

# Emerging Subspecialties in Neurology: Neurorehabilitation

Chen Lin, MD  
Jodi Hawes, MDCorrespondence to  
Dr. Lin:  
chen.lin@duke.edu

Since the initial Emerging Subspecialties article on neurorehabilitation was published in 2008,<sup>1</sup> much has changed in the world and in medical practice. Veterans, athletes, and concussion patients have increased our awareness of traumatic brain injury (TBI) and neurorehabilitation has sought to optimize clinical outcomes by improving research.<sup>2</sup> For interested trainees, there is now subspecialty certification in brain injury available, which had its inaugural examination in 2014. TBI care pathways are needed to provide the best evidence-based care and assist with managing populations in the changing landscape of health care reimbursement. This article highlights the past, present, and future of neurorehabilitation.

In 1887, Dr. Heinrich Frenkel, a Swiss internist, was examining a patient with tabes dorsalis who failed the coordination examination. Months later, to Dr. Frenkel's amazement, the patient had improved. When asked how, the patient replied, "I wanted to pass and so I practiced." Dr. Frenkel became inspired to help other patients improve their coordination as well in Heiden, Switzerland. Physicians from the Salpêtrière in Paris noticed and began describing the process as "ré-éducation fonctionnelle."<sup>3</sup>

Today, this process is better known as neurorehabilitation. Like the days of past, the field still attracts providers interested in improving patients' functional status, now, with a focus on impairment-directed functional practice over rote exercise and muscle-building. Neurology has changed dramatically in recent years with more acute management options. Still, most patients require some period of time in a rehabilitation facility to recuperate functioning. Trainees spend limited time seeing how patients' deficits, including speech, weakness, and coordination, improve. With a team-based approach, neurorehabilitation is a field where neurologists' knowledge is crucial in developing plans with the patient, occupational/physical/speech therapists, psychiatrists, and physiatrists. Neurologists' experience in the mechanism of injury and time course of recovery, in addition to our understanding of neuroanatomy and neurophysiology, is critical to guide clinical care and research.

As the survival outcomes improve, an emphasis on functional recovery must be made. From 2000 to 2010, the annual stroke death rate decreased by 35.8%.<sup>4</sup> Among all Medicare patients admitted for acute stroke care, 24% go to an inpatient rehabilitation facility and 31% to a skilled nursing facility.<sup>4</sup> Of those discharged home, 32% require home health services.<sup>4</sup> In routine poststroke care, rehabilitation is usually recommended to begin within 24–48 hours of admission.<sup>5</sup> Stroke survivors are initially unable to walk independently but 54%–80% are able to do so within the first 3 months.<sup>6</sup> Long-term survivors of stroke show good recovery of functional mobility with 80% being independent in mobility.<sup>7</sup> This is just one example of functional recovery. Brain and spinal cord injury are only 2 divisions. Some institutes further specialize in traumatic brain and spinal injury, musculoskeletal, sports medicine, and neural engineering.

Over the last few decades, advances in technology have been remarkable. Neurorehabilitation has been a benefactor in the advances in bioengineering, robotics, and computer science. For example, Collinger et al.<sup>8</sup> implanted a brain-machine interface into a tetraplegic patient to control an anthropomorphic prosthetic limb. Technology will continue to advance while research discoveries will continue to increase. Neurorehabilitationists will continue to push the boundaries, and clinicians will be challenged to incorporate these advances, both now and in the future, to benefit patient care.

With health care reform, more focus has been placed on bundled payment from insurance and decreasing rehospitalization rates. As hospital structures change, so will the incorporation of rehabilitation into patient care. Neurorehabilitation should attract people interested in influencing health policy. Some European hospitals combine rehabilitation into their inpatient care, including inpatient stroke units for stroke care and subsequent stroke rehabilitation units in the same facility. In the United States, the location of rehabilitation is more variable and usually offsite. The payer system is still a question, as limitations in duration and intensity of rehabilitation by

From the Department of Neurology, Duke University, Durham, NC.

