

**American Academy of Neurology  
Graduate Education Subcommittee  
Residency Core Curriculum**

The American Academy of Neurology (AAN) Board of Directors charged subspecialty sections and appropriate subcommittees of the AAN to develop core curricula for the medical student/clerkship, residency, and fellowship levels. To fulfill its charge, the Graduate Education Subcommittee (GES) developed the following Residency Core Curriculum for neurology program directors. The Accreditation Council for Graduate Medical Education (ACGME) provides the complete guidelines for Program Requirements for Residency Education in Neurology and can be found at [www.agcme.org](http://www.agcme.org).

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# 1. Introduction

The goal of the graduate education (resident) core curriculum is to define in broad terms the basic educational database for neurology residency training. The information contained within this database consists of knowledge that is considered critical to any physician who completes a neurology residency training program and practices neurology. Such core knowledge involves basic principles of neurologic diagnosis and management, and familiarity with common disease states and basic procedural skills.

## 2. Goals and Objectives

### A. Goal

To prepare physicians to function as effective neurologists, who can recognize and manage patients with neurologic problems, and who can provide expert advice to other medical consultants on neurologic matters.

### B. Objectives

1. To teach or reinforce the following procedural skills:
  - a. Perform a complete neurologic history and examination.
  - b. Perform an urgent screening neurologic history and examination.
  - c. Communicate, both orally and by written record, the patient's neurologic history and examination.
  - d. Provide an appropriate neurologic consultation.
  - e. Perform a lumbar puncture.
  - f. Perform/be familiar with neurophysiologic testing (EEG, EMG, NCV, PSG, MSLT).
  - g. Perform caloric testing.
  - h. Perform/be familiar with prostigmine/tensilon test.
2. To teach or reinforce the following analytical skills:
  - a. To recognize symptoms and signs that suggest neurologic disease.
  - b. To be able to localize symptoms and signs to the appropriate anatomic parts of the nervous system.
  - c. To be able to formulate differential diagnosis, evaluation, and management strategies based on relevant history, examination, and laboratory features.
  - d. To be familiar with the basic tests used to evaluate neurologic problems (neuroimaging, EEG, EMG, NCV, evoked potentials, sleep studies), and how to interpret their results.

### 3. Definitions

The curriculum for a residency training program in neurology should encompass training and educational experiences to prepare a physician for the independent practice of neurology. The training must require the residents to obtain competencies in each of six areas defined by the RRC for neurology.

1. **Patient care:** Ability to perform a comprehensive history and physical examination of a patient, localize the neurological problem, generate an appropriate differential diagnosis, and determine an effective, cost-effective plan of further evaluation and management of the patient. Patient care must be performed in a compassionate, ethical manner.
2. **Medical knowledge:** Knowledge of neurological disorders and basic neurophysiology and genetics. Knowledge of laboratory and diagnostic technology and ability to utilize this technology safely, effectively, and economically. Critical ability to assess evolving medical science, technology and epidemiological and social-behavioral sciences relating to medicine.
3. **Practice-based learning and improvement:** Recognition of the limits of a physician's own cognitive and clinical skills and need for life-long learning. This relates to the ability to obtain current information from science and practice literature to improve patient care; learning systems to evaluate and improve the physician's own practice patterns such as obtaining feedback through patient evaluations and analysis of outcomes; and the ability to critically evaluate the medical literature.
4. **Interpersonal and communication skills:** The ability to effectively exchange information with patients, families and ancillary health professionals. This includes the ability to both listen and understand patients, to recognize the cultural and religious biases of both the practitioner and patients/families and effective methods to deal with such, and the ability to communicate with other professionals and physicians on a consultation basis.
5. **Professionalism:** A commitment to carrying out professional responsibilities including timely and responsive communication with patients and other health care providers, appropriate use of medical records, and coordination of care and patient coverage if unavailable. The adherence to ethical principles with sensitivity to a diverse patient population including but not limited to differences of race, gender, religion, age, cultures, political beliefs and sexual orientation; while always respecting the confidentiality of medical information.
6. **Systems-based practice:** Recognition of the workings of the health care system in the broader setting of society as a whole. This involves recognition of practice guidelines, local and national resources available to enhance the quality of life of patients, and ancillary health services available to affect all aspects of a patient's care. The ability to function effectively within the financial limitations of individual patients and to utilize effectively the community and national resources available. The ability to function in the current system of managed health care and recognition of the legal aspects of the practice of medicine.

