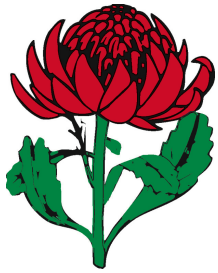

ANZAN REQUIREMENTS FOR TRAINING IN CLINICAL NEUROPHYSIOLOGY (EEG/EP/EMG)

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March 2016

A. Clinical Neurophysiology Training Levels: description and outcomes

Training in EEG & Clinical Neurophysiology is divided into 3 levels of competency.

Level 1 training in EEG and EMG is an essential part of Advanced Training in Neurology for all trainees in **Adult and Paediatric & Child Neurology** and must be satisfactorily completed by all trainees to be eligible for Fellowship of the RACP.
It is designed to equip the trainee with the skills and knowledge required to appropriately request studies and interpret reports as an **informed consumer**.

It is NOT regarded as sufficient training for a neurologist to perform or report EEG or EMG in clinical practice.

Level 1 training should be completed during the two years of core training. It is possible to carry this over to the elective year if the requirements are not met by the end of core training.

Level 2 or Level 3 training is seen as the prerequisite for those neurologists who wish to perform electrophysiological investigations in clinical practice.
These higher levels of training are optional and are administered by the ANZAN EEG & Clinical Neurophysiology Committee. There is **NO** requirement that all trainees complete this during their advanced training. It can be achieved by additional supervised training during an elective training year or after the FRACP is awarded.

> **Level 2** training is for neurologists who wish to perform clinical neurophysiology (EMG, EEG or both) in clinical practice.
>
> **Level 3** is training is for neurologists who wish to specialise in clinical neurophysiology (EMG, EEG or both) and aims to provide the knowledge and experience necessary to establish and supervise a laboratory service in a teaching hospital or academic institution. This is similar to a fellowship for comprehensive subspecialty training in other specialties. Training in evoked potentials has relevance to both EEG and EMG training, with the relevant techniques determined by each trainee's specified goals.
>
> For these higher levels (Level 2 or Level 3) the essential learning activity is clinical experience under the guidance and supervision of mentors who ensure safe and effective patient care and the development of the trainee's skills, knowledge, and attitudes necessary for unsupervised clinical practice.
>
> Upon completion of this training, the fellow will be qualified for competent independent practice in clinical neurophysiology (EMG, EEG or both).

Note: EMG is used as a synonym for electrodiagnostic medicine, incorporating EMG, nerve conduction studies, evoked potentials and related techniques.

B. Supervision of Standards and Accreditation of Training Sites

Level 1 clinical neurophysiology training for trainees in Adult and Paediatric & Child Health Neurology is administered by the RACP-Neurology Advanced Training Committee (ATC) and is a part of the core fellowship requirements.

Accreditation of training sites and supervisors for this purpose is the responsibility of the ATC.

The supervisor/s and other teaching staff in EEG and EMG at ANZAN/RACP accredited training sites should themselves have as a minimum requirement ANZAN recognition of Level 2 training or its equivalent in the appropriate field.

Level 2 and Level 3 clinical neurophysiology training is the responsibility of the ANZAN EEG and Clinical neurophysiology Committee (EEGCNC).
This responsibility extends to:

- accreditation of clinical neurophysiology supervisors,other teaching staff and training institutions
- prospective approval of assignments of trainees to training institutions.
- assessment of supervisors' reports during and at the conclusion of any training period.

This arrangement is similar to other specialties, including cardiology and gastroenterology, in which specialist societies are responsible for the credentialing of specialised procedural skills in their areas of expertise.

Note: Neurologists who are not supervisors or teaching staff may choose to provide documentation of their previous subspecialty training in EEG, EMG or both for approval by the EEGCNC if they wish to obtain written ANZAN confirmation of competency attained according to the current guidelines for Levels 2 & 3.

C. Level 1 Clinical Neurophysiology Training

Requirements:

Level 1 training should ideally be completed during the two years of core training. It is possible to carry this over to an elective year if the requirements are not met by the end of core training.

EEG Basic Training - Core Competencies (Adult /Paediatric & Child Neurology):

The EEG training requirements to be completed through Core Year 1 and 2 are listed in the Level 1 Training Report.

Level 1 training requires **at least 150 EEGs** to be first reported by the trainee and then shown to their supervisor or other teaching staff for correction.
The focus should be on exposure to a wide range of EEG findings, covering the syllabus and obtaining basic competencies.

Syllabus (see below)
In addition supervisor/s are expected to cover through didactic tutorials (preferably weekly-30-60 min through the training year) the EEG syllabus.

Outcome:
When the training requirements are complete the EEG supervisor confirms in the end of year report to ATC that the advanced trainee is aware of the role and limitation of EEG in clinical neurology, and is able to interpret an EEG report in the clinical context, as an informed consumer.

EMG Basic Training - Core Competencies (Adult /Paediatric & Child Neurology):

The EMG training requirements to be completed through Core Year 1 and 2 are listed in the Level 1 Training Report.