Go to [Neurology.org](http://Neurology.org) for full disclosures. Funding information and disclosures deemed relevant by the authors, if any, are provided at the end of the article.

third-party payers have resulted in continued clinical emphasis toward compensatory approaches, using adaptive devices and compensatory strategies like environmental modifications. Newer research has demonstrated opportunities to facilitate neurologic recovery with advances in plasticity, not just compensatory approaches.<sup>9</sup> The number of rehabilitation beds available is limited, decreasing accessibility for all patients who might need inpatient rehabilitation. With rehabilitation units starting to emphasize multidisciplinary care, many policies remain unwritten that will go hand in hand with research and technological advances. Clinicians with vision are needed to integrate this information and become leaders in the field.

**Training opportunities.** Neurorehabilitation is an umbrella term for multiple different training pathways including through neurology, psychiatry, or physical medicine and rehabilitation (PMR). In September 2011, the subspecialty of brain injury medicine was approved after a joint application process from the American Board of Psychiatry and Neurology (ABPN) and the American Board of Physical Medicine and Rehabilitation (ABPMR) through the American Board of Medical Subspecialties. This formalized the field of brain injury medicine as a subspecialty, recognizing trained and experienced physicians in brain injury medicine. The first certification examination was offered October 2014 and was administered to candidates who maintained certification by the ABPMR, ABPN, or sports medicine. Starting in September 2013, the Accreditation Council for Graduate Medical Education approved program requirements for Graduate Medical Education in Brain Injury Medicine through Neurology or PMR. This formalizes a pathway for trainees to pursue a recognized subspecialty certification.

Training in neurorehabilitation provides neurologists with a unique perspective in disease and treatment. During residency, trainees learn how to identify and manage specific neurologic processes by localizing the lesion. In advanced training in rehabilitation and brain injury, the trainee will appreciate the functional process of recovery after injury. Neurorehabilitationists learn to work through a different approach involving a multidisciplinary team including occupational, physical, and speech therapists along with recreational and vocational therapists. Trainees learn about the medical issues facing specific disorders during patient recovery, including arousal and inattention in brain injury patients, the appropriate use of neuroplasticity-inducing medications in stroke patients, and management of spasticity.

The United Council for Neurologic Subspecialties (UCNS) manages the accreditation of neurorehabilitation fellowships through neurology. Currently, there is only one UCNS-accredited fellowship program at the Burke Institute in New York, but 11 other nonaccredited programs are listed. A detailed set of programs, recommended readings, and certification requirements can be found on the American Society of Neurorehabilitation (ASNR) Web site. There are other brain injury programs that are run by PMR programs that are listed through ABPMR. Training opportunities can be found through the ASNR, UCNS, American Academy of Neurology (AAN), and ABPMR websites.

Another pathway to consider is a specific disease emphasis. There are specific programs that focus on spinal cord injuries or other CNS disorders such as stroke and multiple sclerosis. There are also programs that focus on the peripheral nervous system such as neuromuscular disorders. A more traditional route would be to consider specializing in a certain subspecialty such as stroke or neuromuscular disease and then deciding to focus on the rehabilitation aspect of those diseases specifically, including research training.

Sorting out this information can find it to be somewhat daunting at first. Residents must consider their primary interest and programs they would be most compatible with. Some 1-year neurology-based fellowships tailor their curriculum focus based on AAN or UCNS guidelines. There are other PMR programs related to brain injury and spinal cord rehabilitation that also are 1-year programs. Since these are PMR programs, the trainee can be exposed to a different perspective from faculty and other trainees. Most 1-year fellowships also offer opportunities to supplement or extend training over multiple years with a research-based curriculum. In a small but expanding field, neurorehabilitation can be a rewarding track for those interested in pursuing an academic career.

**Career prospects.** Currently, there are multiple paths to pursue a career in neurorehabilitation. There are both neurologist- and physiatrist-run programs that have the same goal of patient rehabilitation. In 2008, a brief survey by healthjobs.com revealed 8 positions for neurologists and one for physiatrists.<sup>1</sup> On repeat survey at the time of this writing, there are 46 positions for neurologists and 34 for physiatrists. For the most part, many of the positions for neurologists are for general or vascular neurologists at institutes that have rehabilitation facilities. These opportunities include director of a rehabilitation unit, for those with administration interests. Many academic centers are developing inpatient and outpatient

rehabilitation centers with a neurorehabilitation focus, and considerable growth has occurred over the last decade.<sup>10</sup>

**DISCUSSION** The field of neurorehabilitation has grown considerably from its infancy in Heiden, Switzerland. From stand-alone rehabilitation practices to integral components of large tertiary academic centers, there are more opportunities than ever before for both neurologists in training and experienced practitioners. As long as an interest in patient improvement exists, there will be a need for rehabilitation. With basic science research being translated with our colleagues in psychiatry and bioengineering, neurorehabilitation is a cutting-edge subspecialty within neurology. A career in neurorehabilitation can satisfy any hunger for a career in clinical medicine, academic research, health policy, and administration.

