriovenous fistula  
d. feeding vessels  
e. draining veins  
f. associated aneurysms  
g. degree of shunting

35. Discuss the angiographic evaluation of carotid and vertebral disease.
36. Review the role of MR angiography and venography in the evaluation of cerebrovascular disease, neoplasms, and trauma.
37. Describe the radiological evaluation of CNS vasculitis.
38. Describe the radiological evaluation of spinal vascular malformations.
39. Discuss the role of myelography in the evaluation of neurosurgical patients.
40. Discuss the radiological evaluation of suspected CNS and spinal infection.
41. Review MR neurography.
42. Describe the appearance of peripheral nerve tumors on MR scans.
43. Review the role of radionuclide scans in the evaluation of patients with suspected cranial and spinal disease.
44. Discuss the use of intraoperative radiographs and fluoroscopy.
45. List the indications for CT- and MR-guided biopsies.
46. Describe the concepts of ultrasonography.
47. Review the findings of normal and abnormal neonatal cranial ultrasound.
48. Review the findings of normal and abnormal carotid ultrasounds.
49. Discuss the use of transcranial doppler ultrasonography in the management of patients with subarachnoid hemorrhage, trauma, and occlusive vascular disease.
50. Review the indications for interventional endovascular therapies for:
   a. aneurysms  
b. vasospasm  
c. cranial vascular malformations  
d. spinal vascular malformations  
e. tumor embolization  
f. carotid and vertebral stenosis  
g. carotid and vertebral dissection
51. Describe the indications and techniques of endovascular trial occlusions.
52. Review the role of quantitative cerebral blood flow studies in the management of neurosurgical patients.
53. Describe the concepts of positron emission tomography. Review the indications for obtaining such scans.
54. Describe the concepts of functional MR imaging. Review the indications for obtaining such scans.
55. Describe the concepts of MR spectroscopy. Review the indications for obtaining such evaluations in neurosurgical patients.
56. Discuss the indications and technique of discography. Describe the procedure.
57. Discuss the indications for percutaneous vertebroplasty. Describe the procedure.

B. Competency-Based Performance Objectives:
1. Order appropriate radiological evaluations in a timely fashion.
2. Demonstrate the ability to accurately interpret the radiographic studies of trauma patients.

Update: May 1, 2013
3. Demonstrate the ability to accurately interpret carotid and vertebral angiograms.
4. Demonstrate the ability to accurately interpret spinal angiograms.
5. Demonstrate the ability to accurately interpret spinal myelograms and post-myelogram CT scans.
6. Demonstrate the ability to accurately interpret cranial and spinal CT and MR scans of nontraumatic lesions.
7. Demonstrate the ability to accurately interpret radiological examinations of neurosurgical patients.
8. Demonstrate the ability to use intraoperative ultrasonography.

NEUROPATHOLOGY

UNIT OBJECTIVES

Residents are expected to develop an increasing understanding of the pathology pertinent to neurosurgical practice over the course of their residency. This will occur during clinical rotations with didactic and practical teaching from the neurosurgical and neuropathology faculty. A two-month off service rotation in Neuropathology is also offered in the PGY2-4 years. Graduating residents will be expected to demonstrate knowledge of pathology that is pertinent to the diagnosis of diseases of the nervous system and the practice of neurological surgery as outlined below.

A. Competency-Based Knowledge Objectives: General Neuropathology

1. Describe the techniques available for examination of surgical specimens from central nervous system, peripheral nervous system, skeletal muscle, pineal and pituitary.
2. Review the use of standard chromatic, histochemical and selected immunohistochemical stains employed in the evaluation of surgical specimens from the central nervous system, peripheral nervous system, skeletal muscle, pineal and pituitary.
3. List the techniques available for morphological examination of cerebrospinal fluid and the abnormalities observed in cerebrospinal fluid from patients with meningeal carcinomatosis, meningeal lymphomatosis, pyogenic meningitis and aseptic meningitis.

Central Nervous System

1. Describe the gross and histopathological features and, when applicable, the genetic basis of the following congenital and perinatal disorders:
   a. encephaloceles and cranial meningoceles
   b. myelomeningoceles and meningoceles
   c. hydromyelia
   d. diastematomyelia and diplomyelia
   e. syringomyelia and syringobulbia
   f. Chiari I malformation
   g. Chiari II malformation
   h. Dandy-Walker malformation
   i. arachnoid cysts
   j. porencephaly
   k. aqueductal stenosis
   l. subependymal germinal matrix hemorrhages
   m. posthemorrhagic hydrocephalus
   n. periventricular leukomalacia (white matter infarcts)
2. Describe the gross and histopathological features and characteristics of the causative agents of the following infectious diseases:
   a. cranial and spinal epidural abscesses
   b. cranial and spinal subdural abscesses
   c. pyogenic bacterial meningitis and ventriculitis
   d. brain abscesses
   e. tuberculous meningitis and tuberculomas
   f. central nervous system sarcoidosis
   g. central nervous system cryptococcosis
   h. central nervous system mucormycosis
   i. central nervous system toxoplasmosis
   j. central nervous system cysticercosis
   k. Herpes simplex encephalitis
   l. central nervous system HIV infections
   m. central nervous system cytomegalovirus infection

3. Describe the gross and histopathological features of the following vascular lesions:
   a. acute, subacute, and remote infarcts
   b. border zone and watershed infarcts
   c. manifestations of embolic infarcts including those secondary to atheromatous embolization and embolization from extracorporeal pumps
   d. vasculitis including temporal arteritis, primary central nervous system vasculitis, granulomatous angiitis, and Wegener's granulomatosis
   e. moyamoya
   f. hypertensive intracerebral hemorrhages
   g. lobar intracerebral hemorrhages
   h. amyloid angiopathy
   i. malformations including arteriovenous malformations, cavernous angiomas, venous angioma and capillary telangiectases
   j. Vein of Galen "aneurysms"
   k. saccular aneurysms
   l. infectious ("mycotic") aneurysms
   m. giant aneurysms
   n. traumatic and dissecting aneurysms
   o. venous and dural sinus occlusive disease
   p. vascular malformations of the spinal cord
   q. spinal cord infarcts

4. Describe the gross and histopathological features of the following traumatic lesions:
   a. skull fractures
   b. entrance and exit gunshot wounds of the skull
   c. gunshot wounds of the brain including internal ricochet
   d. epidural hematomas
   e. acute subdural hematomas
   f. chronic subdural hematomas
   g. recent and remote cerebral contusions
   h. traumatic intraparenchymal hemorrhages
   i. diffuse axonal injury
   j. traumatic cranial nerve injuries
   k. spinal cord injuries
1. cerebral herniation syndromes  
2. fat embolization  
3. central nervous system trauma in infancy  
4. central nervous system radiation injuries  
5. manifestations of prior surgical intervention

5. Describe the gross and histopathological features and, when applicable, the metabolic basis for the following intoxications and deficiency states:
   a. hypoxic-anoxic encephalopathy  
   b. carbon monoxide intoxication  
   c. ethanol intoxication  
   d. alcoholic cerebellar degeneration  
   e. central pontine myelinolysis  
   f. CNS complications of antimicrobial therapy  
   g. CNS complications of antineoplastic therapy  
   h. CNS complications of "street drugs"  
   i. Wernicke's encephalopathy and thiamine deficiency  
   j. Subacute combined degeneration and B12 deficiency

6. Describe the gross and histopathological features of the following demyelinating diseases:
   a. multiple sclerosis  
   b. progressive multifocal leukoencephalopathy  
   c. HIV vacuolar myelopathy  
   d. postinfectious encephalomyelitis

7. Describe the gross and histopathological features and the metabolic basis for the following leukodystrophies:
   a. adrenoleukodystrophy and adrenomyeloneuropathy  
   b. Krabbe's disease  
   c. metachromatic leukodystrophy

8. Describe the gross and histopathological features and, when applicable, the genetic basis for the following dementias and degenerations:
   a. Alzheimer's disease including familial forms  
   b. vascular dementia including Binswanger's disease and cerebral autosomal dominant arteriopathy (CADASIL)  
   c. Pick's disease  
   d. other fronto-temporal dementias  
   e. Creutzfeldt-Jacob disease and other prion diseases  
   f. Parkinson's disease  
   g. diffuse Lewy body disease  
   h. Huntington's disease  
   i. amyotrophic lateral sclerosis  
   j. paraneoplastic degenerative diseases

9. Describe the gross and histopathological features and, when applicable, the biochemical and genetic basis for the following metabolic diseases:
   a. Wilson's disease  
   b. Tay Sachs disease and other GM-2 gangliosidoses  
   c. neuronal ceroid-lipofuscinoses  
   d. hepatic encephalopathy  
   e. Reye's syndrome
10. Describe the gross and histopathological features and, when applicable, the grading criteria for the following central nervous system neoplasms:
   a. diffuse fibrillary astrocytomas
   b. gemistocytic astrocytomas
   c. anaplastic astrocytomas
   d. glioblastoma multiforme including giant cell glioblastoma and gliosarcomas
   e. pilocytic astrocytomas including cerebellar, diencephalic, dorsal exophytic pontine, and cerebral pilocytic astrocytomas
   f. subependymal giant cell astrocytomas
   g. pleomorphic xanthoastrocytoma
   h. oligodendrogliomas including anaplastic oligodendrogliomas and mixed oligoastrocytomas
   i. ependymomas including myxopapillary ependymomas
   j. subependymomas
   k. choroid plexus tumors
   l. colloid cysts
   m. gliomatosis cerebri
   n. gangliocytomas and gangliogliomas
   o. dysembryoplastic neuroepithelial neoplasms
   p. central neurocytomas
   q. medulloblastomas
   r. atypical teratoid/rhabdoid tumors
   s. primitive neuroectodermal tumors and cerebral neuroblastomas
   t. olfactory neuroblastoma
   u. spinal paragangliomas
   v. meningiomas including meningotheial (syncytial) fibrous, transitional, psammomatous, angiomatic, and papillary meningiomas
   w. anaplastic and malignant meningiomas
   x. meningeal hemangiopericytomas
   y. other meningeal mesenchymal tumors
   z. meningeal melanomatosis and melanomas
   aa. hemangioblastomas
   bb. lipomas
   cc. primary central nervous system lymphomas
   dd. metastatic carcinomas including leptomeningeal carcinomatosis
   ee. teratomas
   ff. dermoids and epidermoids
   gg. schwannomas including acoustic neurinomas or vestibular schwannomas, schwannomas of other cranial nerves, and spinal root schwannomas

11. Describe the gross and histopathological features and the genetic basis for the following tumor syndromes:
   a. Neurofibromatosis type 1
   b. Neurofibromatosis type 2
   c. von Hippel-Lindau syndrome
   d. Tuberous sclerosis
   e. Cowden syndrome
   f. Turcot syndrome
Peripheral Nervous System
1. Describe the gross and histopathological features and, when applicable, the genetic and biochemical basis for the following disorders of peripheral nerves:
   a. compressive and traumatic neuropathies
   b. leprosy
   c. diabetic and uremic neuropathy
   d. Charcot-Marie-Tooth disease
   e. Guillain-Barre syndrome
   f. sympathetic dystrophy
2. Describe the gross and histopathological features of the following neoplastic and tumorous disorders of peripheral nerves:
   a. peripheral schwannoma
   b. neurofibromas
   c. malignant peripheral nerve sheath tumors
   d. spinal root and peripheral nerve root cysts

Pituitary and Pineal
1. Describe the gross and histopathological features of the following pituitary conditions:
   a. pituitary adenomas including null cell adenomas, growth hormone secreting adenomas, prolactin secreting adenomas, ACTH secreting adenomas, and oncocytomas
   b. craniopharyngiomas including adamantinomatous and squamopapillary craniopharyngiomas
   c. Rathke pouch (cleft) cysts
   d. pituitary involvement by metastatic neoplasms
   e. lymphocytic hypophysitis
   f. pituitary infarcts including pituitary "apoplexy"
   g. pituitary lesions resulting from closed head trauma
   h. empty sella syndromes
2. Describe the gross and histopathological features of the following lesions of the pineal:
   a. germinomas
   b. teratomas and embryonal carcinomas
   c. pineoblastomas and pineocytomas
   d. metastatic carcinoma

Skull and Spine (including intervertebral discs)
1. Describe the gross and histopathological features of the following disorders of the skull:
   a. dermoids and epidermoids
   b. hemangiomas
   c. osteomas
   d. chordomas
   e. solitary and multifocal eosinophilic granuloma
   f. Paget's disease including secondary osteosarcoma
   g. metastatic carcinomas
   h. plasmacytoma including myeloma
2. Describe the gross and histopathological features of the following disorders of the spine and intervertebral discs:
   a. herniated inter-vertebral discs
   b. pyrophosphate disease including involvement of ligamentum flavum
c. tumoral calcinosis
d. hemangiomas
e. chordomas
f. eosinophilic granulomas
g. metastatic carcinomas including epidural metastases
h. plasmacytoma including myeloma
i. lymphomas
j. primary bone tumors
k. spinal osteomyelitis including tuberculous and fungal spinal osteomyelitis

Eye and Orbit
1. Describe the gross and histopathological features of the following ocular lesions:
   a. retinoblastomas
   b. ocular melanomas
2. Describe the gross and histopathological features of the following orbital lesions:
   a. optic nerve gliomas
   b. optic nerve meningiomas
   c. orbital lymphomas and pseudotumors
   d. orbital metastases

Miscellaneous
1. List the gross and histopathological features found in temporal lobectomy and cerebral hemispherectomy specimens removed during epilepsy surgery.
2. Review the gross, histopathological, and cytopathological features that can be observed in shunt revision specimens.
3. Describe the gross, histopathological, and cytopathological features that can be observed with indwelling pump and intrathecal catheter specimens.
4. Cite the techniques for examination of foreign objects removed from the nervous system and the need for documentation of chain of custody when of potential legal significance.
5. Describe the histopathological features of myotonic dystrophy and central core myopathy and list the potential implications of these diseases with regard to adverse anesthetic reactions including development of malignant hyperthermia.
PATIENT CARE AND MEDICAL KNOWLEDGE

PGY2-4 CLINICAL ROTATIONS

Neurosurgery residents are expected to develop an increasing understanding of the subspecialties of neurosurgical practice over the course of their residency. This will occur during clinical rotations on the various subspecialty services and via didactic and experiential teaching from the neurosurgical faculty. Each of the first three years of the neurosurgery residency the resident will spend two months on the Red Service (emphasis on cerebrovascular, endovascular, peripheral nerve and skull base and tumor surgery), two months on the Blue Service (emphasis on spine, pain management, epilepsy, stereotactic and functional neurosurgery), two months on the White Service (neurotrauma and neurocritical care) and two months on the Pediatric Service. In addition, a two-month clinical elective on one of the neurosurgery services at Penn State Hershey or at Penn State neurosurgery at Wyoming Valley will occur each year. A two-month off service rotation also occurs each year. As residents progress through the program they will be expected to demonstrate knowledge and skills pertinent to the neurosurgical subspecialties as outlined below.

