



## Editorial

## Education and training in clinical neurophysiology: Actual state and future needs



Although medical specialization has been described since the times of Galen, true medical specialties began to develop in the 19th century. From the initial differentiation between surgery and internal medicine, numerous other specialties emerged during the 20th century. Among several criteria, medical specialties are divided between diagnostic and therapeutic, while other axis of classification state that some medical specialties are related to specific techniques. Clinical Neurophysiology is considered a diagnostic and technique related specialty, but this classification is valid only in the context of the most classical definition of the specialty as a branch of medicine that “studies function and dysfunction of the nervous system caused by disorders of the brain, spinal cord, peripheral nerve, and muscle, using physiological and imaging techniques to measure nervous system activity”. This definition is given by the International Federation of Clinical Neurophysiology (IFCN). This specialty can assist in diagnosis and localization of a lesion, and in staging the development or recovery from a neurological disorder. It forms part of a neurologist’s array of tools, among other specialties.

The field of Clinical Neurophysiology expands when biochemical and morphological techniques are incorporated, and directly linked to the diagnosis of neurological disorders (see [Pelosi et al., 2022](#)); it also expands when some techniques, such as transcranial magnetic brain stimulation, have a therapeutic effect (see [Lefaucheur et al., 2020](#)). After being developed in the first half of the 20th century, Clinical Neurophysiology ([Berlucchi, 2010](#)) is now clearly considered as a specialty or, as it occurs in most countries, a subspecialty of neurology of increasing demand. Despite the significance of clinical neurophysiology in neurological clinical practice, there is little published data that refers to training and education practices.

Usually, the inception of a new specialty comes about when professionals from other related areas begin to practice in the new field without formal training, often in response to a need that has surfaced in their work. With the consolidation of the new specialty formal requirements for its exercise emerge. In the present volume of *Clinical Neurophysiology Practice*, Cole and colleagues ([Cole et al., 2022](#)) present results from the first international survey of training and education, undertaken by the Europe-Middle East-Africa (EMEAC), the Latin America (LAC) and the Asia-Oceania (AOC) Chapters of IFCN. In summary, training in Clinical Neuro-

physiology is extremely variable among different countries. Although it is frequently considered a neurology subspecialty, some large psychiatric, pediatric and physical therapy centers, have their own Clinical Neurophysiology section. Cole et al.’s survey shows that there is significant variation in the training period and evaluation methodologies amongst IFCN member societies. There were also considerable differences in the number of tests performed under supervision. Another interesting topic is the interplaying role of the neurophysiologist technician during the performing of tests and/or reporting.

Although there are methodological limitations, the significant heterogeneity in training and education across the different IFCN chapters and society members, and the lack of a unified curriculum to train clinical neurophysiologists worldwide, is clear. It seems that one of the central limitations in delivering an ideal level of CN training and service may be the lack of human resources. Therefore, an increase in this workforce is urgently required, in order to cope with an increasing demand and to assure adequate education and training in the field. Geographical distribution is another factor to consider. IFCN and its member societies should contribute to create, in the near future, a unified curriculum and competency evaluation that defines the minimal requirements for Clinical Neurophysiology training. This is not an easy task, considering the differences across centers and regions.

The limitations in Clinical Neurophysiology education are apparently not restricted to the sub-specialty program, but are also present during Neurology residency. In the USA, [Daniello and Weber \(2018\)](#) developed a survey for program directors and residents in Neurology, asking about confidence in knowledge in EEG and EMG. They reported that up to a quarter of residents are graduating without meeting the recommended milestones of the American Council of Graduate Medical Education. Unfortunately, there is no information from other countries; in any case, it is not expected to be better.

In summary, there is an urgent need to define educational and homogeneous training standards for neurologists and post graduate clinical neurophysiology.

**Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## References

- Berlucchi, G., 2010. Chapter 13: the contributions of neurophysiology to clinical neurology: an exercise in contemporary history. *Handb. Clin. Neurol.* 95, 169–188. [https://doi.org/10.1016/S0072-9752\(08\)02113-1](https://doi.org/10.1016/S0072-9752(08)02113-1).
- Cole, J., Kamondi, A., Kimaid, P.T., Shahrizaila, N., 2022. Training and education Practice in the Europe, Middle-East and Africa, Latin America and Asia Oceania Chapters, IFCN; an international survey. *Clin Neurophysiol Pract. This Volume.*
- Daniello, K.M., Weber, D.J., 2018. Education research: the current state of neurophysiology education in selected neurology residency programs. *Neurology* 90, 708–711.
- Lefaucheur, J.P., Aleman, A., Baeken, C., Benninger, D.H., Brunelin, J., Di Lazzaro, V., et al., 2020. Evidence-based guidelines on the therapeutic use of repetitive transcranial magnetic stimulation (rTMS): An update (2014–2018). *Clin. Neurophysiol.* 131, 474–528. <https://doi.org/10.1016/j.clinph.2019.11.002>.
- Pelosi, L., Arányi, Z., Beekman, R., Bland, J., Coraci, D., Hobson-Webb, L.D., et al., 2022. Expert consensus on the combined investigation of carpal tunnel syndrome with electrodiagnostic tests and neuromuscular ultrasound. *Clin. Neurophysiol.* 135, 107–116. <https://doi.org/10.1016/j.clinph.2021.12.012>.

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