



# Emerging Subspecialties in Neurology: Neuroimmunology

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Autoimmune and immune-mediated mechanisms are increasingly appreciated in many neurologic diseases. The goal of fellowship training is to develop an understanding of the pathophysiology and treatment of these diseases with a focus on immunology that is not traditionally afforded to most trainees during residency or fellowship. Neuroimmunology is an expanding subspecialty with rapidly emerging developments from the clinical and basic sciences necessitating frequent change in clinical practice. Historically, the first international congress of neuroimmunology was held in 1982, with the actual founding of the International Society of Neuroimmunology not occurring until after the second international congress in 1987. The origins of neuroimmunology, however, pre-date the establishment of the society by nearly a century, and modern clinical neuroimmunology has its roots in the interdisciplinary collaboration of neurologists, pathologists, internists, and other specialists in the early 1950s. The field of neuroimmunology intersects many traditional neurology subspecialties, including diseases within epilepsy, movement disorders, neuromuscular, autonomic neurology, neuro-oncology, behavioral neurology, degenerative disorders, and demyelinating diseases.

Training programs in neuroimmunology focus on autoimmune and immune-mediated diseases, with attention to the contribution of immune system-based mechanisms to the neurologic manifestations. Training also focuses on the pharmacologic and treatment implications of these diseases. Within neuroimmunologic disease, multiple sclerosis (MS) is perhaps the most prominently studied disease, likely owing to its prevalence and the early recognition of the role of the immune system in the pathophysiology of MS. Despite its prominence, however, it is only one of many neuroimmunologic diseases.

**TRAINING OPPORTUNITIES IN NEUROIMMUNOLOGY** There are currently no Accreditation Council for Graduate Medical Education–supported fellowships for neuroimmunology, autoimmune neurology, or MS and related diseases. This has funding implications, as some programs may strongly encourage or require the fellow to identify funding for his or her fellowship. In addition, there is presently no board

examination and no specific diploma is issued at the end of the fellowship. Non-accredited subspecialty fellowship training is currently available in this field at several institutions.

The amount of time devoted to patient care, basic science research, or clinical research varies considerably between programs. Some neuroimmunology fellowship training programs essentially focus solely on MS, with other programs having variable amounts of exposure to MS as a part of a more comprehensive immunology approach. Successful training in neuroimmunology, as in any subspecialty, greatly benefits from mentorship with an expert in the field.

Individual programs vary widely in the availability of training in the management of the neurologic manifestations of rheumatologic diseases. Similarly, exposure to paraneoplastic syndromes with either peripheral or CNS manifestations varies widely between institutions. Trainees with a special interest in these diseases should specifically query each program to determine the institutional approach to the interdisciplinary management of such patients, estimated patient volume, and mentor expertise. Additionally, some institutions may offer training to further subspecialize by combining fellowships. The addition of neuroimmunology training to more traditional fellowship tracks would allow the trainee a unique perspective to approach the emerging and increasingly recognized associations of neuroimmunology with a variety of neurologic conditions, including autoimmune dementia, epilepsy, and nerve and muscle disease, as well as the neurologic complications of rheumatologic diseases such as systemic lupus erythematosus, Sjögren syndrome, and thyroid disease. For example, a neuroimmunology fellowship could be preceded or followed by a neuromuscular fellowship with the goal of specializing in immune-mediated/paraneoplastic disorders of the peripheral nervous system. Alternatively, epilepsy fellowship training in addition to training in neuroimmunology would allow for specialization in autoimmune epilepsy.

An alternative training path to a neuroimmunology fellowship could be a customized experience establishing joint training with rheumatology and clinical immunology services; this approach would rely on a strong mentor.

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The National Multiple Sclerosis Society sponsors several different types of clinical and research fellowship awards, contingent upon the applicant making arrangements with an appropriate mentor and sponsoring institution prior to application.<sup>1</sup> Award types are listed in table 1 and additional information can be found at [www.nationalMSSociety.org/for-professionals/index.aspx](http://www.nationalMSSociety.org/for-professionals/index.aspx). This funding mechanism can be utilized to fund a position in an established fellowship program, or to create an individualized fellowship at a supportive institution. As described in the criteria in table 1, these fellowship awards necessarily have an MS focus.