1. Cerebrovascular

A. Competency-Based Knowledge Objectives:

1. Describe the location of key perforating arteries involving the anterior and posterior circulation, their target distribution, and the consequence of occlusion or injury.

2. Identify the classic syndromes of vessel occlusion of the
   a. including internal carotid artery
   b. middle cerebral artery
   c. anterior cerebral artery
   d. recurrent artery of Heubner
   e. anterior choroidal artery
   f. vertebral artery
   g. posterior inferior cerebellar artery (PICA)
   h. lower and upper basilar trunk

3. Identify the classic brainstem ischemic syndromes.

4. Explain the concepts of cerebral blood flow, cerebral autoregulation (hemodynamic and metabolic), ischemic thresholds, intracranial pressure, cerebral perfusion pressure. Describe the impact of intracranial hypertension with and without mass lesion on cerebral blood flow.

5. Recognize the common causes of brain ischemic states including:
   a. cardiac embolism
   b. embolism from proximal vasculature
   c. large vessel occlusion
   d. intracranial conducting vessel occlusion
   e. small vessel disease

6. Associate computed tomography (CT) and magnetic resonance (MR) evidence of ischemic injury with likely anatomic substrate.

7. Describe the epidemiology, physiology, and underlying pathophysiology of ischemic brain injury, including concepts of critical therapeutic window.

8. Recognize the common causes of intracranial and intraspinal hemorrhage including:
   a. aneurysmal disease
   b. vascular malformations
   c. hypertension
Update: May 1, 2013

B. Competency-Based Performance Objectives:
1. Adapt comprehensive evaluation to specific pertinent positives and negatives with regard to ischemic and hemorrhagic stroke.
2. Demonstrate an understanding of urgency and the ability to prioritize during emergent aspects of hemorrhagic and ischemic disease states.
3. Demonstrate the ability to manage cardiac and pulmonary complications following cerebrovascular illness and therapy, and review the need for specialty and subspecialty consultations.
4. Apply the principles of perioperative care following common endovascular and surgical procedures directed at cerebrovascular disease.
5. Demonstrate the ability to be vigilant in the clinical detection of subtle neurological change during the acute and subacute phases of illness.
6. Define the proper placement of a craniotomy flap in the planned surgical evacuation of hematoma. This should be performed using both topographical as well as stereotactic-assisted navigation techniques.
8. Assist during pterional craniotomy for vascular disease.

2. Neuro-Oncology and Skull Base Surgery

A. Competency-Based Knowledge Objectives:
1. List differential diagnoses of lesions requiring biopsy and describe their pathophysiology.
2. List the various types of bone tumors involving the calvarium.
3. Describe and differentiate:
   a. astrocytomas, including the accepted World Health Organization grading scheme.
   b. gliomas other than astrocytomas.
   c. metastatic tumors, including location and common origins.
   d. infectious, granulomatous, and cystic lesions that may present in a tumor-like manner.
4. Define the cell or origin of meningioma, its common intracranial locations, and the expected presentation for each location.
5. Define the embryological origin of arachnoid cysts and their natural history; list the etiologies of other cystic lesions of the brain, including tumoral and infectious.
6. Describe the anatomic location, cell of origin, clinical presentation, age at presentation, and natural history of common intrinsic posterior fossa neoplasms, including cerebellar astrocytoma, medulloblastoma, and ependymoma.
7. Describe the various tumors that may arise in the cerebello-pontine angle (CPA).
8. Describe the management of a patient with a brain abscess, including the role of stereotactic drainage or open drainage.
9. Explain the medical work up of a patient with a diagnosed brain abscess.
10. Specify the follow up and evaluation of the patient with a brain abscess following surgical treatment.
11. Describe the embryological origin of craniopharyngioma. List the common locations of the tumor.
12. Describe the common presentations of pituitary tumors, the cell of origin, and endocrinopathies associated with:
   a. null cell adenomas
   b. somatotroph adenomas
   c. prolactinomas
   d. corticotroph secreting adenomas
   e. thyrotrrophic-secreting adenoma
Define the medical management of the secreting pituitary tumors. Explain the role of surgery in each of the tumors above.
13. Describe the etiology of fibrous dysplasia, its presentation and general management. List the indications for surgery for benign tumors of bone at the base of the skull, and potential adjuvant therapy.
14. List the tumors that may be routinely approached through a transtemporal route.
15. Describe the indications for use of lumbar spinal drainage in skull base surgery, and its implementation. List all complications associated with continuous lumbar spinal drainage.
16. Illustrate the general principles of stereotaxis and the underlying localization techniques used in the presently used frame-based and frameless systems.

B. Competency-Based Performance Objectives:
1. Understand the positioning of patients for craniotomy and craniectomy.
2. Assist in the opening and closing of craniotomies and craniectomies for neoplasms.
3. Place lumbar drains.
4. Demonstrate the ability to open and close scalp incisions.
5. Perform ventriculostomies.

3. Pain Management

A. Competency-Based Knowledge Objectives:
1. Differentiate the basic categories of pain syndromes:
   a. acute
   b. chronic
   c. nociceptive
   d. neuropathic (including complex regional pain syndromes)
   e. myofascial
   f. cancer-related
   g. post-operative
2. Explain the concept of pain as a biopsychosocial disorder.
3. Discuss the role of rehabilitation in pain management.
5. Discuss methods of assessing outcomes of pain treatment and describe common assessment tools.
6. Describe a typical history and medical management of a patient with trigeminal neuralgia, trigeminal neuropathic pain, and atypical facial pain.
7. Discuss the potential complications of percutaneous procedures for trigeminal neuralgia.
8. Identify the primary indications for spinal cord stimulation, peripheral nerve, stimulation, and intraspinal (epidural, intrathecal) drug infusion therapy.
10. List the common mechanisms of peripheral nerve injury and describe the changes which occur in an injured nerve at both the microscopic and macroscopic level. Explain the theories of pain generation in peripheral nerve injury.
11. Describe the pharmacology of local anesthetic agents (e.g., lidocaine, procaine, tetracaine, bupivacaine) and the use of epinephrine with local anesthetic agents.
12. Discuss the indications for peripheral neural blockade. Explain the principles of blocking procedures including the techniques and expected outcomes. Cite the complications of peripheral neural blockade (including anaphylaxis, neural injury, intravascular or intrathecal administration). List the alternatives to temporary blockade including neurolytic blocks, ablative neurosurgical procedures, augmentative neurosurgical procedures, alternative traditional pain management procedures, and alternative medicine approaches.
13. Review the indications for radiofrequency facet rhizolysis.
14. Discuss the anatomy and biomechanics of the facet complex with emphasis on bone, cartilage, fibrous capsule, synovial fluid, and innervation of this structure.

B. Competency-Based Performance Objectives:
1. Formulate and implement treatment plans for simple pain syndromes (e.g., acute post-operative pain, acute low back pain).
2. Evaluate and diagnose a patient with trigeminal neuralgia, trigeminal neuropathic pain, and atypical facial pain.
3. Assist with radiofrequency, glycerol or balloon compression neurolysis of the trigeminal nerve in patients with trigeminal neuralgia.

4. Assist with surgical exploration of the trigeminal nerve, nervus intermedius, or glossopharyngeal nerve for MVD or rhizotomy.

5. Illustrate appropriate patient selection for spinal ablative or augmentative procedures for pain management.

6. Locate the spinal epidural space and place a percutaneous spinal cord stimulation electrode with supervision.

7. Assist with implantation of a plate electrode for spinal cord stimulation.

8. Insert with supervision a spinal catheter for drug administration.

9. Implant with supervision a spinal cord stimulation system pulse generator/receiver and extension wire.

10. Implant with supervision an intraspinal drug infusion pump.

11. Assist with spinal ablative procedure for pain management (cordotomy, myelotomy, DREZ).

12. For peripheral nerve repair, neurectomy, and neurolysis perform, record, and report complete patient evaluation and assessment, including comprehensive neuromuscular examination of affected nerve distribution.

13. Evaluate electrodiagnostic studies pertaining to peripheral nerve injury.

14. Assist in surgical treatment of peripheral nerves.

15. Assist with implantation of a peripheral nerve stimulation system.


17. Recognize and treat the potential complications of dorsal root ganglionectomy including cerebrospinal fluid leak, infection, and local wound problems.


19. Assess patients for appropriateness of local anesthetic block(s).

20. Perform simple superficial blocks with supervision and assist in complicated procedures. Following such procedures:
   a. assess outcome of nerve block
   b. recognize and treat complications
   c. record and monitor effects of block over a specified time interval
   d. assess need for repeat blocks

21. Assess patient for appropriateness of ablative neurolysis. Perform simple superficial neurolysis with supervision and assist in complicated procedures. Following ablative neurolysis:
   a. assess outcome of procedure
   b. recognize and treat complications
   c. record and monitor effects of neurolysis over a specified time interval
   d. assess need for repeat procedures

4. Pediatrics

   A. COMPETENCY-BASED KNOWLEDGE OBJECTIVES:
   Myelomeningocele and its variants, meningocoele, encephalocoele, Chiari malformations, occult spinal dysraphism, split cord anomalies, segmentation anomalies, craniofacial syndromes and phakomatosis

Update: May 1, 2013
1. List the abnormalities a neurosurgeon may treat which are congenital/developmental in nature and classify them with respect to their embryology defect.
2. Describe the incidence, epidemiology and inheritance patterns.
3. State other disorders associated with this set of diseases.
4. Describe the anatomic and pathophysiologic parameters which distinguishes amongst these diseases.
5. Develop a diagnostic treatment plan along with prognostication of outcome with optimal treatment.
6. List disorders which may be referred for neurosurgical care but do not require surgery.
7. Display current knowledge of the molecular basis for these diseases where known.
8. Describe the expected outcome if treatment is not undertaken.

**Hydrocephalus and Other Disorders of CSF Circulation**
1. Delineate the different etiologies of hydrocephalus and their relative incidence.
2. Explain how to differentiate between CSF collections which require treatment and those which do not.
3. Indicate the various treatment options for the management of hydrocephalus.
4. Distinguish between treatment options for hydrocephalus with normal CSF and contaminated (e.g. infection, blood) CSF.
5. List the complications associated with each treatment option for hydrocephalus and the diagnosis and treatment of same.
6. Differentiate between low-pressure and high-pressure hydrocephalus.
7. Describe the presentations and diagnostic approach to a patient with suspected shunt malfunction.
8. Define how the diagnosis of hydrocephalus is made.
9. List nonsurgical diseases which may be mistaken for hydrocephalus but require treatment different than surgery.

**Neoplasia**
1. Delineate the differences between pediatric and adult tumors.
2. List the common tumor types occurring in children and their typical location.
3. Describe the changing tumor type and location based upon age.
4. Identify lesions which require biopsy as part of the treatment/diagnostic plan.
5. Describe the typical presentations of tumors.
6. Describe appropriate evaluation for patients suspected of having a tumor.
7. Classify tumor types as to degree of malignancy, role of surgical vs. nonsurgical therapy, and outcomes of optimal treatment.
8. Discuss the possible complications associated with specific tumor types.
9. Describe the pertinent anatomy for surgical treatment of midline or hemispheric cerebellar tumors and hemispheric cerebral tumors.
10. Discuss appropriate preoperative management of patients with tumors.
11. Compare the role of biopsy, subtotal resection and total resection in the management of tumors.
12. List possible complications of the treatment options, their diagnostic evaluation and treatment.

**Infection**
1. Describe the presentations of a shunt infection.
2. List the indications for ventricular lumbar and subarachnoid CSF sampling.
3. List the common organisms seen in shunt infections.
4. Describe optional treatment plans for shunt infection.
5. List risk factors and risks of shunt infection and the proper diagnostic protocol to establish the presence of a shunt infection.
6. Describe common presentations of intracranial and intraspinal suppuration.
7. List host risk factors which are associated with CNS infections.
8. Describe appropriate diagnostic protocol to establish the presence of CNS infection.
9. Discuss the timeliness and utility of surgical therapy for the treatment of CNS infection both shunt-related and non-shunt-related.

Other
1. Delineate the various types of spasticity and movement disorders seen in children.
2. List seizure types.
3. Describe surgical lesions which may be related to seizures.
4. Describe surgical and non-surgical treatment options regarding the alleviation of spasticity in children.

Cerebrovascular
1. Delineate the possible causes of an atraumatic intracerebral or subarachnoid hemorrhage.
2. Delineate the possible causes of cerebral infarction/ischemia.
3. Discuss the common locations of arteriovenous shunts and their presentation, evaluation, and treatment (includes dural AVM).
4. Discuss the embryology of the cerebral and spinal vasculature and its possible role in vascular anomalies in children.
5. Describe the common locations and types of aneurysms seen in children and how they differ from those seen in adults.
6. List the possible presentations of Vein of Galen aneurysms, their diagnosis and management.
7. List the possible causes of aneurysms in children which are not congenital in nature.