The core competencies were adapted from the ACGME guidelines for Program Requirements for Residency Education in Neurology, [www.acgme.org](http://www.acgme.org). A complete summary of the ABPN core competencies can be found at [www.abpn.com](http://www.abpn.com).

## 4. Content of Subjects to be Taught

Training in Neurology residencies must be very broad. It must encompass both clinical and research aspects of Neurology, including both clinical and basic science research. There should be significant emphasis on both inpatient and outpatient practice of clinical Neurology. Ethical decision-making, including end-of-life decisions and cost-effectiveness in Neurology must be taught. Training should include didactic sessions and practical, hands-on experience. There should be an ascending level of autonomy in clinical training as the trainee progresses. All content should conform to program requirements of the Residency Review for Neurology, as outlined in the most recent version of the Graduate Medical Education Directory. Thus, as a minimum, there must be at least 18 months of clinical adult Neurology with primary responsibility in patient care, a minimum of 3 months in clinical pediatric Neurology with primary responsibility in patient care, and at least six months of clinical Neurology training in an outpatient setting. Included below are the areas of Neurology which must be included in a core curriculum of Neurology residency training:

### A. Neurosciences

- Neuroanatomy
- Neurophysiology
- Neuropharmacology/Neurochemistry
- Neuropsychology
- Neuropathology
- Neuroimmunology
- Neurogenetics
- Neuroepidemiology
- Neuroendocrinology
- Embryology and development of the nervous system
- The aging brain

### B. Clinical Neurology

- Epilepsy and related convulsive disorders
- Disease of the peripheral nerve, autonomic nerves, neuromuscular junction and muscle
- Loss and alteration of consciousness
- Headache and facial pain
- Neck and back pain
- Head and spinal cord trauma and injury
- Disorders of the special senses
- Inherited and acquired metabolic disorders
- Neurotoxicology and effects of drugs and alcohol on the nervous system
- Stroke and related disorders of brain ischemia
- Behavioral Neurology
- Neurology of aging
- Movement disorders
- Demyelinating disorders

Neuro-intensive care  
Neuro-ophthalmology  
Neuro-oncology  
Neuro-otology  
Neuro-infectious diseases  
Sleep disorders  
Pediatric Neurology  
Neurosurgery  
Neuro-rehabilitation  
Psychiatry  
Pain management

**C. Laboratory Neurology**

Familiarity with indications for and interpretation of results of:  
Neuroradiology, including MRI, MRA, CT, SPECT, angiography, myelography;  
invasive thrombolysis and related procedures such as stent placement  
EEG, EMG, Evoked potentials, and sleep monitoring  
Ultrasonography, including cardiac, and carotid and intracranial vasculature  
ENG, VOR and formal visual field tests  
Nerve, muscle, and brain biopsies  
Neurocognitive tests

**D. Procedures**

Significant, hands-on experience with indications for, and performance and interpretation of, lumbar puncture, tensilon test, and caloric testing  
Familiarity with performance aspects of:  
EMG, NCV, Evoked Potentials, and sleep testing, including when to order, how to place electrodes and needles, and interpretation of results  
Baclofen pumps, deep brain stimulators, and vagal stimulators, including indications for placement and manipulation, and how to manipulate  
Botulinum toxin injection, including indications for its use, and techniques and side effects of injections

**E. Other**

End-of-life decisions  
Ethics  
Cost-effective medicine  
Practice management  
Medical-legal implications of Neurology practice  
Outcomes research  
Medical record keeping  
Documentation for third-party payors  
Interactions with pharmaceutical company representatives  
Difficult or hostile patient  
Conflicts of interest  
Alternative/complementary medicine

## **5. Prerequisites for Trainee**

Trainees must have completed an acceptable internship and otherwise meet ABPN requirements for beginning training in Neurology. Trainees must have sufficient command of English to understand the didactics presented. Trainees should have access to, and be familiar with, the use of computerized learning tools and databases, such as Medline.

