APPENDIX J: GOALS AND OBJECTIVES FOR THIS CLINICAL NEUROPHYSIOLOGY RESIDENCY PROGRAM. (PR II.A2)

Goals and Objectives of Training in Clinical Neurophysiology

Program Overview:
During the period of training (one year), the CN residents will be trained in the following areas of clinical neurophysiology.

- Performance of Electromyography and Nerve Conduction Studies and the appropriate use of these tests for the evaluation and treatment of neuromuscular diseases including myelopathies, motor neuron diseases, radiculopathies and plexopathies, mononeuropathies, polyneuropathies, myopathies and disorders of neuromuscular transmission.

- Performance and interpretation of Electroencephalography, Video-Electroencephalography, Intraoperative Electrocorticography, and Evoked Potentials and the appropriate use of these tests for the evaluation and treatment of epilepsy as well as dementia, encephalopathy, multiple sclerosis, myelopathy, central nervous system tumors and traumatic disorders.

- Performance and interpretation of Polysomnography with or without CPAP titration and Multiple Sleep Latency Testing and the appropriate use of these tests for the assessment and treatment of sleep disorders including central sleep apnea, obstructive sleep apnea, narcolepsy, restless leg syndrome, periodic limb movements and parasomnias.

The residents will spend more time in their area of emphasis (any one of the above); however, the overall goal of training is to become proficient in two of the three major areas and be sufficiently familiar with the basics and common disorders in the third area that after the completion of the training program, the CN residents will be able to practice competently and independently.

Instruction will be performed predominantly by supervised performance and interpretation of the various tests and procedures but will also include evaluation of patients in subspecialty clinics, didactic lectures, case presentation conferences, journal clubs, and independent reading of textbooks and the primary literature. In addition to the acquisition of the detailed medical knowledge outlined in the following sections, this broad array of training experiences will also provide instruction in the application of the special skills and knowledge of clinical neurophysiology to compassionate, appropriate patient care and how these special skills contribute to the overall health care system (systems based practice). Furthermore, participation in case presentation conferences, journal clubs and review of the primary literature will provide opportunities to participate in practice based learning in settings where patient care is reviewed and new scientific evidence is reviewed, assessed and applied to patient care as appropriate.

As this specialty has a strong focus on the performance of diagnostic testing, timely and effective communication of results is a major facet of professionalism for a Clinical Neurophysiologist. Therefore, an important part of the training includes acquiring the communication skills to clearly and succinctly communicate test results to patients and families as well as to other health care professionals. Training in communication with patients and families will occur in both the subspecialty clinics and in the performance of procedures requiring direct physician-patient interaction such as EMG. Training in communication with health care professionals will come in the generation of written reports for all tests performed as well as from participation in case presentation conferences.

Goals and Objectives for Electromyography/Nerve Conduction Studies/Neuromuscular Diseases:
Through participation in outpatient clinics, inpatient services, the EMG laboratory, the Clinical Neurophysiology Core Lecture series, Neurology Grand Rounds, EMG/Neuromuscle specific conferences and independent study, all Clinical Neurophysiology Residents are expected to obtain the following medical knowledge (MK) and patient care (PC) skills as well as an appreciation of the use of these skills in the evaluation of neurological disease (systems based practice (SBP)):
**Basic Science (MK)**
- The anatomy of the peripheral and autonomic nervous systems
- The anatomy and innervation of muscles
- The normal and altered physiology of the peripheral and autonomic nervous system, the neuromuscular junction and muscle
- The pathology of muscle, neuromuscular junction and nerves

**Nerve Conduction Studies (MK/PC)**
- Motor NCSs
  - Cranial: Facial nerve
  - Upper limbs: median, ulnar, radial, musculocutaneous, and axillary nerve
  - Lower limbs: peroneal, tibial, and femoral nerves
- Sensory NCSs
  - Upper limbs: median, ulnar, radial, medial antebrachial, lateral antebrachial, posterior antebrachial
  - Lower limbs, sural, superficial peroneal, saphenous, lateral femoral cutaneous, posterior femoral cutaneous.
- Mixed nerve studies
  - Orthodromic median/ulnar studies for carpal tunnel syndrome
- Repetitive Nerve Stimulation (RNS)
  - Slow rate repetitive nerve stimulation
  - Fast rate repetitive nerve stimulation
- Late responses (F-waves, A-waves, H-reflex)

**Electromyography (MK/PC)**
- Insertional activity
- Normal and abnormal spontaneous activity
- Morphology and stability of motor unit potentials
- Recruitment patterns