#### **AUTHOR CONTRIBUTIONS**

Chen Lin: main author. Jodi Hawes: coauthor, reviewer.

#### **STUDY FUNDING**

No targeted funding reported.

#### **DISCLOSURE**

The authors report no disclosures relevant to the manuscript. Go to [Neurology.org](http://Neurology.org) for full disclosures.

#### **REFERENCES**

1. Dimyan MA, Dobkin BH, Cohen LG, et al. Emerging subspecialties: neurorehabilitation: training neurologists to retain the brain. *Neurology* 2008;70:e52–e54.
2. The changing landscape of traumatic brain injury research. *Lancet Neurol* 2012;11:651.
3. Zwecker M, Zeilig G, Ohry A. Professor Heinrich Sebastian Frenkel: a forgotten founder of rehabilitation medicine. *Spinal Cord* 2004;42:55–56.
4. Go AS, Mozaffarian D, Roger VL, et al. Heart disease and stroke statistics: 2014 update: a report from the American Heart Association. *Circulation* 2014;129:e28–e292.
5. Gresham GE, Duncan PW, Stason WB, et al. Post-Stroke Rehabilitation: Clinical Practice Guideline No. 16. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research; 1995. AHCPR Publication No. 95–0662.
6. Skillbeck CE, Wade DT, Hewer RL, et al. Recovery after stroke. *J Neurol Neurosurg Psychiatry* 1983;46:5–8.
7. Gresham GE, Fitzpatrick TE, Wolf PA, et al. Residual disability in survivors of stroke—the Framingham study. *N Engl J Med* 1975;293:954–956.
8. Collinger JL, Wodlinger B, Downey JE, et al. High performance neuroprosthetic control by an individual with tetraplegia. *Lancet* 2013;381:557–564.
9. Sterr A. Training-based interventions in motor rehabilitation after stroke: theoretical and clinical considerations. *Behav Neurol* 2004;15:55–63.
10. Greenwood R. The future of rehabilitation. *BMJ* 2001;323:1082–1083.

# Neurology®

## Emerging Subspecialties in Neurology: Neurorehabilitation

Chen Lin and Jodi Hawes

*Neurology* 2015;85:e50-e52

DOI 10.1212/WNL.0000000000001802

**This information is current as of August 3, 2015**

|   |   |
|---|---|
| <b>Updated Information &amp; Services</b> | including high resolution figures, can be found at:<br><a href="http://n.neurology.org/content/85/5/e50.full">http://n.neurology.org/content/85/5/e50.full</a>  |
| <b>References</b>                         | This article cites 9 articles, 4 of which you can access for free at:<br><a href="http://n.neurology.org/content/85/5/e50.full#ref-list-1">http://n.neurology.org/content/85/5/e50.full#ref-list-1</a>  |
| <b>Subspecialty Collections</b>           | This article, along with others on similar topics, appears in the following collection(s):<br><b>All Education</b><br><a href="http://n.neurology.org/cgi/collection/all_education">http://n.neurology.org/cgi/collection/all_education</a><br><b>All Rehabilitation</b><br><a href="http://n.neurology.org/cgi/collection/all_rehabilitation">http://n.neurology.org/cgi/collection/all_rehabilitation</a> |
| <b>Permissions &amp; Licensing</b>        | Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:<br><a href="http://www.neurology.org/about/about_the_journal#permissions">http://www.neurology.org/about/about_the_journal#permissions</a>   |
| <b>Reprints</b>                           | Information about ordering reprints can be found online:<br><a href="http://n.neurology.org/subscribers/advertise">http://n.neurology.org/subscribers/advertise</a>   |

*Neurology*® is the official journal of the American Academy of Neurology. Published continuously since 1951, it is now a weekly with 48 issues per year. Copyright © 2015 American Academy of Neurology. All rights reserved. Print ISSN: 0028-3878. Online ISSN: 1526-632X.