## **6. Personnel Needed for Training**

### **A. Support Staff – Administrative Assistant**

Responsibilities may include:

1. For current residents:  
Maintain a file  
Communicate with housestaff office to obtain contracts  
Send out evaluation forms and assure they are returned  
Record vacation and sick time  
Submit call schedule
2. For new residents:  
Maintain a file  
Send newcomer's packet/ agreement letter/ contract after the match  
Reconfirm appropriate documentation of the resident's degree and paperwork from ECFMG when needed
3. For resident applicants:  
Maintain a file  
Send out training program information, application  
Arrange interviews

### **B. Neurology Program Director**

Responsibilities:

1. Be able to devote sufficient time to the program and residents.
2. Prepare goals and objectives for residents, and see that they are being met.
3. Select new residents.
4. Evaluate residents and meet with residents to review evaluations.
5. Provide a written final evaluation for residents upon completion of the program.
6. Ensure the residency program is in compliance with the Residency Review Committee requirements.

7. Organize and insure that neurology conferences, lectures in basic sciences, and journal clubs take place and are attended by residents.

**C. Neurology Teaching Faculty**

1. In addition to the program director, there should be a minimum of five adult neurology faculty members in addition to pediatric neurology faculty.
2. The faculty: neurology resident ratio should be 1:1 (can include the resident director).
3. Faculty should have expertise in the various fields of neurology, including: neuro-ophthalmology, neuromuscular disease, cerebrovascular disease, epilepsy, movement disorders, critical care, clinical neurophysiology, behavioral neurology, neuro-immunology, infectious disease, neuro-otology, neuro-imaging, neuro-oncology, pain management, neurogenetics, child neurology, geriatric neurology and sleep disorders medicine.
4. Faculty should be available to residents, interested in the education of residents, and meet regularly to review the program.
5. A faculty member should be assigned to be responsible for the day-to-day activities of the program at each institution.
6. Selected faculty should be available to act as mentors to provide individual advice and guidance to residents on an on-going basis.

## **7. Qualifications of the Trainers**

**A. Neurology Program Director**

1. Full time member of the department/division of neurology.
2. Board certified by the American Board of Psychiatry and Neurology.
3. Member in good standing of the medical staff of the sponsoring institution.
4. Licensed to practice medicine in the state the program is located (Federal programs may be exempt)
5. Demonstrate administrative, educational and clinical skills.

**B. Neurology Faculty**

1. Board certified by the American Board of Psychiatry and Neurology, or Board eligible and currently pursuing certification.
2. Member in good standing of the medical staff of the sponsoring institution.
3. Licensed to practice medicine in the state the program is located (Federal programs may be exempt).

## **8. Facilities Needed for Training**

All aspects of facilities should conform to program requirements of the Residency Review for Neurology, as outlined in the most recent version of the Graduate Medical Education Directory. Facilities may be construed as consisting of the actual buildings where training may take place, patient demographics and associated programs.

### **A. Buildings**

There must be at least one large teaching hospital, and preferably two or more. There must be adequate facilities for training in both adult and pediatric Neurology. There must be adequate inpatient and outpatient facilities, including examining areas, conference rooms, consultation rooms, dictation areas, dining facilities and on-call rooms and showers. There must be adequate office space for faculty, staff and residents. There must be adequate research laboratory space and money to support its enterprise. Residents must have 24-hour access to an on-site library with appropriate texts, journals, and modern on-line computer facilities for medical searches in all institutions in which Neurology residents train. There must be adequate, contemporary clinical laboratory facilities that report rapidly, with computer access, the results of necessary laboratory evaluations, including clinical-pathological, electrophysiological, imaging, sleep, and other studies. Each training institution must have an adequate chart and record-keeping system for patient treatment.