The trainee must perform, attend or report with the supervisor or other teaching staff
at least 150 (Adult Neurology trainees)
at least 25 (Paediatric & Child Neurology trainees)
EMG studies across a range of conditions**.**

At least 100 EMG studies **(10** for Paediatric & Child Health trainees) must be done in the room ***'hands on'*** with the trainee placing the electrodes on the patient and performing stimulation under supervision. Studies which are not ***'hands on'*** can include both those observed directly and those where the trainee goes through EMG reports at a later time with a member of the teaching staff.

Syllabus (see below)
In addition supervisor/s are expected to cover through didactic tutorials (preferably weekly-30-60 min through the training year) the EMG syllabus.

Outcome:
When the training requirements are complete the EMG supervisor confirms in the end of year report to ATC that the advanced trainee is aware of the role and limitation of EMG in clinical neurology, and is able to interpret an EMG report in the clinical context, as an informed consumer.

C. Level 1 Clinical neurophysiology Training

Evaluation of trainee progress

At the conclusion of each year of advanced training a Level 1 training report for EEG, EMG & EPs is completed by the supervisor in each discipline to monitor training and to guide subsequent supervisors. **(see below)**

The final clinical neurophysiology supervisor/s must decide if a trainee's experience, skills and knowledge meet the Level 1 training and outcome requirements in EMG, EEG and EPs. It is understood that evoked potentials may come under either the EMG or EEG supervisor depending on the local environment.

A logbook listing each study performed and the clinical details should be kept by each trainee as a means of tracking experience in the use of neurophysiological testing across a range of neurological conditions.

Each supervisor should check this regularly to confirm the trainee is meeting or has met the Level 1 requirements.

A final logbook copy, signed each year by the EMG & EEG supervisors, is to be sent to the ATC as a training requirement.

LEVEL 1 TRAINING REPORT
RACP SPECIALIST TRAINING COMMITTEE (NEUROLOGY) REQUIREMENTS:
TRAINING IN EMG/EEG (ADULT)

Level 1 EMG training

The trainee has achieved the following goals

- **to be completed through Yr 1 core training**

Regularly attends the training hospital EMG Tutorials covering the syllabus ☐
Understands the physiological basis of NCS/EMG potentials and waveforms ☐
Understands the technology of NCS/EMG recording ☐
Regularly attends at least one session per week in NCS/EMG ☐
Has performed, attended or reported on at least 50 NCS/EMG studies ☐
(> 50% of these studies should be performed 'hands on' by the trainee under supervision)

- to be completed through Yr 2 core training

Regularly attends the training hospital EMG Tutorials covering the syllabus ☐
Regularly attends at least one session per week in NCS/EMG ☐
Is able to critically assess NCS/EMG reports performed by others ☐
Has performed, attended or reported on at least 150 NCS/EMG studies in total Yr 1 & Yr 2 ☐
(Trainees must perform a minimum of 100 "hands on" studies with supervision)

Has attended an ANZAN EMG Workshop ☐

For candidates completing Yr 1 core training
Please comment on training needs in Yr 2 to guide subsequent EMG supervisors.

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.....

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For candidates completing Yr 2 core training

Has the candidate achieved all the Level 1 Training Requirements Yes ☐ No ☐
If the candidate has not yet reached the Level 1 requirements, what needs to be achieved in Yr 3.
.....

.....

Outcome: for those ticked Yes
The Advanced Trainee is aware of the role and limitation of EMG in clinical neurology, and is able to interpret an EMG report in the clinical context, as an informed consumer (not the provider of EMG services).

Logbook summary:
Number of NCS/EMG's performed (hands on) Yr 1_____ Yr2_____

NCS/EMG studies observed or attended reporting session Yr 1_____ Yr2_____
(must include observation of needle EMG)

_____ _____ _____
Clinical Neurophysiology Supervisor (EMG) **Signature** **Date:**

Level 1 EEG training

- **to be completed through Yr 1 core training**

Regularly attends the training hospital EEG Tutorials covering the syllabus ☐
Understands the physiological basis of EEG potentials and waveforms ☐
Understands the technology of EEG recording ☐
Has watched EEG electrode placement and an EEG being recorded ☐
Regularly attends at least one reporting session/week in EEG ☐
Has seen examples of normal and abnormal EEG material in the syllabus ☐
Understands the ontogeny of EEG between infancy and adulthood ☐
Has reported independently on > 50 EEG studies and had these reviewed by consultant ☐

- **to be completed through Yr 2 core training**

Regularly attends the training hospital EEG Tutorials covering the syllabus ☐
Regularly attends at least one reporting session/week in EEG ☐
Is able to interpret an EEG report in the clinical context ☐
Is aware of the role and limitations of EEG in clinical neurology ☐
Has reported independently on > 150 EEG studies and had these reviewed by consultant ☐

Has attended an ANZAN EEG Workshop ☐

Level 1 Evoked Potential training

Understands the physiological basis of Evoked Potentials and waveforms ☐
Has observed and understands the technology of Evoked Potential recording VEP, SEP ☐
Has attended reporting sessions in Evoked Potentials ☐

For candidates completing Yr 1 core training

Please comment on training needs in Yr 2 to guide subsequent EEG supervisors.