**Autonomic Testing (MK/PC)**
- RR interval variation
- Sympathetic skin response
- Sweat test

**Neuromuscular Diseases (MK/PC/SBP)**
- The epidemiology of common neuromuscular diseases such as diabetic neuropathy
- The identification and treatment of common neuromuscular disorders in children and adults
- The inpatient and outpatient evaluation of new onset neuropathy including obtaining an appropriate history, physical examination, and the use of ancillary testing.
- The inpatient and outpatient evaluation of new onset myopathy including obtaining an appropriate history, physical examination, and the use of ancillary testing.
- The inpatient and outpatient evaluation of new onset neuromuscular junction disease including obtaining an appropriate history, physical examination, the use of ancillary testing and indications for thymectomy.
- The use of nerve and muscle biopsy in the evaluation of neuromuscular diseases
- The use of genetic testing in the evaluation of neuromuscular diseases
- The evaluation and treatment of emergent neuromuscular conditions like Guillain Barré Syndrome, myasthenic crisis, rhabdomyolysis, etc.

Residents who chose Electromyography/Nerve Conduction Studies/Neuromuscular Diseases as their secondary focus will be expected to have a greater degree of proficiency in all of the above plus additional proficiency in
- Blink reflex (PC)
- Brief exercise test for Lambert-Eaton Myasthenic Syndrome (PC)
- The differentiation of subtypes of genetic neuromuscular diseases by history, physical examination, EMG/NCS and genetic testing (MK/PC/SBP)
Residents who chose Electromyography/Nerve Conduction Studies/Neuromuscular Diseases as their primary focus will be expected to have a greater degree of proficiency in all of the above plus additional proficiency in

- Single fiber EMG (PC)
- Quantitative sensory testing (PC)
- The interpretation of nerve and muscle biopsies (MK/PC)
- The use of immune modulating agents for the treatment of autoimmune neuromuscular disease (MK/PC/SBP)

**Goals and Objectives for Electroencephalography/Evoked Potentials/Epilepsy:**

Through participation in outpatient clinics, inpatient services, the EEG laboratory, the Clinical Neurophysiology Core Lecture series, Neurology Grand Rounds, EEG/Epilepsy specific conferences and independent study, all Clinical Neurophysiology Residents are expected to obtain the following medical knowledge (MK) and patient care (PC) skills as well as an appreciation of the use of these skills in the evaluation of neurological disease (systems based practice (SBP)):

**Basic Science (MK)**
- The electrophysiology of neurons
- The basis of electrical signals recorded on the scalp
- The basics of EEG instrumentation including amplifiers, filtering, digital sampling, and digital signal processing
- The mechanisms of action of commonly used antiepileptic drugs
- The clinical pharmacology of commonly used antiepileptic drugs
- The pathophysiology of common epilepsy syndromes

**Electroencephalography (MK/PC)**
- The placement and location of EEG electrodes and the 10-20 system
- How EEG data is displayed including the polarity convention, the difference between bipolar and referential montages
- The commonly used EEG montages
- The patterns in normal EEG including awake background activity, drowsiness and sleep
- How and when the EEG patterns change with maturation
- The unique features of neonatal and pediatric EEG
- How to identify artifacts and be able to distinguish from abnormal patterns
- How to identify normal variants and be able to distinguish from abnormal patterns
- How to identify and lateralize/localize abnormal patterns
- How to distinguish epileptiform from non-epileptiform abnormalities
- How to identify EEG patterns associated with common epilepsy syndromes
- How to identify EEG patterns associated with acute and chronic cerebrovascular disease, coma, encephalopathy and neurodegenerative diseases

**Epilepsy (MK/PC/SBP)**
- The epidemiology of epilepsy
- The identification and treatment of common epilepsy syndromes in children and adults
- The clinical semiology of common seizure types
- The inpatient and outpatient evaluation of new onset seizures including obtaining an appropriate history, physical examination, and the use of ancillary testing such as neuroimaging
- The indications for initiation and discontinuation of antiepileptic treatment
- The identification and treatment of convulsive and non-convulsive status epilepticus
- The identification and evaluation of potential epilepsy surgery candidates including when to refer for evaluation and the role of video/EEG monitoring, neuroimaging, neuropsychological evaluation and WADA testing in the presurgical evaluation.
**Evoked Potentials (MK/PC/SBP)**

- How to identify the major waveforms of visually evoked potentials, brainstem auditory evoked potentials, and somatosensory evoked potentials
- The presumed generators of the major waveforms
- The typical latencies of the major waveforms
- The pathological significance of prolonged or asymmetric latencies and the significance of absent waveforms
- The use of evoked potentials in the diagnosis of multiple sclerosis and other demyelinating diseases.
- The use of evoked potentials to localize lesions in the central nervous system due to trauma, mass lesions or other causes.
- The use of evoked potentials for intraoperative monitoring