### **B. Patient Population**

There must be an adequate and appropriate number of patients available who are diversified as to age, sex, race, neurological problem, and socioeconomic status. This must include a wide variety of both adult and pediatric patients. Neurology residents must have PRIMARY management responsibility for adult and pediatric neurologic inpatients, outpatients, emergency ward patients, and intensive care unit patients. Neurology residents must also consult on the patients of other services, including Internal Medicine, Surgery, Neurosurgery, Orthopedics, and others.

### **C. Associated Programs**

Neurology residents must train in an environment in which all medical, surgical and psychiatric specialties are represented. Specifically, there at a minimum must be departments or sections of Internal Medicine (especially Cardiology, Rheumatology, Pulmonology, Renology, and Hepatology), General Surgery, Neurosurgery, Orthopedic Surgery, Transplant Surgery, Pathology, Neuropathology, Psychiatry,

Rehabilitation Medicine, Radiology, and Neuroradiology. Neurology residents should also train in an environment in which they are exposed to trainees and practitioners of Pharmacy, Physical Therapy, Occupational Therapy, Speech Therapy, Psychology, Physician's Assistants, and Advance Practice Nurses. Training institutions must have available ethicists and ethics counselors.

## **9. Set up for the Training**

Training should be set up according to a graduated level of both complexity and autonomy of study. In the second and third years of training, the trainee should be required to participate in the process by giving a portion of the curriculum to first year residents and participate in the teaching of medical students. At least one formal teaching round should be prepared by the trainee and presented during residency.

## **10. Methods of Training**

The most important method of training is at the side of the patient, either in the hospital or in an outpatient setting. For the former, case presentations and demonstrations of the neurological examination by the resident to the teacher are the foundation of clinical teaching. Clinical discussions between the resident and faculty will focus on the diagnosis, treatment, and management of neurological disorders. This should be supplemented with assigned readings. In the outpatient setting, shorter patient encounters in general should also be supplemented by assigned readings and other self-study assignments.

A required reading list should be provided to the trainee at the beginning of the residency, with a list of supplementary readings as well. The lists should include 'classic' papers and books which should be familiar to all neurologists, as well as a comprehensive neurology text, contemporary review articles, and well-recognized texts in important subspecialty areas of neurology (e.g., stroke). A computer station should be provided to the trainees, as well as a self-study library of CDs, educational videos, and other multimedia teaching programs chosen by the faculty. Trainees should be encouraged to use the Internet for literature searches, retrieval of papers, and reading of journals online.

Regular grand rounds, journal clubs, and lecture series should be part of the training program.

Training in electroencephalography and electromyography should be based on active participation of the trainee in the acquisition and interpretation of clinical data under the direct supervision of faculty.

Neuropathology should include the review of current case material from autopsies and biopsies, as well as systematic review of archival material such as slides.

Presentation of pathological results by trainees at case conferences is encouraged. Similar techniques are appropriate for training in neuroradiology.

Training in basic neuroscience should include recommendations for textbook and article reviews, lectures by faculty, and small group discussions between trainees and faculty. Over the course of the residency, the topics outlined in Section 4 (Contents to be Taught) should be covered.

All programs are encouraged to provide the AAN CONTINUUM for the use of trainees.

Supervised research projects by residents are encouraged.

## **11. Timetable for Training**

Each program has unique features that may dictate specific sequencing of resident training; however, the schedule of experiences should parallel the goals and objectives of the curriculum. Elective time is encouraged as well as the opportunity to engage in basic/clinical research.

- A. **Year I** should be devoted to learning the skills of interview, examination and management of both hospitalized and ambulatory patients under close supervision.
- B. **Year II** should allow training in Neuropathology, Clinical Neurophysiology and in other Clinical and Basic Neurosciences. Night call and short block assignments in patient care help maintain clinical skills learned in the initial year. Rotations in Child Neurology often fit well into the learning patterns of this year.
- C. **Year III** should be structured to allow the trainee to mature by exercising independent judgement in outpatient assignments or in supervisory positions on inpatient services. Consultation Neurology should be emphasized during this year as well. Electives are an important part of the maturing process and should also be scheduled during the year.