Trauma
1. List the appropriate diagnostic tests to evaluate a child who has sustained multisystem trauma.
2. Describe the Glasgow Coma Scale and its use.
3. List the salient historical and exam feature which lead one to the diagnosis of non-accidental trauma.
4. Discuss the management of the cervical spine in a child who is comatose.
5. Describe the anatomy of the child's spine which causes the epidemiology of spinal cord injury to differ from adults.
6. Describe the common injuries seen as a result of birth trauma and discuss their diagnosis and management.
7. Describe the use of antibiotics and anticonvulsants in CNS trauma.
8. List the evaluation and management of a child who has sustained a head injury with loss of consciousness but is now awake.
9. Discuss the management of depressed skull fractures, both open and closed.
10. Describe the diagnosis and management of spinal column injury.
11. Discuss the diagnosis and management of spinal cord injury without radiologic abnormality (SCIWORA).

Update: May 1, 2013
12. Describe the intracranial pressure (ICP) compliance curve and discuss its utility in the management of head injury.
13. List the parameters needed to decide on letting an athlete who has sustained a CNS injury return to activity.
14. Discuss the importance and interplay between ICP and cerebral perfusion pressure (CPP) in the management of head and spinal cord injury.
15. Define the concept of "secondary injury".
16. Discuss the role of invasive monitoring in all its forms in closed head injury (CHI).

B. Competency-Based Performance Objectives:
1. Perform complete history, physical examination and assessment on newborns, infants, and children.
2. Interpret results of the physical examination, laboratory and radiological studies to arrive at a differential diagnosis.
4. Perform a shunt tap.
5. Perform a twist drill or burr hole for subdural, parenchymal, or ventricular access or as part of a craniotomy.
6. Perform a craniotomy or craniectomy for evacuation of subdural or epidural lesion.
7. Perform a craniectomy as part of skull biopsy.
8. Perform craniotomy for elevation of depressed skull fracture.
9. Place a ventriculoperitoneal, jugular, or pleural shunt.
10. Revise a ventriculoperitoneal, jugular, or pleural shunt.
11. Perform a cranioplasty with artificial material or homologous material.
13. Position a patient for intracranial or intraspinal surgery.
14. Demonstrate an ability to open and close cranial and spinal wounds to include dural opening and repair.
15. Complete a sagittal synostectomy.

5. Peripheral Nerve

A. Competency-Based Knowledge Objectives:
1. Discuss the patho-physiological response to various injuries by a nerve
   a. compression
   b. ischemia
   c. metabolic
   d. concussive
   e. stretch
2. Define and discuss apoptosis.
3. Discuss nerve regeneration
   a. sprouting
   b. nerve growth factors
   c. rate of growth
   d. re-myelination
4. Define Neuroma
   a. axonal-sensitivity
b. mechan-sensitivity  
c. neuroma-in-continuity

5. Define the pathophysiology and clinical significance of the Tinel sign.

6. Describe the symptoms and signs of typical nerve injuries.
   a. entrapment syndromes
   b. stretch injuries
   c. laceration injuries
   d. concussive injuries
   e. injection injuries

7. Distinguish upper versus lower motor neuron symptoms and signs in nerve injury.
   a. anatomical definition
   b. degree of atrophy
   c. distribution of weakness
   d. reflex changes
   e. potential for recovery

8. Describe the classification of nerve injury
   a. Seddon classification
   b. Sunderland classification

9. Describe the rating scales for motor power

10. Describe the symptoms and signs of common nerve entrapments
    a. carpal tunnel
    b. ulnar entrapment at the elbow
    c. lateral femoral cutaneous nerve
    d. peroneal at fibular head

11. Describe the changes in EMG and NCV in nerve entrapment.

12. Define
    a. coaptation
    b. neurorrhaphy
    c. neurotization
    d. nerve transfer

**B. Competency-Based Performance Objectives:**

1. Based on history and physical anatomically localize the lesion
2. Obtain appropriate ancillary tests
   a. EMG/NCV
   b. metabolic screens
   c. imaging studies
3. Formulate a differential diagnosis for common entrapments
4. Position and prep for common entrapment releases.
5. Perform a diagnostic nerve and muscle biopsy.
6. Obtain sural nerve for grafting.

6. Spine

**A. Competency-Based Knowledge Objectives:**

1. Review the signs, symptoms, and pathophysiology of common syndromes of degenerative spinal disorders: radiculopathy, myelopathy, and neurogenic claudication.
2. Identify the common syndromes of spinal cord injury, including complete transverse injury, anterior cord injury, Brown-Sequard injury, central cord injury, cruciate paralysis, syringomyelia, conus syndrome and sacral sparing. Describe the pathophysiology of spinal cord injury.

3. Describe the cauda equina syndrome.

4. Recite the differential diagnosis of cervical, thoracic, and lumbar pain.

5. Discuss the indications for cervical, thoracic, and lumbar discectomy.

6. Identify non-surgical spinal cord syndromes including amyotrophic lateral sclerosis, demyelinating conditions, and combined systems disease.

7. Review the initial management of spine and spinal cord injured patients including immobilization, traction, reduction, appropriate radiographic studies, and medical management.

8. Classify fractures and dislocations of the craniocervical region, subaxial cervical spine, thoracic, thoracolumbar junction, lumbar, and sacral spine. Describe the mechanism of injury and classify the injuries as stable or unstable. Review the indications for surgical management.

B. Competency-Based Knowledge Objectives:

1. Prepare patients for spinal surgery, including proper positioning, protection to pressure points, and placement of indicated arterial and central venous catheters, indwelling urinary catheters and anti-embolism devices.

2. Perform lumbar punctures and placement of lumbar drains.

3. Demonstrate the ability to place and manage a halo vest, including indications for placement and criteria removal.

4. Demonstrate the ability to properly place the Mayfield head holder and other headrests.

5. Demonstrate the ability to harvest autologous bone graft from the calvarium, rib, fibula, and anterior or posterior iliac crest.

6. Perform dorsal exposure of the spinous processes, lamina, and facets of the cervical, thoracic, and lumbar spine.

7. Demonstrate the ability to close dorsal, ventral and lateral spinal incisions.

8. Demonstrate the ability to perform, with supervision, a lumbar decompressive laminectomy for spinal stenosis.

9. Demonstrate the ability to excise, with supervision, a herniated lumbar disc.

7. Epilepsy/Stereotactic/Functional

A. Competency-Based Knowledge Objectives:

1. Discuss the considerations of stereotactic frame placement in regard to target localization, purpose of procedure (biopsy, craniotomy, functional, radiosurgery).

2. Define and distinguish each of the following entities:
   a. tremor
   b. rigidity
   c. dystonia
   d. chorea
   e. athetosis.

3. Describe the pathophysiology of Parkinson's disease, cerebellar tremor.

4. Explain the primary symptoms treated by ventro-lateral (VL) thalamotomy pallidotomy.
5. Discuss the advantages, disadvantages of stereotactic biopsy compared to open biopsy procedures.
6. Discuss the differential diagnosis of a newly discovered ring-enhancing intracranial mass.
7. Discuss the differential diagnosis of a newly discovered non-enhancing intracranial mass.
8. Define different seizure types (partial, partial-complex, generalized, etc).
10. Describe the anatomy of the mesial temporal lobe.
11. Define brachytherapy.
12. Review the limitations of conventional care for patients with high-grade gliomas.
14. Explain the differences between radiosurgery and radiation therapy.
15. List the potential indications for radiosurgery.
16. List the reported complications of radiosurgery.
17. Compare advantages, disadvantages of frame-based or frameless stereotactic craniotomies to non-stereotactic craniotomies.

B. Competency-Based Performance Objectives

1. Place stereotactic frame.
2. Perform biopsy using frame based and frameless stereotactic approaches.
3. Correctly localize lesions using frame based and frameless stereotactic approaches.

8. Trauma/Critical Care

A. Competency-Based Knowledge Objectives:

1. Describe the systematic assessment of polytrauma patients.
2. Rank management priorities in polytrauma patients appropriately.
3. Discuss principles of resuscitation of polytrauma patients.
4. Name an initial choice for intravenous fluids for a newly admitted ICU patient and explain changes in that choice based upon specific changes in the patient's electrolyte or volume status.
5. Propose appropriate initial ventilator settings for patients with different types of common neurosurgical conditions and explain changes in that choice based upon specific changes in the patient's metabolic or pulmonary status.
6. List the mechanisms of action and potential complications of commonly used pressors and hypertensive agents.
7. Discuss indications, pharmacologic mechanism, duration of action, and effect on the neurologic examination for sedative and analgesic agents commonly used in the ICU.
8. Explain the indications, advantages, and risks for various hemodynamic monitoring tools (e.g., pulmonary artery catheters, indwelling arterial lines) used in critically ill patients.
9. Discuss the pathophysiology and management of coagulopathy after head injury.
10. Describe basic principles of nutritional management in neurosurgical critical care.
11. Explain the treatment of posttraumatic seizures.
12. Outline basic principles of ICU management of patients with spinal cord injury.
13. Discuss the evaluation, treatment, and prognosis of subarachnoid hemorrhage, both traumatic and spontaneous.
14. Explain the evaluation and management of birth-related intracranial hemorrhage, spinal cord injury, and brachial plexus injury.
15. List principles of rehabilitation of different types of neurosurgical patients.
16. Define brain death and discuss methods of making such a diagnosis.

B. Competency-Based Performance Objectives:
1. Insert intravascular monitoring devices for use in the hemodynamic management of critically ill patients, including central venous lines, pulmonary artery catheters, and arterial catheters.
2. Insert intracranial pressure monitoring devices, including ventriculostomy catheters and electronic (fiberoptic or miniaturized strain gauge) devices.
3. Perform twist-drill or burr-hole drainage of subdural fluid collections.
4. Decide appropriately which patients require emergency craniotomy and other procedures.
5. Position patients appropriately for procedures/surgery and begin emergency procedures if more experienced neurosurgeons have not yet arrived.
6. Assist with closure of craniotomies.
7. Perform elective tracheostomies and be able to perform emergency tracheostomies.
8. Be able to intubate patients in both emergency and elective situations.

PATIENT CARE AND MEDICAL KNOWLEDGE

PGY5 SENIOR RESIDENT CLINICAL ROTATION

Neurosurgery residents are expected to develop an increasing understanding of the subspecialties of neurosurgical practice over the course of their residency. This will occur during clinical rotations on the various subspecialty services and via didactic and experiential teaching from the neurosurgical faculty. Each of the first three years of the neurosurgery residency the resident will spend two months on the Red Service (emphasis on cerebrovascular, endovascular, peripheral nerve and skull base and tumor surgery), two months on the Blue Service (emphasis on spine, pain management, epilepsy, stereotactic and functional neurosurgery), two months on the White Service (neurotrauma and neurocritical care) and two months on the Pediatric Service. In addition, a two-month clinical elective on one of the neurosurgery services at Penn State Hershey or at Penn State neurosurgery at Wyoming Valley will occur each year. A two-month off service rotation also occurs each year. The fourth year of the program is the senior resident year. The senior resident is not assigned to a particular clinical service but is assigned by the chief resident to more challenging cases in the operating room, neuroendovascular suite and radiosurgical suite. With the approval of the program director the senior resident may elect to spend six months working under the supervision of Drs. Agarwal and de Luna in the Penn State Neurosurgery facilities at Wyoming Valley. While there, they will see patients in the outpatient clinics, in the operating room, in the neuroendovascular suite and in the radiosurgery suite. During the NS4 year the Senior Resident will assume greater responsibility for patient care, education and administrative duties. By the time residents have completed their PGY 5 year they are expected to demonstrate competencies in each of the neurosurgical subspecialties, as listed below that would allow them to assume the role of Chief Resident.

1. Cerebrovascular

A. Competency-Based Knowledge Objectives:
1. Explain the principles of ischemic neuronal protection and salvage.

B. Competency-Based Performance Objectives:
1. Perform pterional craniotomy for vascular disease
2. Demonstrate the ability to make independent management decisions regarding ischemic and hemorrhagic stroke states.
3. Demonstrate efficient prioritization skills for clinical assessment of multiple simultaneous problems in the same or different patients. Display a clear sense of prioritization regarding timing and urgency of medical and surgical intervention for ischemic and hemorrhagic stroke states. Recognize the impact of systemic conditions on prioritization and timing issues.
4. Correctly interpret and respond to changes in patient status related to systemic and neurological parameters.
5. Implement patient-care protocols regarding perioperative management.
6. Display skills in prioritization of diagnostic interventions, including the choice and sequence of studies in the setting of ischemic and hemorrhagic states.
7. Perform frameless navigation procedures.
8. Perform routine and complicated twist drill or burr-hole procedures for the drainage of the ventricular system or intracranial hematomas.
9. Perform exposure of the cervical carotid artery for endarterectomy or proximal arterial control.
11. Demonstrate an understanding of the planning and performance of pterional craniotomy for intracranial vascular pathology. Perform pterional craniotomy with initiation of microsurgical clinical skills. Observe the microsurgical dissection of the Sylvian fissure and basal cisterns for vascular pathology.
12. Perform the surgical approach to vascular structures via a craniotomy other than pterional.
13. Supervise and assist Junior Residents in burr-hole and twist-drill procedures for ventricular access or intracranial pressure monitoring.

2. Neuro-Oncology and Skull Base Surgery

A. Competency-Based Knowledge Objectives:
1. Describe appropriate postoperative management with drainage of brain abscess or cyst.
2. Describe the appropriate surgical management and postoperative treatment of bony skull lesions.
3. Describe the role of surgery in arachnoid cysts, infectious cysts, and in tumor-related cystic lesions. Describe the adjuvant treatment of parasitic cysts.
4. Explain the rationale and indications for various skull base approaches to the anterior, middle and posterior cranial fossae. Identify the important anatomical landmarks for each approach. Illustrate the general principles used in prophylaxis of CSF leaks employed in skull base surgery.
5. Describe their neurosurgical management for the following tumors involving the anterior cranial fossa:
   a. meningioma
   b. fibrous dysplasia
c. esthesioneuroblastoma
d. osteoma of the frontal sinus
e. chondroma, chordoma
f. mucocele
g. bony metastases.