The Veterans Administration (VA) offers 1- to 3-year fellowships in MS and neuroimmunology at the VA MS Centers of Excellence.<sup>2</sup> The fellowships are offered affiliated with the VA Centers of Excellence, with locations in 3 states: Washington (Seattle), Oregon (Portland), and Maryland (Baltimore). Fellows have the opportunity to customize training to obtain skills in clinical, scientific, and applied therapies for MS. More information is available at <http://www.va.gov/oa/>.

Given the scope and variety of neuroimmunology programs, it can be challenging to attain a comprehensive overview of available training opportunities. There is no clearinghouse of all neuroimmunology/autoimmune neurology fellowships, and thus the prospective trainee should consider proactively approaching his or her ideal fellowship by identifying a mentor or contact person within the field, and discussing potential career goals within neuroimmunology. Internet searches directed toward “neuroimmunology fellowship,” “autoimmune neurology,” and “MS fellowship” yield several leads on prominent programs. Table 2 provides a sample of available fellowships in neuroimmunology, representing the results of a Google Internet search (January

30, 2012) for “Neuroimmunology Fellowships.” The table lists all programs returned utilizing these search terms, inclusive of the top 100 results. Program directors were sent an e-mail query to verify the accuracy of the information on the fellowships. Please note that this list is not inclusive of all neuroimmunology fellowships available, but is provided to represent the breadth of programs demonstrated by performing a basic Internet search. Also, many institutions do not specifically promote a neuroimmunology or MS fellowship, but create positions for qualified candidates.

This approach, coupled with contacting specific individuals within institutions based on an applicant’s desired location, is a reasonable one. Given that many fellowships prefer trainees to apply for funding, applicants will likely need at least 18 months of lead time in contacting and applying to programs to allow for interviews, program selection, and identification of funding opportunities. Many programs have a rolling admission process, while others have a strict application deadline extending as far as 18 months prior to matriculation.

### CAREER PROSPECTS IN NEUROIMMUNOLOGY

MS and neuroimmunology specialists are in high demand because of the advent of new therapeutic agents, which require specialized knowledge to use successfully. Outside of the treatment and management of patients with MS in the private practice setting, a career in neuroimmunology would necessarily be located in a university-affiliated hospital or large neurology clinic, with opportunities for clinical or basic laboratory research. In the inpatient setting, a neuroimmunology disease specialist in a hospital would likely act as consultant, especially for acute presentations and complications of ongoing disease. Additionally, a specific outpatient

**Table 1** Fellowships offered through The National Multiple Sclerosis Society<sup>a</sup>

	Criteria	Details
Clinical Care Physician Fellowship	Mentored postresidency training in specialized multidisciplinary MS clinical care for US-licensed neurologists	1-year award; \$65,000 for salary, fringe, administrative
Sylvia Lawry Physician Fellowship	Mentored postresidency training in the design and conduct of MS clinical trials for board-eligible/certified neurologists licensed in the United States	Formal coursework in clinical research included in training; 2- to 3-year award; \$65,000/year for salary, fringe, tuition
National MS Society-American Academy of Neurology MS Clinician Scientist Development Award	Mentored training for postresidency physicians committed to a career in academic MS clinical research	Open to PGY 4 and 5 residents/fellows licensed in the United States; 3-year award; \$75,000/year for salary plus institutional allowance
Postdoctoral Fellowship	Mentored training for MD or PhD postdoctoral fellows for MS-related research projects in basic science, clinical, or patient management, care, and rehabilitation topics	Open to individuals with 0-36 months of postdoctoral training; 1- to 3-year award; salary plus institutional allowance
Career Transition Award	Provides 2 years of mentored advanced postdoctoral training and 3 years of faculty support for MDs or PhDs pursuing research projects in MS	Open to individuals with 2-5 years of previous postdoctoral training; salary and \$25,000/year research allowance for postdoctoral phase; \$125,000/year in direct costs for faculty phase

Abbreviation: MS = multiple sclerosis.

<sup>a</sup> This table was adapted from the MS Society Web site with only minor changes.