## **12. Methods of Evaluation of Trainee**

- A. **Resident evaluation:**  
Evaluation should include assessment of clinical skills, medical knowledge, practice-based learning and improvement, systems-based practice, attitude and interpersonal communication skills, patient care, professionalism, reliability, teaching skills, and administrative duties.
- B. **Suggested intervals:**  
Yearly evaluation by program director with summary meeting/letter at end of residency. Biannual evaluation by resident preceptor including broader goals and objectives for training. Rotation specific evaluation focused on rotation specific goals and objectives. (All meetings result in letter signed by evaluator and resident).

- C. Suggested testing/monitoring:**  
Supervised history and physical examination by preceptor within 2 months of training to review core aspects of history and physical exam. Annual RITE for self-assessment.  
Mock oral boards (1/2 hour patient exam, 1/2 hour presentation and vignettes) on a yearly basis.  
Resident success on ABPN examination.

### **13. Methods of Evaluation of Training Process**

Yearly evaluation by residents of: rotations, conferences, and faculty members.

Yearly evaluation by residency training committee (faculty) of same.

Regular contact with past residents 3-5 years post-residency to question if areas of training were inadequate for their later clinical needs.

RITE score evaluation to see if specific areas of weakness occur across multiple residents' scores.

ABPN board pass rate. Follow-up with residents who did not pass.

### **14. Mechanisms for Feedback**

Feedback should be a two-way avenue of information for both the resident trainee and the faculty. Feedback sessions or interviews should be conducted in an open and honest manner in which the faculty and the resident feel comfortable in expressing their opinions concerning resident performance, faculty performance and program performance. Feedback at its best should provide a forum for exchange of information that will be useful not only to the resident trainees in improving their performance but also for the faculty improving their teaching techniques. The same forum should be utilized to inform program directors and chairs in terms of overall organization of the program.

#### **A. Regularly Scheduled Feedback Sessions**

At the conclusion of each defined rotation within the residency faculty and residents involved in that particular rotation should have the opportunity to fill out written standard evaluation forms concerning all aspects of resident and faculty performance. These evaluations could be shared with each resident in a person-to-person discussion of the form filled out by the faculty. Such oral discussions are encouraged on a regular, ongoing basis throughout the training. The evaluation forms of the faculty by the residents are probably best given to the concerned faculty in an anonymous fashion. In addition to these formal structured appraisals of performance given at the end of each rotation within the residency, there should be ongoing individual meetings in which faculty have the

opportunity in the course of a rotation to express positive and negative features about each resident's performance. If a particular rotation is one month, perhaps two-week intervals would be satisfactory; if a particular rotation were three months, then monthly oral evaluations might prove useful before the final written standardized form is filled out by both residents and faculty. In addition, every three months, there should be a scheduled first, second, and third year resident group meeting with the program director and chair to review any communal problems that have arisen. In addition, every six months or perhaps every twelve months, a meeting of all the residents with the program director and chair to discuss overall issues regarding the program should be scheduled.

**B. Written Comments on Written Presentations**

On a weekly basis, a single written presentation of an initial admission to the hospital or to an outpatient facility should be evaluated by the faculty. The faculty should carefully review the note and given specific written instructions to the resident regarding content and style of the written presentation.

**C. Oral and/or Written Comments on Oral Presentations**

Oral comments on oral presentations of new patients in the hospital or in the outpatient setting should be a routine part of the daily communication between residents and faculty. Oral comments should be directed at the accuracy, clarity and reliability of the oral presentation of the resident. Perhaps we can consider introducing a format in which a particular resident on a given day is made "more responsible" for the oral presentations on that day with the knowledge that he or she will be specifically evaluated with instant oral feedback on that particular day.

## **15. Methods of Constantly Upgrading Knowledge**

There are multiple methods that can be used for constantly upgrading resident knowledge and learning.

- A. Clinical case material can be utilized by the faculty to instruct the residents to go to the literature to summarize current knowledge concerning aspects of the case under review. Residents should be expected to report back with short oral reports within 24 to 48 hours. In some instances, attending faculty might set aside time for longer presentations to the clinical group so that a resident might have to make a 15- to 30-minute report on a particular subject.