6. Explain the use of the balloon occlusion test of the carotid artery, its indication for use in skull base tumor surgery, how it is performed, and how the information gained influences surgical management.

7. Explain the surgical advantage of transposing the facial nerve during a transtemporal skull base approach.

8. Describe the transcondylar approach, the relationship of the lower cranial nerves, and the exposure gained over a routine suboccipital craniectomy.

9. Illustrate the transpetrosal approach, and the relationship of the transverse and sigmoid sinus with skull bony landmarks such as the asterion, mastoid and inion. Describe the intradural course of the trochlear nerve, trigeminal nerve through Meckel's cave and the abducens nerve and Dorello's canal.

10. Describe the surgical management of the frontal sinus which has been exposed during craniotomy for anterior skull base surgery. Illustrate the development and use of a frontal vascularized pericranial flap and explain its indication. Similarly, illustrate the use of a myocutaneous flap of the temporalis muscle and list the locations for application.

11. Describe the general methods employed for embolization of tumors of the head and neck, and the indications for such procedures.

12. Compare and contrast the methods for stereotactic radiation, including particle beam, gamma ray or linear accelerator, and the indications for each technique.

B. Competency-Based Performance Objectives:

1. Independently determine a differential diagnosis based on the patient's history, physical examination, and radiographic studies.

2. Perform the opening and closing of craniotomies and craniectomies under supervision.

3. Assist in the resection of intracranial neoplasms.

4. Resect skull lesions.

5. Operatively treat supra- and infratentorial brain abscesses.

6. Demonstrate the ability to manage post operative complications including but not limited to:
   a. brain edema
   b. meningitis
   c. cranial flap infection
   d. postoperative seizures

7. Assess the need for appropriate pre, intra, and postoperative monitoring.

3. Pain Management

Update: May 1, 2013
A. Competency-Based Knowledge Objectives:

1. Name and differentiate the major classes of medications that are used commonly for pain treatment (opioids, non-steroidal and acetaminophen, antidepressants, anticonvulsants).
2. Review the psychosocial issues that may influence a pain disorder and describe the role of behavioral interventions in pain management.
3. Explain the rationale for multidisciplinary management of pain disorders.
5. Explain the basis of chemical, balloon compression, and radiofrequency neurolysis as applicable to the trigeminal nerve.
6. Relate subcortical and brain stem sites that appear to be involved in the modulation of nociception to targets for deep brain stimulation (DBS) for pain control.
7. Explain how central neurostimulation (cortical, subcortical) is thought to produce analgesia.
8. Explain the role of ablative brain and brain stem procedures, e.g., cingulotomy, mesencephalic tractotomy, trigeminal tractotomy, in the management of chronic benign pain and cancer pain.
9. Discuss the possible complications of subcortical and brain stem ablative procedures for deafferentation pain.
10. List the primary indications for the following spinal ablative lesions: dorsal root entry zone lesion, open and percutaneous anterolateral cordotomy, myelotomy.
11. Discuss spinal cord stimulation (SCS), including types of stimulation systems and electrodes available, basic techniques of insertion of percutaneous and plate electrodes, the rationale and goals of intraoperative SCS testing (paresthesiae coverage of painful area, avoidance of undesirable stimulation), the rationale and techniques for trialing SCS, and advantages and disadvantages of different sites of implantation of SCS pulse generator/receiver.
12. Explain the key aspects of intraspinal drug administration, including the pharmacology of intraspinal drugs, the various types of infusion systems available, the rationale for trialing intraspinal drug infusions, basic techniques for insertion of intrathecal and epidural catheters, and the proper location for infusion pump implantation.
13. Discuss the role of neurectomy and neurolysis for pain control in nerve injury and compare alternative techniques for pain control.
14. Describe the anatomy of the dorsal root ganglion, the bony anatomy of the nerve root foramen and the location of the ganglion within that foramen. Discuss indications for ganglionectomy and describe long term outcome from ganglionectomy with emphasis on pain recurrence and deafferentation.
15. Describe the indications for peripheral nerve stimulation and contrast to spinal cord stimulation.
16. Describe indications for ablative peripheral neurolysis. Review the pharmacology and histopathologic effects of neurolytic agents (e.g., phenol, glycerine/glycerol, chlorcreosol, absolute alcohol, ammonium chloride/ sulfate).
17. Discuss basic principles of ablative neurolytic procedures in terms of technique, expected outcomes, complications including neural injury, injury to surrounding soft tissue, inadvertent intravascular or intrathecal administration. Describe the alternatives to neurolysis including temporary anesthetic blocks, ablative neurosurgical procedures, augmentative procedures, alternative traditional pain management procedures, and alternative medicine approaches.

Update: May 1, 2013
18. Describe the principles of radiofrequency lesioning probe, thermocouple or thermistor, time, duration, and intensity of heat, and isotherm fields.

19. Discuss basic principles of radiofrequency facet rhizolysis and list the equipment utilized, technique employed, expected outcomes, and complications (including damage to other nerve root branches, potential for spinal instability, inadvertent damage to radicular artery, CSF leak, and spinal cord injury).

20. Compare the alternatives to radiofrequency lesioning
   a. local anesthetic facet blocks
   b. epidural injections
   c. neurolytic facet blocks
   d. ablative neurosurgical procedures
   e. augmentative neurosurgical procedures
   f. alternative traditional pain management procedures
   g. alternative medicine approaches
   h. surgical intervention such as instrumentation and fusion

B. Competency-Based Performance Objectives:

1. Formulate and implement an appropriate treatment program for complicated pain syndromes (e.g., chronic back pain, "failed back surgery syndrome").
2. Assess the need for multidisciplinary management of pain disorders.
3. Demonstrate appropriate management of psychosocial factors complicating a pain disorder.
4. Employ the Hartel technique to perform radiofrequency, glycerol or balloon compression neurolysis of the trigeminal nerve in patients with trigeminal neuralgia.
5. Implant a plate electrode.
6. Demonstrate appropriate methods for trialing spinal cord stimulation and intraspinal drug administration systems.
7. Implant a peripheral nerve stimulation system.
8. Assess patient for appropriateness of radiofrequency facet blocks. Perform radiofrequency facet blocks with supervision. Following the performance of such procedures:
   a. assess outcome of facet blocks
   b. recognize and treat complications
   c. record and monitor effects of facet blocks over a specified time interval
   d. assess need for repeat facet blocks
9. Diagnose and formulate appropriate treatment plans for sympathetically maintained pain.
10. Diagnose and formulate an appropriate treatment plan for a patient with occipital neuralgia.

4. Pediatrics

A. Competency-Based Knowledge Objectives:

Myelomeningocele and its variants, meningocele, encephalocele, Chiari malformations, occult spinal dysraphism, split cord anomalies, segmentation anomalies, craniofacial syndromes and phakomatosis

1. Enumerate the indications for surgery, surgical options and expected outcomes for each disease entity.
2. Explain the indications for and utility of intraoperative monitoring.
3. Describe appropriate timing of intervention and its rationale.
4. Describe the pathophysiology and presentation of the tethered cord syndrome.

Hydrocephalus and Other Disorders of CSF Circulation
1. Describe normal ICP dynamics and its use in the differential diagnosis of CSF flow disturbance.
2. Define "slit ventricle system" and how it is diagnosed and treated.
3. Define "brain compliance" and relate how that can affect ventricular size.
4. List indications for and describe technique of accessing a shunt for CSF samples.
5. List disease states which are commonly associated with hydrocephalus.

Neoplasia
1. Discuss the differential diagnosis and evaluation of tumors located in the following areas:
   a. suprasellar
   b. pineal region
   c. intraventricular
2. Discuss the treatment/diagnostic options for tumors in each location listed in #1 including surgical approaches.
3. Describe neoplastic processes associated with:
   a. neurofibromatosis
   b. tuberous sclerosis
   c. von Hippel Lindau Describe the appropriate evaluation and treatment of patients with these entities.
4. Discuss the appropriate use of skull base approaches for specific tumor locations.
5. List tumors which will require adjunctive therapy and describe those therapies and potential complications thereof.
6. Discuss the global management of tumoral hydrocephalus.
7. Cite the long-term outcome and complications for treatment of the common cerebellar and supratentorial hemispheric tumors.

Infection
1. Compare the differing patterns of infection as seen in immune compromised patients to those with a functioning immune system.
2. Discuss the sequelae of CNS infection, both shunt-related and non-shunt related.
3. List all acceptable treatment options for CNS infection with the pros and cons of each plan.
4. Demonstrate an understanding of the different etiologies for subdural and epidural empyema and brain abscess and differing treatments thereof.
5. Provide a complete differential diagnosis as regards to infectious disease for ring enhancing brain lesions.
6. Discuss the role of osteomyelitis in CNS infection.
7. Differentiate radiographically between infection and tumor of bone.

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Other
1. Discuss variance in the surgical management of tumoral vs non-tumoral seizure foci.
2. Discuss surgical options, indications and outcome for non-lesional approaches (e.g., callosotomy).
3. Discuss various surgical options for the management of spasticity.
4. Discuss preoperative evaluation and planning for seizure treatment.
5. Discuss preoperative evaluation and planning for treatment of spasticity and postoperative management.

Cerebrovascular
1. Describe the nomenclature for congenital vascular anomalies and what, if any, role inheritance plays.
2. Describe the pathology, risk factors, diagnosis and treatment of moyamoya in children.
3. List the phakomatoses which have vascular anomalies associated with them and their treatment.

Trauma
1. Discuss the role of apoptosis in brain and spinal cord injury.
2. Compare the utility of epidural, subdural, parenchymal, and intraventricular ICP monitoring.
3. Differentiate between retinal hemorrhages and Terson's syndrome.
4. Describe the role of electrophysiological monitoring in the management and prognostication of the CNS injured patient.
5. Discuss the evidence for and role of steroid therapy in CNS injury.
6. Discuss the prognosis and management of penetrating injuries to the brain and spine.
7. Discuss the management of CSF leaks after head injury.
8. Describe the diagnosis and treatment of a traumatic leptomeningeal cyst.

B. Competency-Based Performance Objectives:
1. Close an open spinal or cranial neural tube defect.
2. Repair an intracranial encephalocele.
3. Perform the opening for a complex craniofacial repair.
4. Perform the exposure for supratentorial and infratentorial lesions (excluding pineal, suprasellar and intraventricular locations).
5. Perform the exposure for spinal exploration in a patient with abnormal spinal anatomy or reoperation.
6. Evacuate an intraparenchymal hematoma.
7. Accomplish endoscopic third ventriculostomy in uncomplicated settings.
8. Apply and utilize frameless or framed stereotactic modalities for lesion location and shunt placement.
10. Accomplish an uncomplicated detethering procedure.
11. Perform a cranial vault expansion.
12. Perform placement of baclofen type pumps.
13. Perform spinal fusion without instrumentation.
5. Peripheral Nerve

A. Competency-Based Knowledge Objectives:

1. Define the autonomic system a. discuss Homer's syndrome
2. Compare and contrast a peripheral nerve to a cranial nerve
   a. histology
   b. response to injury
   c. root entry zone
3. Describe nerve regeneration in terms of
   a. specificity
   b. pruning of sprouts
   c. end to side sprouting
4. Discuss Stretch injury, Missile injury and Avulsion injury
   a. definition
   b. typical etiology
   c. physical findings
   d. electrical findings
   e. non-operative management
   f. indications for surgery
   g. intra-operative findings
   h. potential for recovery
5. Describe the anatomical location of the common entrapment sites
   a. describe the various bands and arcades that the nerves are entrapped by
6. Provide a differential diagnosis for common entrapment syndromes.
   a. differentiate radiculopathies from entrapments
   b. discuss repetitive strain disorder
7. Discuss uncommon entrapment neuropathies
   a. Guyon's canal
   b. suprascapular entrapment
   c. radial tunnel/PIN
   d. Median nerve in forearm/AIN
   e. Tarsal tunnel (anterior and posterior)
   f. pyriformis syndrome
8. Discuss burn and electrical injuries affects on nerve
9. Classify peripheral nerve tumors
10. Discuss the pathophysiology of NF 1 and NF2
11. Discuss the timing of peripheral nerve surgery
    a. laceration injury
    b. blunt injury
    c. missile injury
    d. iatrogenic injury
    e. surgical injection
12. Discuss outcome priorities in brachial plexus surgery
    a. motor versus sensory
    b. functional outcome ► elbow flexion, shoulder abduction, etc.
13. Discuss tension at the nerve repair site
14. Discuss nerve repair techniques
   a. direct coaptation
   b. nerve graft
   c. nerve transfer
   d. donor (graft) nerves
   e. epineurial repair
   f. fascicular repair
15. Describe intra-operative nerve evaluation
   a. visual
   b. palpation
   c. internal neurolysis
   d. nerve conduction
   e. biopsy

B. Competency-Based Performance Objectives:

1. Perform pre and post operative care of the patient with a missile injury to peripheral nerve.
2. Evaluate a child with birth palsy.
3. Position a patient for nerve surgery
   a. all entrapment sites
   b. brachial plexus surgery
4. Perform a neurolysis/decompression.
5. Expose the brachial plexus.
6. Manage the pain associated with nerve injury:
   a. use of medications
   b. use of rehabilitation
   c. use of stimulation

6. Spine

A. Competency-Based Knowledge Objectives:

1. Review the biomechanics of the craniocervical junction, cervical spine, and thoracolumbar and lumbar spine.
2. Review the biomechanics of common internal spinal fixators.
3. Review the definition of spinal instability based upon the principles of Punjabi, White, and other authors.
4. Review the indications for, and relative effectiveness of common spinal orthoses. Discuss the degree of segmental and regional immobilization these orthoses provide.
5. Compare and contrast indications for anterior and posterior approaches to the cervical spine for the treatment of herniated cervical discs, spondylosis, and instability.
6. Discuss the role of corpectomy in the management of cervical disorders.
7. Compare and contrast the indications for anterior cervical discectomy with and without anterior interbody fusion.
8. Discuss the indications and techniques for anterior and posterior cervical spinal internal fixators.
10. Review the diagnosis and management of primary spinal tumors, spinal cord tumors and spinal metastatic disease including indications for dorsal decompression, ventral decompression, and radiotherapy.
11. Discuss the management principles for gunshot and other penetrating wounds to the spine.
12. Review the signs, symptoms, and management options in the treatment of the adult tethered cord syndrome and syringomyelia.
13. Review the management principles for spontaneous and postoperative spinal infections.
14. Review the management principles for intraoperative and postoperative cerebrospinal fluid leaks.
15. Discuss the surgical management of intradural congenital, neoplastic, and vascular lesions.