Residents who chose Electroencephalography/Epilepsy as their secondary focus will be expected to have a greater degree of proficiency in all of the above plus additional proficiency in

- The use of extended EEG monitoring in the evaluation and treatment of convulsive and non-convulsive status epilepticus (MK/PC/SBP)
- The use of video/EEG monitoring in the evaluation and treatment of refractory epilepsy (MK/PC/SBP)
- The use of video/EEG monitoring for the identification of common mimics of epilepsy such as psychogenic non-epileptic events (MK/PC/SBP)

Residents who chose Electroencephalography/Epilepsy as their primary focus will be expected to have a greater degree of proficiency in all of the above plus additional proficiency in

- The use of video/EEG monitoring in the presurgical evaluation of patients with refractory epilepsy (MK/PC/SBP)
- The use of ancillary testing including cranial MRI, cranial PET and neuropsychological testing in the presurgical evaluation of patients with refractory epilepsy (MK/PC/SBP)
- The indications for using WADA testing in the presurgical evaluation of patients with refractory epilepsy (MK)
- The indications for using Ictal SPECT in the presurgical evaluation of patients with refractory epilepsy (MK)
- The indications for and interpretation of intracranial video/EEG monitoring to localize the ictal onset zone prior to resective surgery (MK/PC/SBP)
- The indications for and performance of bedside speech and motor mapping to localize eloquent cortex prior to resective surgery (MK/PC/SBP)
- The indications for and interpretation of intraoperative electrocorticography during resective surgery (MK/PC/SBP)
- The indications for corpus callosotomy in the treatment of refractory epilepsy (MK)
- The indications for and use of vagal nerve stimulation for the treatment of refractory epilepsy (MK/PC/SBP)

**Goals and Objectives for Polysomnography/Sleep Disorders:**

Through participation in outpatient clinics, inpatient services, the Sleep laboratory, the Clinical Neurophysiology Core Lecture series, Neurology Grand Rounds, Sleep specific conferences and independent study, all Clinical Neurophysiology Residents are expected to obtain the following medical knowledge (MK) and patient care (PC) skills as well as an appreciation of the use of these skills in the evaluation of neurological disease (systems based practice (SBP)):

**Basic Science (MK)**

- The neuroanatomy of sleep-wake and circadian mechanisms
- The neuroanatomy and physiology of respiratory control
- The mechanisms of action and clinical pharmacology of commonly used hypnotic and stimulant medications
- The basics of polysomnographic instrumentation including nature of signals detected, amplifiers, filtering, digital sampling and signal processing
- The pathophysiology of common sleep disorders

**Polysomnography (MK/PC)**

- Performance and interpretation of standard polysomnography
- Knowledge of standard polysomnography montages and instrumentation
  - Placement of EEG electrodes and the 10-20 system
  - Eye movement, muscle tone and leg movement monitoring
  - Instrumentation for monitoring respiration including airflow sensors, respiratory effort sensors, oximetry, and noninvasive CO2 monitoring techniques
• Snoring and body position monitors
• Role of video monitoring
  o Staging of human sleep
  o Scoring of respiratory events
  o Scoring of periodic limb movements
  o Split-night protocols
  o BiPAP and CPAP titration protocols
  o Changes in sleep over the life-cycle
  o Appearance of normal and abnormal EEG patterns on limited polysomnography montages
  o How to identify artifacts and distinguish from abnormal patterns
  o Montages and protocols for multiple sleep latency testing and maintenance of wakefulness testing
  o Polysomnography in pediatric patients

Clinical Sleep Disorders (MK/PC/SBP)
  o Be familiar with classification of sleep disorders as presented in the ICSD2
  o Be familiar with the epidemiology and public health consequences of sleep disorders and sleep deprivation
  o Be familiar with indications for polysomnography and related procedures
  o Be familiar with diagnosis and treatment of common sleep disorders including:
    • Obstructive sleep apnea syndrome
    • Central sleep apnea syndrome
    • Insomnia
    • Narcolepsy and idiopathic hypersomnia
    • Restless legs syndrome and periodic limb movement disorder
    • REM sleep behavior disorder and other parasomnias

Residents who choose polysomnography/sleep disorders as their secondary focus will be expected to have a greater degree of proficiency in all of the above plus additional proficiency in:
  o The role of actigraphy in diagnosis and treatment of insomnia (MK/PC)
  o The indications for and use of specialized polysomnographic monitoring techniques (MK/PC/SBP)
    • Esophageal pressure monitoring
    • SIT protocol in restless legs evaluation
    • Knowledge of nocturnal penile tumescence monitoring
    • Knowledge of esophageal pH monitoring
  o The use of screening questionnaires and outcomes measures for common sleep disorders (MK/PC)
  o The uses and limitations of unattended and ambulatory studies (MK/PC/SBP)