- B. Journal Clubs -- The monthly meeting of journal clubs addressing a specific topic with assigned article which require resident participation and faculty supervision is another useful tool.
- C. CONTINUUM -- The use of the CONTINUUM format as a special review feature of a particular subject would be particularly useful for the residents. Within one month of CONTINUUM being published, residents could meet in a special CONTINUUM group with faculty supervision to discuss that particular issue.
- D. Encouraging residents to subscribe to *Neurology*, *Annals of Neurology*, *Archives of Neurology* and subspecialty journals of their interest.
- E. Encourage resident participation in worthwhile outside educational experiences.
- F. Encourage resident attendance at educational meetings including local meetings as well as the American Academy of Neurology annual meeting.
- G. Encourage programs to send residents to meetings as well as encourage participation in hospital committees and other organizations.

## 16. List of References/Resources

The resources listed below are general, aimed at providing access to and coverage of a broad range of neurologic topics. The list is not meant to be inclusive: AAN specialty sections included a list of resources and references pertinent to that specialty which complements the list given here. A residency program in Neurology should have most, if not all, of these resources readily available to trainees.

### A. Journals

*Neurology*

*Annals of Neurology*

*Archives of Neurology*

*Brain*

*Journal of Neurology, Neurosurgery and Psychiatry*

*New England Journal of Medicine*

### B. Textbooks

*Merritt's Textbook of Neurology*: Rowland LP, ed. 10<sup>th</sup> ed. Lea & Febiger, 2000.

*Principles of Neurology*: Adams RD, Victor M, Ropper AH. 7<sup>th</sup> ed. McGraw-Hill, 2000.

*Clinical Neurology*: Baker AB, Baker LB. Harper & Row. Revised annually.

*Neurology in Clinical Practice*: Bradley WG, Daroff RB, Fenichel GM, Marsden CD. 3<sup>rd</sup> ed. Butterworth-Heinemann, 2000.

*Pediatric Neurology. Principles and Practice*: Swaiman KF, Wright. 3<sup>rd</sup> ed. Mosby, 1999.  
*Harrison's Principles of Internal Medicine*: 15<sup>th</sup> ed. McGraw-Hill, 2001.  
*Neurological Differential Diagnosis*: Patten, John, Springer-Verlag. 2<sup>nd</sup> ed. New York, 1996.  
*Neurology in General Medicine*: Aminoff, M. 3<sup>rd</sup> ed. 2001.  
*Diagnostic Radiology*: Osborn, A. Mosby, 1994.

C. **Other Resources**

*CONTINUUM*: AAN publication; <http://www.aan.com>  
*Medline* access; <http://medline.cos.com>  
*Harrison's Online Principles of Internal Medicine*;  
<http://www.pbg.mcgraw-hill.com/medical/products/honline.html>

D. **AAN Subspecialty Sections**

Behavioral Neurology  
Child Neurology  
Clinical Neurophysiology  
Critical Care & Emergent Neurology  
Epilepsy  
Geriatric Neurology  
Headache & Facial Pain  
Movement Disorders  
Multiple Sclerosis  
Neuro-epidemiology  
Neurogenetics  
Neuroimaging  
Neuromuscular  
Neuro-oncology  
Neuro-oph/Neuro-otology  
Neural Repair & Rehabilitation  
Pain  
Sleep  
Stroke  
Women's Issues in Neurology

## **17. Continuing Medical Education Needed**

The necessary amount of CME is generally legislated at the state level and required for licensure. Pertinent to the core curriculum of Neurology, CME should be obtained from several sources to provide breadth and variety of continuing education. These sources should include regular perusal of a neurology journal as listed previously, and also a general medical journal. Attendance at regular hospital conferences for lectures and case presentations is also suggested. Local CME opportunities are encouraged. Periodic attendance at national scientific and education conferences is highly recommended, such

as the AAN annual meeting or the ANA meeting. Lastly, use of the AAN program CONTINUUM, is highly recommended for regular review of subspecialty topics in Neurology.