B. Competency-Based Performance Objectives:

1. Demonstrate the ability to prepare structural allografts for use in spinal surgery.
2. Determine the need for postoperative inpatient or outpatient rehabilitation in patients with spinal disorders.
3. Demonstrate the ability to perform a ventral exposure of the cervical spine followed by anterior cervical discectomy.
4. Demonstrate the ability to perform an anterior cervical interbody arthrodesis.
5. Demonstrate the ability to place anterior cervical instrumentation.
6. Demonstrate the ability to perform posterior cervical decompressive laminectomy.
7. Demonstrate the ability to perform posterior cervical foraminotomy with or without discectomy.
8. Demonstrate the ability to perform medial and lateral approaches to a far lateral lumbar disc herniation.
9. Demonstrate appropriate surgical technique in the management of recurrent lumbar disc herniations and recurrent lumbar stenosis.
10. Demonstrate the ability to perform posterior lumbar arthrodesis with or without the use of interbody instrumentation.
11. Demonstrate exposure of the cervical lateral masses, thoracic and lumbar transverse processes, and the sacral ala.
12. Demonstrate the ability to perform posterior/intertransverse arthrodesis in the cervical, thoracic and lumbar regions.
13. Demonstrate the ability to perform a laminectomy with or without transpedicular decompression for tumor, infection, or trauma.
14. Demonstrate techniques for spinous process arthrodesis of the subaxial cervical spine for fracture or dislocation.
15. Demonstrate the ability to manage postoperative complications of spinal surgery including:
   a. hematoma
   b. infection
   c. spinal fluid leak
   d. new neurologic deficit
16. Demonstrate the ability to perform a tethered cord release.
7. Epilepsy/Stereotactic/Functional

A. Competency-Based Knowledge Objectives:
1. Discuss the benefits and limitations of frame-based stereotactic procedures.
2. Discuss patient selection for VL thalamotomy, pallidotomy.
3. Discuss the advantages and disadvantages of ablative procedures.
4. List the potential complications of VL thalamotomy, pallidotomy; bilateral thalamotomies or pallidotomies.
5. Discuss technical considerations to minimize the potential for an intracranial hemorrhage after a stereotactic biopsy.
6. Discuss technical considerations to minimize the potential for a nondiagnostic stereotactic biopsy.
7. Describe the appropriate trajectories to biopsy a lesion in the pineal region, midbrain, pons, and medulla.
8. Compare the advantages, disadvantages of radiosurgery and surgical resection for tumors, vascular malformations.

B. Competency-Based Performance Objectives:
1. Perform simple dose-planning for radiosurgery.
2. Perform temporal lobectomy for epilepsy.
3. Perform stereotactically directed lesionectomy for epilepsy.

8. Trauma/Critical Care

A. Competency-Based Knowledge Objectives:
1. Describe the pathophysiology of intracranial hypertension and explain a plan for its management, including arguments for and against various treatments.

B. Competency-Based Performance Objectives:
1. Perform the following surgical procedures in uncomplicated cases:
   a. Craniotomy for subdural and/or epidural hematoma
   b. Craniotomy for penetrating head injury
   c. Craniotomy for intracerebral hematoma or contusion
   d. Craniotomy for depressed skull fracture
   e. Decompressive craniectomy
   f. Repair/cranialization of frontal sinus fracture
   g. Posterior fossa epidural, subdural, or intracerebral hematoma
   h. Simple cranioplasty
2. Manage traumatic skull base fractures with CSF leak.
3. Manage infections associated with open CNS injuries.
PATIENT CARE AND MEDICAL KNOWLEDGE

CHIEF RESIDENT CLINICAL ROTATION

Neurosurgery residents are expected to develop an increasing understanding of the subspecialties of neurosurgical practice over the course of their residency. By the time residents have completed their PGY6 year, they are expected to demonstrate competencies in each of the neurosurgical subspecialties that would allow them to assume the role of Chief Resident. During the Chief Resident year the resident develops the additional competencies that will allow him or her to enter practice independently. The sixth year resident assumes not only the highest clinical, operative, radiosurgical and endovascular responsibilities but also assumes significant administrative duties. Administrative duties include the day-to-day operation of the neurosurgical services, supervision of the junior and senior neurosurgery residents and allocation of residents to operating rooms, radiosurgical procedures and endovascular procedures. With the approval of the program director, the chief resident assigns the junior residents to clinics, call, and vacation/meeting schedules, and co-ordinates the academic conferences. He or she is expected to demonstrate competence to safely practice independently by the end of the chief resident year.

I. Cerebrovascular

A. Competency-Based Knowledge Objectives:

1. Demonstrate an understanding of current literature related to basic neuroscience knowledge objectives acquired as a Junior and Senior Resident. Define scientific hypotheses in relationship to controversies and evolving knowledge regarding these same objectives and demonstrate the ability to interpret and adapt new knowledge to evolving patient-care paradigms.

B. Competency-Based Performance Objectives:

1. Review fundamental concepts of cerebrovascular disease during conferences and clinical rounds with the house staff and medical student.
2. Demonstrate clinical judgment related to the spectrum of problems encountered in hemorrhagic and ischemic stroke states.
3. Formulate independent plans for patient assessment and management, including prioritization in cerebrovascular disease while maintaining a clear reporting relationship with faculty.
4. Identify the indications and controversies of endovascular catheter procedures, perioperative management, and follow-up. Implement and supervise patient care protocols related to these procedures.
5. Display a detailed understanding of indications, principles, and interpretation of the full spectrum of neurodiagnostic armamentarium. Formulate independent management plans based on sophisticated interpretation of diagnostic studies for concise presentation to faculty.
6. Demonstrate an understanding of surgical strategies and approaches to common and unusual vascular disease.
7. Apply the principles of intraoperative anesthetic management, proximal and distal control, temporary arterial occlusion, brain protective strategies, and intraoperative localization as applied to vascular disease.

Update: May 1, 2013
8. Complete the planning, positioning, and execution of pterional craniotomy for common vascular disease under supervision.
9. Perform microsurgical dissection of the Sylvian fissure and exposure of the basal cisterns for vascular disease.
11. Complete the planning, positioning, and execution of non-pterional craniotomy for intracranial vascular disease.
12. Assist in the microsurgical management of highly complex cerebrovascular disease.
13. Plan and execute the craniotomy for the evacuation of intracranial hematomas.

2. Neuro-Oncology and Skull Base Surgery

A. Competency-Based Knowledge Objectives:
1. Describe the indications for transcranial orbitotomy and pathology approached.
2. Discuss the surgical management and postoperative treatment of astrocytomas, gliomas other than astrocytomas, metastatic brain tumors, infectious granulomas, and cystic lesions presenting in a tumor-like manner. Review the role of radiotherapy, chemotherapy, and other adjunctive treatments of these neoplasms.
3. Describe the role of surgery for intracranial meningioma, and the relation between the surgical option and location or tumor. Discuss optional adjuvant treatments of meningioma and their efficacy.
4. Discuss the surgical treatment of common intrinsic posterior fossa neoplasms, including cerebellar astrocytoma, medulloblastoma, and ependymoma including the role of ventricular drainage, and surveillance imaging. Present adjuvant treatment options and outcomes for the various posterior fossa intrinsic tumors.
5. Address the surgical goals of treatment, complications of surgical treatment, and adjuvant therapy for posterior fossa meningioma.
6. List and illustrate the various approaches for removal of a vestibular schwannoma, and the rationale and indication for each approach.
   a. middle cranial fossa
   b. trans labyrinth
   c. retro sigmoid
7. Describe the role of stereotactic radiosurgery and microsurgery in the management of vestibular schwannoma and other tumors.
8. List the various approaches to the midline clivus, including the cervical-medullary junction the indications for each approach. Outline the surgical and medical management of tumors of the clivus and midline skull base.
9. Explain the management goal for a patient with craniopharyngioma, and the risks of surgical treatment and conservative treatment. Describe the various surgical approaches used to resect craniopharyngiomas and the options for adjuvant treatment, including radiotherapy, chemotherapy (systemic and local).
10. Illustrate the transnasal-transsphenoidal approach and its indications. Define the options for treatment of recurrent pituitary tumors of all types (including medical management). Describe the risks of the approach and the management of the complication of CSF leak.
11. Illustrate the various skull base approaches to the anterior, middle and posterior cranial fossa in detail, explaining the key anatomical landmarks and strict indications for the
approach. List the complications relevant to each approach, and the management of each complication.

12. List a differential diagnosis of orbital tumors, their usual location within the orbit, medical and surgical management of the tumor and the approach used to remove the tumor if indicated.

13. List the various tumors and their location in which an orbitocranial approach may be indicated for their removal.

14. Compare and contrast the exposure offered by the pre-and postauricular infratemporal approach, and the indications for each approach.

15. Illustrate transposition of the facial nerve during a transtemporal skull base approach.

16. Describe the location of meningiomas intracranially which are amenable to preoperative embolization.

B. Competency-Based Performance Objectives:
   1. Demonstrate the capability to function independently in all phases of management of patients with intracranial neoplasms.
   2. Perform resection of supra and infratentorial intra-axial and extra axial neoplasms.
   3. Perform resection of pituitary lesions.
   4. Perform under supervision skull base procedures.

3. Pain Management

A. Competency-Based Knowledge Objectives:
   1. Distinguish the indications for surgical and non-surgical treatment of pain.
   2. Construct a management strategy relating to application of percutaneous trigeminal neurolytic procedures, retrogasserian rhizotomy and microvascular decompression in the care of patients with trigeminal neuralgia.
   3. Describe and contrast the approaches to the cerebellopontine angle for microvascular decompression or rhizotomy of the trigeminal and glossopharyngeal nerves.
   4. Identify the various target spine levels for spinal cord stimulation according to the pain topography (simple and complex).
   5. Identify the various intraspinal structures based on their responses to mechanical and electrical stimulation (dura mater, lateral canal wall, dorsal columns, dorsal roots, ventral roots, motorneurons).
   6. Compare the different methods of intraspinal drug administration (epidural, intrathecal, tunneled catheter, implanted infusion system).
   7. Describe the techniques for trialing intraspinal drugs.
   8. Compare the pharmacodynamics of different drugs delivered intrathecally (e.g., hydrophilic vs. lipophilic).
   9. Describe the possible complications of spinal cord stimulation electrode or spinal catheter insertion, their evaluation and treatment:
      a. paralysis
      b. nerve root damage
      c. electrode or catheter migration
      d. electrode or catheter breakage

Update: May 1, 2013
1. Demonstrate appropriate use of each of the major classes of medications in common use for treating pain disorders.
2. Demonstrate appropriate selection of patients for surgical treatment of pain disorders.
3. Perform microvascular decompression, and rhizotomy on the trigeminal nerve, and glossopharyngeal nerves.
4. Assist a junior resident in performing a percutaneous ablative procedure for trigeminal neuralgia.
5. Formulate and implement an appropriate treatment plan for management of pain using spinal ablative and augmentative techniques according to pain etiology, pain topography, and status of spinal column (e.g., previous surgery at implant level, scoliosis, stenosis, etc.).
6. Select and implant an appropriate SCS system, recognizing how to modify electrode insertion technique and location based upon intraoperative responses.
7. Implant a plate electrode in a patient with previous spinal surgery at the same level.
8. Demonstrate proficiency with maintenance and programming of spinal drug administration systems and spinal cord stimulation systems.
9. Recognize and evaluate malfunctions of SCS and intraspinal drug administration systems.
10. Perform surgical revision of SCS and intraspinal drug administration systems.
11. Demonstrate proficiency in identification and lesioning of the dorsal root entry zone, even in cases of nerve root avulsion.
12. Demonstrate proficiency in performing myelotomy and cordotomy.
13. Demonstrate proficiency in technique of ganglion resection.
14. Incorporate ganglionectomy as one part of an integrated approach to the patient with intractable pain.
15. Display appropriate patient selection for local anesthetic blocks.
16. Perform simple superficial blocks with minimal supervision. Relative to these blocks perform the following:
   a. assess outcome of block
   b. recognize and treat complications
   c. maintain detailed records of effects of block and follow-up
   d. assess need for repeat blocks
17. Provide information regarding alternatives for failed nerve block.
18. Perform complicated procedures with direct supervision. Recognize and treat the complications of these procedures.
19. Display appropriate patient selection for ablative peripheral neurolysis.
20. Perform simple neurolytic procedures with minimal supervision. Relative to these procedures perform the following:
   a. assess outcome of the procedure
   b. recognize and treat complications
   c. maintain detailed records of effects of neurolysis and follow-up
   d. assess need for repeat neurolysis
22. Perform complicated neurolytic procedures with direct supervision.
23. Display appropriate patient selection for ablative peripheral neurolysis.
24. Perform simple facet blocks with minimal supervision. Relative to these procedures perform the following:
   a. assess outcome of the procedure
   b. recognize and treat complications
   c. maintain detailed records of effects of facet blocks and follow-up
   d. assess need for repeat facet blocks
25. Provide information regarding alternatives for failed facet blocks.
26. Perform complicated facet blocks with direct supervision.
27. Perform sympathectomy.

4. Pediatrics

A. Competency-Based Knowledge Objectives:

   Myelomeningocele and its variants, meningocele, encephalocele, Chiari malformations, occult spinal dysraphism, split cord anomalies, segmentation anomalies, craniofacial syndromes and phakomatosis

   1. Differentiate between the use of rigid and non-rigid skeletal fixation in the appropriate surgical setting for this group of disorders.
   2. Explain the rationale for surgical treatment of a symptomatic disease.