**Table 2** Sample of available fellowships in neuroimmunology, representing the compiled results of a Google Internet search (January 30, 2012) for "Neuroimmunology Fellowships"<sup>a</sup>

Institution	Years of training	Program description and focus, derived from program Web site
Cleveland Clinic: Clinical Neuroimmunology Fellowship	1-3	Academically oriented neurologists to pursue a career in patient care and clinical research in MS and related disorders
Johns Hopkins University: Neuroimmunology & Neurological Infections Fellowship Program	2+	Pursue careers in academic medicine as independent clinician investigators either solely in the clinic or with laboratory research
Mayo Clinic: Autoimmune Neurology and MS Fellowships	1-2	1) Autoimmune Neurology Fellowship: combines diagnosis/management of idiopathic and paraneoplastic disorders with contemporary immunologic concepts. The program complements many subspecialties (neuromuscular, autonomic/PNS, inflammatory and demyelinating CNS disorders, behavioral/cognitive, movement and seizure disorders). Abundant opportunities for translational/clinical research and optional rotations. Prepares trainees to pursue a career in academic neurology, tailored to fellow's goals.  2) MS Fellowship: combines clinical and research experience with exposure to a spectrum of adult and pediatric demyelinating diseases. Fellows are expected to spend 50% of time in research and 50% of time in the clinic.
NIH: Neuroimmunological Diseases Unit	2+	Geared to applicants interested in career of physician-scientist; it combines clinical training in neuroimmunology with extensive research experience
St. Joseph's Hospital and Medical Center/Barrow Neurological Institute: Neuro-Immunity Fellowship Program	1-2	The first year focuses on the clinical and clinical research program, developing the skills necessary to diagnose, treat, manage, and conduct clinical research; if desired, the fellow can develop a focused laboratory experience beginning in the second year of the fellowship, or pursue research in the clinical and neuroimaging arenas
University of Alabama: Neuroimmunology/MS Fellowship	2	The fellowship combines clinical patient care and investigation in an environment that has immunopathogenesis of demyelinating disease as its principal focus
University of California San Francisco: Clinical Research Fellowships in MS	1-3	Offers either clinical- or research-focused fellowships; the clinical fellowship is 1-2 years, allows for multidisciplinary exposure to clinical MS and related diseases through the adult and pediatric MS clinics; research-focused fellowships can be oriented either toward clinical research or basic research, duration is 2-3 years developing research projects under the mentorship of MS center faculty and seeing patients in clinic
University of Maryland: Fellowship training program in Neuroimmunology at the Maryland Center for MS	2+	The program enables trainees to become independent investigators in the conduct of basic and clinical research in the broad field of MS
University of Massachusetts: Fellowship in Neuroimmunology	1-2	Intensive clinical training in MS, and design and implementation of clinical trials
University of North Carolina: Neuroimmunology/MS Clinical Fellowship	1+	Provide a comprehensive training in clinical care, and in conducting clinical trials for patients with MS
University of Texas Southwestern: MS Fellowship Program	1	Comprehensive training in the clinical evaluation and management of the patient with MS and related disorders
University of Washington: MS & Neuroimmunology Fellowships	1	Clinical fellowship in MS rehabilitation, emphasizes rehabilitative MS care in a clinical setting
Vanderbilt University: Neuroimmunology Fellowship	1-2	Train physicians for careers in clinical therapeutics as pertains to MS and neuroimmunologic diseases
Washington University, St. Louis: Neuroimmunology Clinical and Basic Research Fellowships	2-3	Two fellowship types (or hybrids) are available to selected neurologists and PhD scientists, to equip them for an academic career with emphasis on MS  1) clinical, with formal training in biostatistics, clinical trial design, and ethics of human research, and the opportunity to obtain Master of Science in Clinical Investigation degree  2) basic research in neuroimmunology

Abbreviations: MS = multiple sclerosis; PNS = peripheral nervous system.

<sup>a</sup> The top 100 search results were reviewed, and results were excluded if they did not link to or directly refer to a fellowship program.

subspecialty autoimmune neurology or neuroimmunology clinic could be run independently or in conjunction with an MS clinic. An important role in the outpatient setting is the diagnosis and management of chronic immune-mediated or autoimmune disorders affecting the nervous system, as well as the differentiation of these disorders from disease mimics.

There are numerous opportunities to focus on MS and related diseases in private practice, and an MS-focused, clinically oriented fellowship would provide additional expertise in the treatment of this patient population. In private practice, a more plausible arrangement may be an MS specialty clinic in addition to general practice.

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## DISCLOSURE

S. Clardy serves as a member of the Editorial Board of the Resident & Fellow section of *Neurology*<sup>®</sup>. Go to [Neurology.org](http://www.neurology.org) for full disclosures.

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