   Hydrocephalus and Other Disorders of CSF Circulation

   1. Discuss the utility of expansion craniotomy in the treatment of hydrocephalus.
2. Differentiate between ventriculomegaly, compensated hydrocephalus, and pseudotumor cerebri.
3. Describe the role of venous outflow obstruction in hydrocephalus.

**Neoplasia**

1. Describe the pertinent surgical anatomy for approaches to tumors in the following locations:
   a. suprasellar
   b. pineal region
   c. intraventricular
2. Discuss the role of endoscopic third ventriculostomy in management of tumoral hydrocephalus.
3. Cite the long-term outcome and complications of all treatment options for tumors arising in the following locations:
   a. suprasellar
   b. pineal region
   c. intraventricular
4. Discuss the utility of preoperative embolization and/or chemotherapy in the surgical management of specific tumors.
5. Discuss the role of stereotactic radiosurgery in the management of selected tumors.
6. Describe the presentations of hypothalamic hamartomas and the role of surgery in management.
7. Describe options for CNS monitoring during surgical therapy and their efficacy.
8. Discuss options for treatment and expected outcomes for recurrent tumors.

**Infection**

1. Describe in detail the differential diagnosis, evolution and treatment options of an immune compromised patient with a ring enhancing brain lesion.
2. List the important aspects of the patient's history which may lead one to entertain the diagnosis of CNS infection, both shunt-related and nonshunt-related.
3. List diagnostic tools, other than CSF culture, which are utilized to diagnose a shunt infection.

**Cerebrovascular**

1. List the locations for traumatic vascular lesions and their risk factors, diagnosis, and treatment.

**Trauma**

1. Discuss the potential complications and evaluation of comatose patients with skull base fractures.
2. Discuss the utility of lumbar drains and expansion craniectomy and the removal of frontal or temporal lobe in the management of refractory elevated ICP.
3. Describe the approaches to the management of traumatic ICH and its supporting data, both surgical and non-surgical.
4. List the vascular and endocrine complications seen after head injury.
5. Discuss the long-term management of a child who has sustained CNS trauma including rehabilitation and neuro-cognitive issues.
6. Discuss the management of peripheral nerve injuries in a child.

B. Competency-Based Performance Objectives:

1. Perform exposure for suprasellar, pineal and intraventricular lesion (including orbito-frontal, transcallosal and supracerebellar).
2. Remove uncomplicated posterior fossa and supratentorial lesions.
3. Repair complex tethered cords (e.g. lipomyelomeningocele, retethering, and diastematomyelia).
4. Accomplish exposure for intradural spinal neoplasms.
5. Utilize an endoscope to communicate trapped CSF spaces.
6. Remove intracranial vascular malformation less than 3 cm in size and in
7. Perform placement of grids for seizure monitoring.
5. Perform rhizotomy for spasticity.
10. Perform stereotactic biopsy of supratentorial lesion.
11. Perform spinal fusion utilizing instrumentation.

5. Peripheral Nerve

A. Competency-Based Knowledge Objectives:

1. Discuss the use of nerve grafting
   a. types of fixation (suture/glue)
   b. types of grafts (nerve, vein, artificial)
   c. end to side
2. Discuss entrapment syndromes
   a. thoracic outlet
   b. double crush syndrome
   c. repetitive strain
3. Discuss ulnar nerve decompression
   a. in situ decompression
   b. transposition (subcutaneous/intramuscular/submuscular)
   c. medial epicondylectomy
4. Differentiate brachial plexus injury from brachial plexitis
5. Formulate a management plan for
   a. birth brachial plexus injury
   b. acute nerve injury (stretch/compression/laceration/injection)
   c. chronic nerve injury
   d. failed nerve decompression
   e. painful nerve/neuroma
6. Describe the management of nerve tumors
   a. indications for surgery in NF1
   b. operative and adjuvant treatment for malignant peripheral nerve sheath tumors
c. use of monitoring during tumor surgery
d. fascicular dissection

7. Describe adjuvant therapies in nerve injury
   a. muscle and tendon transfers
   b. prosthesis
   c. joint fusion

B. **Competency-Based Performance Objectives:**

1. Determine the parameters confirming anticipated nerve regeneration:
   a. anticipated advancing Tinel sign
   b. order of muscle re-innervation
2. Perform a nerve decompression:
3. Excise a nerve sheath tumor
4. Expose a brachial plexus injury
   a. determine possible repairs including nerve transfers
   b. expose the spinal accessory nerve
   c. expose the intercostal nerves

6. **Spine**

A. **Competency-Based Knowledge Objectives:**

1. Describe indications for the use of angiography and endovascular procedures in the management of spinal disorders.
2. Discuss the management of cervical degenerative disease secondary to rheumatoid arthritis. Describe factors which make it different from the management of non-rheumatoid disease.
3. Compare and contrast the treatment options for cervical spondylotic myelopathy and ossification of the posterior longitudinal ligament, including multilevel anterior cervical corpectomy and fusion, laminectomy, laminectomy and fusion, laminoplasty, and nonoperative therapies.
4. Discuss the indications for posterior cervical spinal internal fixators.
5. Compare and contrast the transthoracic, transpedicular, costotransverse, and lateral extracavitary approaches to a herniated thoracic disc, thoracic tumor, or thoracic spinal injury.
6. Discuss the indications for lumbar fusion for congenital disorders, iatrogenic disease and degenerative disease, ranking indications from least to most controversial.
7. Compare and contrast the indications for anterior or posterior lumbar interbody fusion and intertransverse fusion in degenerative lumbar disease.
8. Discuss internal fixation options for posterior lumbar interbody fusion and intertransverse fusion.
9. Summarize the most common types of spinal tumors in the following categories:
   a. intradural/intramedullary
   b. intradural/extramedullary
   c. extradural/extramedullary.

*Update: May 1, 2013*
10. Discuss nonoperative and operative treatment options for fractures and dislocations affecting the atlas and axis.
11. Compare and contrast the indications for nonoperative treatment, anterior approaches, and posterior operative approaches for the treatment of fractures and dislocations of the subaxial cervical spine.
12. Describe the indications for anterior, posterior, and posterolateral procedures in the management of thoracolumbar tumor, trauma, or infection.
13. Compare and contrast the indications for anterior and posterior spinal fixators in the management of thoracolumbar tumor, trauma, or infection.
14. Discuss reconstruction options for vertebral body defects after corpectomy for tumor, trauma, or infection.

B. Competency-Based Performance Objectives:

1. Demonstrate the ability to function independently in all phases of management of patients with spinal disorders.
2. Demonstrate the ability to perform occipital cervical arthrodesis.
3. Demonstrate the ability to properly place sublaminar wires, lateral mass screws, lower cervical/upper thoracic pedicle screws, C2 pars interarticularis screws, and C1-2 transarticular screws for the management of cervical spine disorders.
4. Demonstrate the ability to perform, with assistance if necessary, transoral odontoidectomy.
5. Demonstrate common techniques for performing intraspinous C1-2 arthrodesis.
6. Demonstrate the ability to perform anterior cervical corpectomy followed by arthrodesis.
7. Demonstrate the ability to perform, with assistance if necessary, transthoracic, thoracoabdominal, retroperitoneal, and transabdominal approaches to the thoracic and lumbar spine.
8. Demonstrate the ability to perform costotransverse and lateral extracavitary approaches to the thoracolumbar spine.
9. Demonstrate the ability to excise a herniated thoracic disc by use of the above mentioned approaches.
10. Demonstrate the ability to perform vertebral corpectomy of the thoracolumbar spine for tumor, infection, or trauma, utilizing the above mentioned approaches.
11. Demonstrate the ability to perform anterior arthrodesis of the thoracolumbar spine.
12. Demonstrate the proper placement of transpedicular screws in the thoracic and lumbar spine.
13. Demonstrate the proper placement of laminar, transverse process, and pedicle hooks in the thoracic and lumbar spine.
14. Demonstrate the ability to resect intradural spinal neoplasms.
15. Demonstrate the ability to perform methylmethacrylate vertebroplasty.
16. Demonstrate techniques of open reduction of fractures and dislocations of the cervical, thoracic, and lumbar spine.
17. Demonstrate the ability to surgically manage arachnoid cysts and spinal cord syrinx.
18. Demonstrate the ability to perform intradural procedures for congenital, neoplastic, and vascular lesions.

7. Epilepsy/Stereotactic/Functional

Update: May 1, 2013
A. Competency-Based Knowledge Objectives:

1. Identify the microelectrode recordings of the thalamus, globus pallidus.
2. Identify the primary indications for medial thalamotomy, cingulotomy.
3. Describe the evaluation of a patient with medically intractable epilepsy.
4. Discuss the indications for placement of depth electrodes.
5. Describe the surgical treatment of epilepsy in detail.
6. Discuss the theoretical advantages of brachytherapy over external beam radiation therapy.
7. Describe the most common complications of brachytherapy and their treatment.
8. Explain the effect of patient selection on the reported results of brachytherapy for high-grade gliomas.
9. Describe the methods used to localize and percutaneously penetrate the foramen ovale.
10. Discuss the dose-volume relationships for radiation-related complications after radiosurgery.
11. Discuss potential sources of inaccuracy for stereotactic procedures.
12. Discuss advantages, disadvantages of deep brain stimulation compared to ablative techniques.

B. Competency-Based Performance Objectives:

1. Perform complex dose-planning.
2. Perform stereotactic craniotomies

8. Trauma/Critical Care

A. Competency-Based Knowledge Objectives:

1. Discuss management priorities in polytrauma patients with severe neurological and systemic trauma.

B. Competency-Based Performance Objectives:

1. Perform the above procedures (listed under #1 for "Middle Level") in complicated cases.
2. Reconstruct complex cranial defects, with assistance from other specialties as indicated.
3. Reconstruct traumatic skull base defects, with assistance from other specialties as indicated.
4. Lead the critical care team in the treatment of patients with neurological injuries, either in isolation or in polytrauma patients.
ENDOVASCULAR NEUROLOGICAL SURGERY AND NEUROCRITICAL CARE

The Penn State Department of Neurosurgery views training in Endovascular Neurological Surgery and Neurocritical Care as integral parts of Neurosurgery Resident training. Training in these areas occurs throughout the training program. Penn State Neurosurgery residents are expected to demonstrate achieve the following competency based knowledge and procedural objectives in these areas by the end of their training:

Endovascular Neurological Surgery (ENS)

1. Signs and symptoms of disorders amenable to diagnosis and treatment by neuroendovascular surgical techniques.
2. Neurological examinations to evaluate patients with neurological disorders.
3. Pathophysiology and natural history of these disorders.
4. Indications and contraindications to neuroendovascular surgical procedures.
5. Clinical and technical aspects of neuroendovascular surgical procedures.
6. Medical and surgical alternatives.
7. Preoperative and postoperative management of endovascular patients.
8. Neurointensive care management.
10. Interpretation of radiographic studies pertinent to the practice.
11. The use of needles, catheters, guidewires, and angiographic devices and materials.
12. Understanding the basic radiological sciences, including radiation physics, radiation protection, and the pharmacology of radiographic contrast materials.
14. The proper use and interpretation of laboratory tests and methods that are adjunctive to neuroendovascular surgical procedures, such as physiological monitoring, noninvasive neurovascular testing, and noninvasive neurovascular imaging.
15. The evaluation of patients with neurological disease.

Update: May 1, 2013
16. The basic and clinical neurosciences, including neuroanatomy, neurobiology, and the pathophysiology and natural history of neurological disorders, especially cranial/spinal/peripheral neurovascular diseases and neoplastic conditions.

17. The clinical aspects of patient assessment, treatment planning, and patient management related to Neuroendovascular surgical conditions and procedures, including the fundamentals of invasive monitoring and neurointensive care management.

18. The clinical indications, risks, and limitations of neuroendovascular surgical procedures.

19. The use and administration of analgesics, antibiotics, anticoagulation agents, neuroanesthetic agents, and other drugs commonly used in neuroendovascular surgical procedures.

Penn State Neurosurgery residents will be expected to perform clinical pre-procedure evaluations of patients, interpret preliminary diagnostic studies, consult with clinicians on other services, perform diagnostic and therapeutic neuroendovascular surgical procedures, generate procedural reports, and participate in short-term and long-term postprocedure follow-up care, including neurointensive care. The continuity of care must be of sufficient duration to ensure that the residents are familiar with the outcome of all neuroendovascular surgical procedures. Senior and Chief residents will serve as consultants under the supervision of staff neuroendovascular surgical practitioners. Direct interactions of residents with patients will be closely observed to ensure that appropriate standards of care and concern for patient welfare are strictly maintained. Communication, consultation, and coordination of care with the referring clinical staff and clinical services will be maintained and documented with appropriate notes in the medical record. The program will provide adequate opportunity for residents to participate in and personally perform and analyze a broad spectrum of endovascular procedures in adults and children.

**Neurocritical Care**

**Traumatic Brain Injury (TBI)**

1. Demonstrate technical skill in neuromonitoring technologies
   a. Intracranial Pressure
      i. Intraparenchymal Pressure Monitors
      ii. Ventriculostomy
   b. Brain Tissue Oxygenation Monitoring
   c. Cerebral Perfusion Pressure Monitoring
      i. Placement of Central Venous Catheter
      ii. Placement of Swann-Ganz Catheter

2. Intracranial Pressure Management
   a. Understand individualize critical care therapy using multiple medical modalities available
   b. Be familiar with the evidence-based document: Guidelines for the Prognosis and Management of Severe Traumatic Brain Injury
   c. Discuss the mechanisms of action, side effects, limitations, risks, and advantages of the following forms of therapy for elevated ICP:
      i. Mannitol
      ii. Lasix
      iii. Hypertonic Saline
      iv. Controlled Ventilation
v. Hyperventilation
vi. Cerebrospinal Fluid Drainage
vii. Sedation
viii. Pharmacological Paralysis
ix. Seizure Prevention
x. Barbiturate Coma
xi. Timing and Indications for Surgery

3. Know pathognomonic signs of diffuse axonal injury
4. Recite the indications for seizure prophylaxis in TBI
5. Know the indications for electroencephalography in TBI
6. Describe the indications and optimal route for enteral and parenteral feeding in TBI
7. Be familiar with the nutritional requirements of TBI patients
8. Understand spasticity related complications and their treatment
9. Describe optimal timing of various rehabilitation strategies in TBI
   a. Physical Therapy
   b. Occupational Therapy
   c. Speech Therapy
      i. Speech
      ii. Swallowing
      iii. Cognition
10. Describe outcomes measures utilized in TBI research
11. Be familiar with neuropsychological tests and measures of outcome
12. Discuss impact of co-morbidities on TBI outcomes
13. Know findings associated with lightening and electrocution injuries
14. Describe disorders of level of consciousness / mental status
   a. Brain Death
   b. Coma
   c. Persistent Vegetative State
   d. Herniation Syndromes
   e. Delirium
   f. Abulia
   g. Dementia

Spinal Cord Injury (SCI)

1. Diagnose spinal cord injury by anatomical and functional level
2. Know the ASIA classification of spinal cord injury
3. Describe the signs, symptoms, and treatment of spinal shock
4. Be familiar with the nutritional requirements of SCI patients
5. Discuss appropriate type and timing of rehabilitation strategies for SCI
   a. Physical Therapy
   b. Occupational Therapy
   c. Postural Training
   d. Bowel and Bladder Training
   e. Transfer
   f. Assistive Technologies
Blunt Vascular Injury (BVI)

1. Describe physical findings and symptoms of BVI
2. Name commonly associated injuries
3. Know the advantages and disadvantages of various diagnostic modalities for diagnosing BVI
4. Describe the indications, duration, and risks of antiplatelet therapy for BVI
5. Describe the indications, duration, and risks of anticoagulation therapy for BVI
6. Recognize possible benefit of various interventional procedures for treating BVI
7. Be familiar with timing of follow-up imaging
8. Know the indications for surgery of BVI

Peripheral Nerve Injury

1. Know the different commonly used classification systems of neural injury
2. Understand the timing of surgical exploration and repair for various types of injuries
3. Know brachial plexus and upper extremity peripheral nerve anatomy

Spontaneous Intracranial Hemorrhage

1. Name common causes of spontaneous intraparenchymal hemorrhage
2. Cite literature addressing surgical treatment of intraparenchymal hemorrhages
3. Discuss indications for surgery of IPH
4. Know medical treatment of acute hypertensive crisis
5. Know Spetzler grading system of arteriovenous malformations
6. Discuss natural history of cavernous malformations and venous angiomas
7. Describe presenting symptoms of dural arteriovenous fistula
8. Discuss signs and symptoms of carotid-cavernous fistula

Aneurysmal Subarachnoid Hemorrhage

1. Classify subarachnoid hemorrhage with the Fisher and modified Fisher scales
2. Classify clinical status with the Hunt and Hess classification scheme
3. Identify signs and symptoms of vasospasm
4. Be familiar with specificity and sensitivity of various diagnostic modalities used to identify cerebral vasospasm
5. Know possible treatment modalities for cerebral vasospasm
6. Discuss advantages and disadvantages of endovascular and surgical treatment of cerebral aneurysms

Intracranial Tumors

1. Be able to effectively treat cerebral edema associated with intracerebral tumors
2. Be familiar with complications of irradiation therapy and their management
3. Discuss the indications for chemotherapy and radiation therapy (including targeted XRT) for a variety of intracranial tumor types
4. Identify and treat carcinomatous meningitis
5. Diagnose paraneoplastic syndromes

Central Nervous System Infections
1. Know how to identify and treat meningitis and ventriculitis
2. Identify signs and symptoms of encephalitis
3. Diagnose cranial and spinal epidural abscess
4. Diagnose and treat vertebral osteomyelitis and discitis
5. CNS complications of HIV

Cerebral Ischemia

1. Explain diagnosis and management of the following
   a. Cerebral infarction
   b. Transient Ischemic Attacks
   c. Moya-moya disease
   d. Sickle Cell Ischemia
2. State differential diagnoses of CNS vasculitis
3. Be able to diagnose and treat dural sinus thrombosis

Neuroendocrine Disorders

1. Be able to diagnose panhypopituitarism and specific pituitary syndromes
2. State how to diagnose and treat diabetes insipidus and cerebral salt wasting
3. Recognize pituitary apoplexy

General Critical Care

1. Understand principles of the following critical care monitoring modalities
   a. ECG
   b. Invasive hemodynamic monitoring
   c. Noninvasive hemodynamic monitoring
   d. Respiratory monitoring
   e. Metabolic monitoring
2. Be familiar with various critical care scales of disease severity and prognostication (e.g., GCS, AIS, ISS, APACHE)
3. Be proficient at the following procedures:
   a. Endotracheal intubation
   b. Arterial line placement
   c. NG/OG/ND/OD tube insertion
   d. Central venous catheter insertion
   e. Swann-Ganz catheter insertion
   f. Airway management

Complication Avoidance / Management of Complications

1. Understand how to avoid and treat the following complications
   a. Deep Venous Thrombosis
   b. Gastric Ulcer
   c. Contractions
   d. Complications of Anticoagulation
   e. Contractures
2. Infection

Update: May 1, 2013
a. Central Nervous System
b. Systemic
c. Pulmonary
3. Hydrocephalus
4. Seizures
5. Status Epilepticus
6. Spasticity
7. Dysautonomia
8. Paralysis
9. Wound Breakdown
10. Decubitus Ulcers
11. Rhabdomyolysis
12. Critical Care Myopathy
13. Propofol Infusion Syndrome
14. Central Pontine Myelinolysis
15. Neuroleptic Malignant Syndrome/Malignant Hyperthermia

**Metabolic and Critical Care Illnesses**
1. Understand diagnosis and treatment of the following:
   a. Disorders of Fluid Balance and Electrolytes
   b. Renal Failure
c. Acid-Base Disorders
d. Thyroid Imbalances
e. Adrenal Crisis
f. Diabetes Mellitus
g. Adult Respiratory Distress Syndrome
h. Systemic Inflammatory Response Syndrome
i. Opportunistic and Hospital-Acquired Infections
j. Central Fever
k. Coagulopathies
l. Transfusion Reactions
m. Hypercoagulable Disorders
n. Gastrointestinal Bleeding
o. Ileus and Bowel Obstruction
p. Hepatic Failure
q. Pancreatitis
r. Obstructive Uropathy

**Ethical and Medicolegal Aspects of Neurocritical Care**
1. Address end-of-life issues effectively and compassionately with families
2. Discuss living wills, advance directives, do not resuscitate orders, and other patient rights issues vis-à-vis treatment decisions
3. Understand durable power of attorney
4. Describe ramifications of withdrawal of care

**Socioeconomic Issues**
1. Understand effects of payor mix on hospital neurotrauma programs
2. Describe local and regional methods of trauma system funding

**Neuro Intensive Care Unit Management**

1. Be familiar with staffing needs for Neuro ICU
2. Describe cost containment issues for Neuro ICUs
3. Be familiar with unit-based infection control procedures

**Transplantation**

1. Understand the role of the neurosurgeon in hospital transplantation policy development
2. Describe brain death declaration laws
3. Discuss ethical issues surrounding non-heart-beating donor programs

**Quality Improvement (QI)**

1. Recognize principles of hospital and practice performance improvement processes
2. Discuss the development of
   a. Trauma-specific QI indicators
   b. Neurotrauma-specific QI indicators
   c. Neuro ICU-specific QI indicators

**Trauma Centers**

1. Understand trauma center verification practices in the U.S.
   a. State-to-State Variability
   b. American College of Surgeons system
2. Discuss appropriate referrals for Level I neurotrauma patients
3. Describe concepts of overtriage and undertriage within a trauma center
4. Be familiar with requirements for multidisciplinary involvement in trauma center administration

**Trauma Systems**

1. Be familiar with the necessary components of a mature trauma system
2. Describe concepts of overtriage and undertriage within a trauma system

**Teaching**

1. Demonstrate ability to impart technical skills to residents and students in the Neuro ICU
2. Communicate rationale for treatments at bedside to residents, students, nurses, and families
3. Demonstrate ability to communicate concepts concisely and effectively in didactic teaching situations

**Research**

1. Know principles of clinical research
   a. Study Design
   b. Statistical Analysis
   c. Epidemiology
2. Be familiar with the research literature on Neurocritical Care

PRACTICE BASED LEARNING AND IMPROVEMENT

Basic & Clinical Biostatistics

During their independent study year residents are expected to review statistics applied to medicine. The objective of this course of study is to prepare residents to understand and apply biostatistical techniques used in the design and analysis of biomedical experiments and investigations as listed below.

1. Measures of Central Tendency
   a. Mean
   b. Median
   c. Mode
2. Measures of Dispersion
   a. Variance
   b. Standard Deviation
   c. Coefficient of Variation
3. Normal Distribution
   a. Symmetry and Kurtosis
   b. Distribution of means
   c. Introduction to Hypothesis Testing
4. One Sample Hypothesis
   a. One Tail Hypothesis concerning Mean
   b. Two tail Hypothesis concerning mean
   c. Power & Sample size in Test concerning the means
5. Two Sample Hypothesis
   a. Testing for Difference between two variances
   b. Paired t-test
   c. Unpaired t-test
6. Multisample Hypothesis
   a. Single factor analysis of Variance
   b. Homogenity of Variance
7. Multiple Comparison
   a. The Tukey Test
   b. Scheffe's Multiple Comparison
8. Two Factor Analysis of Variance
   a. Two factor ANOVA with equal replication
   b. Two factor ANOVA with unequal replication
   c. Two factor ANOVA without replication
   d. Randomized Block Design
   d. Repeated -Measure Design
9. Data Transformation
   a. The Logarithmic Transformation
   b. The Square Root Transformation
   c. The Arcsine Transformation
10. Simple Linear Regression
a. Regression vs. Correlation
b. Linear Regression Equation
c. Testing The significance of Regression
d. Power and sample size in Regression
e. Data Transformation in Regression
f. Comparing Simple Linear Regression Equations
g. Comparing Two Slopes
h. Comparing Two Elevations

11. Multiple regression and Correlation
a. Multiple regression Equation
b. Selection of Independent Variables
c. Analysis Of Variance of Multiple Regression
d. Dummy Variables

12. Testing for Goodness of Fit
a. Chi-Square goodness of fit
b. Chi-Square goodness of fit for more than two Categories
c. Chi-Square Correction for Continuity

13. Contingency Tables
a. Chi-Square Analysis of Contingency Table
b. 2 X 2 Contingency Table

INTERPERSONAL & COMMUNICATION SKILLS

UNIT OBJECTIVES

The neurosurgery resident will develop interpersonal and communication skills that result in effective information exchange and team building with patients, their families, and other health professionals. They must also demonstrate an understanding of systems-based practice, as manifested by actions that demonstrate an awareness of and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide care that is of optimal value. Neurosurgery residents will be expected to develop skills in evaluating their patient care practices to demonstrate an understanding of the principles of practice management and the socio-economic aspects associated with the delivery of health care.

A. COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

1. Review the role of the neurosurgical leadership in the community and hospital setting.
2. Explain the neurosurgeon's responsibilities in terms of health care cost containment.
3. Review the features and relationships of the healthcare system including:
   a. treatment facilities
   b. third party payment systems
      i. Medicare
      ii. Medicaid
      iii. employer-provided insurance
      iv. private insurance
   c. physician practice organizations
   d. medical equipment manufacturers
   e. pharmaceutical companies
4. Review the rules and regulations of the training hospital(s) as they pertain to the practice of neurosurgery in which the residency is performed.
5. Name the institutional and social service agencies in your community and review their role in the overall management of neurosurgical patients.
6. Demonstrate a knowledge of the rules and regulations of your State Medical Board.
7. Discuss mandatory reporting laws.
8. Discuss issues pertinent to the topic of the impaired physician.
9. Name and describe the local, regional, and national neurosurgical organizations including their purposes, roles, activities, and interactions.
10. Discuss the importance of tracking morbidity, mortality, and patient outcomes.
11. Review the career options available at the completion of neurosurgical residency in detail including:
   a. private practice
   b. academic practice
   c. subspecialty fellowship
   d. research
   e. administration
   f. military
12. Discuss post-residency fellowship training program availability, application process, and career usefulness.
13. Describe the types and characteristics of surgical practice organizations including:
   a. solo practice
   b. group practice
      i. partnership
      ii. professional association
      iii. corporation
   c. academic practice
   d. Health Maintenance Organizations (HMO)
      i. Preferred Provider Organizations (PPO)
      ii. Individual Practice Associations (IPA)
      iii. staff model (Kaiser-Permanente type)
   e. Federal
      i. Department of Veterans Affairs
      ii. Military
      iii. Public Health Service
14. Discuss hospital payment systems (e.g., DRGs, per diem rates) and describe their incentives and how they affect hospital profitability.
15. Discuss the role and influence of national quality oversight and review organizations for hospitals and health plans (JCAHO, NCQA).
16. Discuss the history, changes, eligibility, funding, and problems associated with the Medicare program.
17. Describe the Medicare program features, such as eligibility, funding, administration, federal-state relationship, benefits, and payment methods.
18. Discuss federal funding of graduate medical education and how current federal budget allocations and proposals for changes in funding affect or will affect neurosurgical training programs.
19. Discuss the significance of the following issues as they relate to the practice of neurosurgery:
   a. legislative/regulatory requirements
i. Americans with Disabilities Act
ii. Clinical Laboratory Improvement Amendments (CLIA)
b. Federal/professional regulatory institutions
   i. Health Care Financing Administration (HCFA)
   ii. Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
   iii. Occupational Safety and Health Administration (OSHA)
c. miscellaneous
   i. affirmative action
   ii. equal opportunity
   iii. sexual harassment
20. Describe the ways, means, and reasons physicians influence the political process at the national, state, and local level.
21. Discuss the demographics of neurosurgeon distribution, numbers, workload studies, and workforce needs.
22. Outline the requirements for certification by the American Board of Neurological Surgery.
23. Formulate a strategy to evaluate personal and professional considerations in making a career choice.
24. Appraise the importance of family involvement in making career choices, including geographic location.
25. Discuss the available opportunities to obtain continuing medical education credits. Describe the political, economic, and social factors which impact on the practice of medicine generally and neurosurgery specifically.
27. Discuss the concept of relative value units (RVUs).
28. Summarize the process of impairment determination as it relates to the neurosurgical patient population.
29. Review the availability, requirements, and application procedures for post residency fellowship if appropriate.
30. Discuss the following issues as they relate to planned neurosurgical practice:
   a. healthcare delivery systems, including managed care
   b. health care economics
   c. political and legislative processes in healthcare
31. Obtain a demographic profile of potential practice locations to include population and medical demographics.
32. Outline the essential business characteristics of neurosurgical practice including:
   a. content and interpretation of financial reports
   b. management of human resources
   c. facility design and maintenance
   d. billing and collection processes
33. Discuss the key elements of a provider professional services agreement, such as a PPO or HMO contract, and identify provisions that require particular attention.
34. Describe the typical provisions and considerations in a physician employment contract including what to look for and what to avoid.
35. Describe, compare, and contrast partnership versus corporate practice structures, including the tax and liability advantages and disadvantages of each.
36. Describe the advantages and disadvantages of solo, single specialty group, and multispecialty group practice.
37. Review the financial issues associated with the neurosurgical career options under consideration.

38. Describe the administrative structures and processes required for managing an office practice including:
   a. billing and collection for medical services
   b. financial accounting and reporting
   c. scheduling
   d. transcription
   e. medical record management for appointment scheduling
   g. information system
   h. facility selection and maintenance
   i. secretarial services

39. Describe the content, interpretation, and utilization of the following financial documents:
   a. balance sheet
   b. income and expense statement
   c. accounts payable and receivable
   d. collection analysis

40. Discuss the insurance requirements associated with neurosurgical practice including:
   a. personal and professional liability
   b. personal health and disability
   c. casualty, fire, and theft
   d. personal life

41. Discuss the issues of quality assurance as related to neurosurgical practice including:
   a. maintenance of the clinical record
   b. review and documentation of morbidity and mortality

42. Describe the considerations in Evaluation and Management (E & M) coding, including documentation requirements.

43. Describe the work, practice expense, and malpractice expense components of Medicare's Resource-based Relative Value Scale (RBRVS) and how they are derived.

44. Explain how Medicare and commercial payer conversion factors are derived and used to create a fee schedule from the RBRVS.

45. Describe commonly used methods of physician risk contracting, such as capitation payment, and explain the considerations in negotiating such a contract.

46. Describe the practice information necessary to safely and profitably manage a neurosurgical risk contract.

47. Review the features, similarities, and differences in various third party payment systems including:
   a. Medicare
   b. Medicaid
   c. commercial insurance
   d. worker's compensation

48. Contrast HMO and PPO health plans.

49. Describe the meaning of "managed care" and its typical components including:
   a. contractual discounts
b. provider risk arrangements
   
c. utilization management
   
d. provider report cards
   
e. practice guidelines
   
f. restricted access models
   
   i. primary gatekeeper
   
   ii. point of service
   
   iii. open access

50. List and discuss the ethical issues and conflicts of interest involved in managed care treatment decisions such as:
   
a. capitation reimbursement
   
b. risk pools
   
c. cost saving incentive bonuses

51. Discuss antitrust considerations faced by physicians in payer contract negotiations including the concepts of collective bargaining, price fixing, and group boycott.

52. Describe types of retirement plans and funding considerations and limitations.

53. Explain the differences between occurrence and claims-made professional liability insurance and considerations made in selecting insurer and coverage levels.

B. COMPETENCY-BASED PERFORMANCE OBJECTIVES:

1. Demonstrate an ability to interact effectively, professionally, and respectfully with:
   
a. patients and their families
   
b. fellow residents
   
c. allied health care personnel
   
d. hospital staff
   
e. medical students
   
f. faculty physicians
   
g. referring physicians

2. Demonstrate the ability to maintain accurate and current medical records.

3. Discuss neurosurgical career options with:
   
a. faculty
   
b. peers
   
c. family
   
d. non-faculty neurosurgeons and other mentors

4. Accumulate information about post-residency career options.

5. Create and keep current a resume/curriculum vitae.

6. Record CPT codes for office visits and procedures performed on service.

7. Accurately document H&P and consultations according to the AMA-CPT E&M documentation guidelines.

8. Demonstrate the ability to properly code neurosurgical activities.

9. Accurately assign and justify medical impairment ratings for neurosurgical patients.

10. Outline a post-residency career track.

11. Apply for post-residency fellowship, if appropriate.

12. Obtain information about specific practice, research, or administrative career opportunities as appropriate.
13. Compose a list of questions to ask and things to see when interviewing for a neurosurgical position.
14. Read and interpret a financial report.
15. Design a structure for an office practice including a listing of the generic office processes and how to arrange staffing.
16. Prepare lists of neurosurgical instruments/equipment needed for specific operative procedures.
17. Select a proper practice, research, or administrative opportunity if appropriate.
18. Complete license and registration requirements for your chosen location.
19. Complete applications for hospital staff membership and clinical privileges.
20. Complete resident case data sheet for the American Board of Neurological Surgery and have same signed by Program Chair.

**PROFESSIONALISM AND SYSTEMS BASED PRACTICE**

**Ethics**

I  Understand the Major Theories of Biomedical Ethics
II Define the Primary Principles of Biomedical Ethics  
   A. Beneficence  
   B. Nonmaleficence  
   C. Autonomy  
   D. Justice
III Informed Consent  
   A. Briefly outline the historical development of informed consent  
   B. Discuss what it means to be "informed" and the role of disclosure in making choices  
   C. Describe the difference between the professional practice standard and the reasonable person standard of disclosure  
   D. Discuss "consent" and the role of competence and the context of decision-making  
   E. Discuss the three areas of exception to the duty of informed consent  
   F. Understand some of the future trends in informed consent  
      1. Governmental regulations  
      2. Multi-center trials  
      3. Outcomes measures  
      4. Case law  
   G. Describe informed refusal
IV Advanced Directives and Substituted Judgment  
   A. Understand the key underlying ethical principle  
   B. Describe some different types of advanced directives  
      1. Living Will  
      2. Durable Power of Attorney  
      3. Values Statement  
   C. Describe durable Power of Attorney  
   D. Discuss some of the problems with advanced directives

Update: May 1, 2013
V  Critical Care and End of Life Issues
   A.  Pain Management
       1.  Discuss the ethical principle of “double effect”
   B.  Futile Care
   C.  Define futility
   D.  Physiological futility
       1.  Imminent demise futility
       2.  Quality of life futility
       3.  Poor probability of efficacy
   E.  Discuss a new approach to the issues of futility
       1.  "Triage planning framework" communities
   F.  Define palliative care
   G.  Persistent vegetative state
       1.  Discuss the difference between vegetative state and persistent vegetative state
       2.  Discuss the legal conclusions in the Nancy Cruzan case
   H.  Brain Death
       1.  Define brain death
       2.  Define "higher brain" or "cerebral" death
   I.  Physician Assisted Death
       1.  Forgoing life sustaining treatment
       2.  Withdrawal vs. withholding of treatment
       3.  Euthanasia
       4.  Physician-assisted suicide
       5.  Physician-assisted death

VI  Ethical Issues in Transplantation
    1.  Discuss the ethical issues in fetal tissue transplantation

VII  Ethical Issues of Gene Therapy
    1.  Germ-line gene therapy
    2.  Human cloning

VIII  The Physician-Societal Relationship
    A.  Describe the physician-patient relationship
    B.  Describe the physician-societal relationship
    C.  Discuss the impact of managed care on these relationships
    D.  Identify the ethical principles that underlie the physician-patient and the physician societal relationship
       1.  Beneficence
       2.  Nonmaleficence
       3.  Justice
    E.  Identify some ethical duties that result from these principles
       1.  Duty to maintain the health of the individual and the group
       2.  Duty to increase the resources available for medical care
       3.  Duty to continue to improve the quality of care
       4.  Duty to lower cost while maintaining quality of care
    F.  Discuss how to resolve when duties conflict
IX  Ethical Issues in Human Experimentation

X  Ethics Committees
   A. Describe the role of ethics committees
   B. Discuss the process of decision making
   C. Discuss who should be a member
   D. Define an ethics faculty

XI Organizational Ethics
   A. Define organizational ethics
   B. Define the characteristics of an ethics infrastructure
   C. Discuss the position of the Joint Council on Accreditation of Health Care Organizations and organizational ethics
   D. Discuss the role of neurosurgeons in organizational ethics
Medico-Legal

Demonstration and understanding of the principles of medico legal practice and the delivery of health care in Neurosurgery.

A. Competency-based knowledge objectives.

1. Review the concepts of Fraud and Abuse legislation pertinent to the practice of Neurosurgery
   a. Understand the limitation of interaction as a provider with another provider in the delivery of healthcare to Medicare, Medicaid, and other Federal supported programs.
   b. Understand the penalties and liabilities associated with the intentional or erroneous infraction of one of these relationships.
   c. Understand the need to set-up a compliance program to prevent infractions of the federally supported programs.

2. Review the concepts of Anti Kick-Back legislature.
   a. Understand the types of kick-backs which can trigger an investigation
   b. Understand the nature of the severity of the violations.
   c. Understand the nature of intent requirement vs. error.
   d. Understand the parties involved, and their possible interactions.

3. Review the principles of compliance with State Licensing laws.
   a. Understand the legal requirements for a medical license.
   b. Understand the legal implications of practicing medicine without a License.

4. Understand the liabilities for those practicing medicine in a state without a license.
   a. Understand the cross-over or reciprocity provisions for medical licensing in different states.
   b. Understand the implications of the practice of medicine by paramedical personnel under the supervision of a physician.
   c. Understand the legality of the prescription of controlled substances under a medical license;
      i. By the practitioner.
      ii. By paramedical personnel under supervision.

5. Review the principles of compliance with hospital regulations and bylaws.
   a. Understand the legal implication of having hospital bylaws.
   b. Understand the legal implications of not complying with hospital bylaws.
   c. Understand the legal meaning and implications of altering hospital bylaws.
   d. Understand the limitations of hospital bylaws and their applicability to controversial situations.

6. Demonstrate knowledge of State mandatory reporting laws.
   a. Demonstrate knowledge of state mandatory reporting laws regarding child abuse.
   b. Demonstrate knowledge of state mandatory reporting laws regarding fraud and abuse pertinent to Medicaid programs.

7. Demonstrate knowledge of the issues pertaining to Impaired Physician legislature.
   a. Understand what the significance of the impaired physician legislation is, and how it applies to neurosurgeons.
   b. Understand the implications of practicing Neurosurgery while impaired.

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c. Understand the liability and sanctions existing regarding the practice of Neurosurgery while impaired.
d. Understand the legal responsibilities for identification, and notification regarding the practice of Neurosurgery while impaired.

8. Demonstrate understanding of the principles of Americans with Disabilities Act legislation, and their application in the practice of Neurosurgery.
   a. Understand the legal obligations applicable to the physician practicing medicine regarding hiring and firing of Americans with disabilities.
   b. Understand the legal obligations in the practice of medicine regarding interaction with patients with disabilities.
   c. Understand the legal requirements regarding accessibility to office resources applicable to patients and employees with disabilities.

   a. Understand the legal implications of sexual abuse legislation applicable to the practice of medicine, and dealing with patients.
   b. Understand the legal issues of sexual abuse legislation in the work place.
   c. Understand the legal necessity of having in place sexual abuse policies, applicable to employees and patients, and the need to enforce those policies.

10. Demonstrate understanding of EMTALA legislation.
    a. Understand the principles of Anti-dumping laws.
    b. Understand limitations of concept of patient stability prior to transfer.
    c. Understand requirements of neurosurgical availability to emergency rooms.
    d. Understand liability for internal transfers within hospital.
    e. Understand liability for transferring unstable patients.

11. Demonstrate understanding of Medical Malpractice litigation.
    a. Understand the concept of medical negligence.
    b. Understand the difference between negligence and maloccurrence.
    c. Understand the concept of medical necessity.
    d. Understand the concept of informed consent.
    e. Understand the concept of Reasonable Medical Certainty.
    f. Understand the concept of Standard of Care.
    g. Understand the concept of Tort Legislation.
    h. Understand the concept of Tort Reform.
    i. Understand the requirements for legal testimony as a medical expert, and as a treating physician.
    j. Understand the concept of the National Physician Data Bank, and its functions.

12. Demonstrate an understanding of basic medico legal procedures.
    a. Understand what a subpoena is and its implications.
    b. Understand what a discovery deposition is.
    c. Understand what is required for trial testimony.
    d. Understand when to produce a medical summary or report as a treating physician, and as a medical expert.
    e. Understand when it is acceptable to charge fees for medical review, and testimony
    f. Understand the purpose of a trier of fact: The Judge, or the Jury.
    g. Understand the difference between civil and criminal liability as applied to medical practice
h. Understand the extent of penalties applicable to civil and criminal liabilities.

i. Understand the need to have independent counsel

ATTACHMENT 6: RECOMMENDED TEXTS

JUNIOR LEVEL:

NEUROANATOMY


NEUROPHARMACOLOGY


NEUROPHYSIOLOGY


MID LEVEL:

NEURORADIOLOGY


NEUROPATHOLOGY


NEUROLOGY

Update: May 1, 2013

**CLINICAL: ALL LEVELS**

**CEREBROVASCULAR**


**NEURO-ONCOLOGY**


**GENERAL NEUROSURGERY**

**PAIN**


**PEDIATRICS**


**PERIPHERAL NERVE**


*Update: May 1, 2013*


**SPINE**


**STEREOTACTIC/FUNCTIONAL**


**TRAUMA/Critical CARE**


ATTACHMENT 7: EVALUATION FORMS