.....

.....

For candidates completing Yr 2 core training

Has the candidate achieved all the Level 1 Training Requirements Yes ☐ No ☐

If the candidate has not yet reached the Level 1 requirements, what needs be achieved in Yr 3.

.....

.....

Outcome: for those ticked Yes

The Advanced trainee is aware of the role and limitation of EEG in clinical neurology, and is able to interpret an EEG report in the clinical context, as an informed consumer (not the provider of EEG services).

Logbook summary:

Number of EEG's reported Yr 1_____ Yr2_____

Number of Video EEG report sessions attended Yr 1_____ Yr2_____

_____ _____ _____

Clinical Neurophysiology Supervisor (EEG) **Signature** **Date:**

LEVEL 1 TRAINING REPORT
RACP SPECIALIST TRAINING COMMITTEE (NEUROLOGY) REQUIREMENTS:
TRAINING IN EMG/EEG (PAEDIATRIC & CHILD NEUROLOGY))

Level 1 EMG training

The trainee has achieved the following goals

- **to be completed through Yr 1 core training**

Regularly attends the training hospital EMG Tutorials covering the syllabus ☐
Understands the physiological basis of NCS/EMG potentials and waveforms ☐
Understands the technology of NCS/EMG recording ☐
Regularly attends at least one session per week in NCS/EMG ☐
Has performed, attended or reported on at least 10 NCS/EMG studies ☐
(> 50% of these studies should be performed 'hands on' by the trainee under supervision)

- to be completed through Yr 2 core training

Regularly attends the training hospital EMG Tutorials covering the syllabus ☐
Regularly attends at least one session per week in NCS/EMG ☐
Is able to critically assess NCS/EMG reports performed by others ☐
Has performed, attended or reported on at least 25 NCS/EMG studies in total Yr 1 & Yr 2 ☐
(Trainees must perform a minimum of 10 "hands on" studies with supervision)

Has attended an ANZAN EMG Workshop (recommended not compulsory) ☐

For candidates completing Yr 1 core training
Please comment on training needs in Yr 2 to guide subsequent EMG supervisors.

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For candidates completing Yr 2 core training

Has the candidate achieved all the Level 1 Training Requirements Yes ☐ No ☐
If the candidate has not yet reached the Level 1 requirements, what needs to be achieved in Yr 3.
.....

.....

Outcome: for those ticked Yes
The Advanced Trainee is aware of the role and limitation of EMG in clinical neurology, and is able to interpret an EMG report in the clinical context, as an informed consumer (not the provider of EMG services).

Logbook summary:
Number of NCS/EMG's performed (hands on) Yr 1_____ Yr2_____

NCS/EMG studies observed or attended reporting session Yr 1_____ Yr2_____
(must include observation of needle EMG)

_____ _____ _____
Clinical Neurophysiology Supervisor (EMG) **Signature** **Date:**

Level 1 EEG training

- **to be completed through Yr 1 core training**

Regularly attends the training hospital EEG Tutorials covering the syllabus ☐
Understands the physiological basis of EEG potentials and waveforms ☐
Understands the technology of EEG recording ☐
Has watched EEG electrode placement and an EEG being recorded ☐
Regularly attends at least one reporting session/week in EEG ☐
Has seen examples of normal and abnormal EEG material in the syllabus ☐
Understands the ontogeny of EEG between infancy and adulthood ☐
Has reported independently on > 50 EEG studies and had these reviewed by consultant ☐

- **to be completed through Yr 2 core training**

Regularly attends the training hospital EEG Tutorials covering the syllabus ☐
Regularly attends at least one reporting session/week in EEG ☐
Is able to interpret an EEG report in the clinical context ☐
Is aware of the role and limitations of EEG in clinical neurology ☐
Has reported independently on > 150 EEG studies and had these reviewed by consultant ☐

Has attended an ANZAN EEG Workshop ☐

Level 1 Evoked Potential training

Understands the physiological basis of Evoked Potentials and waveforms ☐
Has observed and understands the technology of Evoked Potential recording VEP, SEP ☐
Has attended reporting sessions in Evoked Potentials ☐

For candidates completing Yr 1 core training

Please comment on training needs in Yr 2 to guide subsequent EEG supervisors.

.....

.....

For candidates completing Yr 2 core training

Has the candidate achieved all the Level 1 Training Requirements Yes ☐ No ☐
If the candidate has not yet reached the Level 1 requirements, what needs be achieved in Yr 3.

.....

.....

Outcome: for those ticked Yes

The Advanced trainee is aware of the role and limitation of EEG in clinical neurology, and is able to interpret an EEG report in the clinical context, as an informed consumer (not the provider of EEG services).

Logbook summary:

Number of EEG's reported Yr 1_____ Yr2_____

Number of Video EEG report sessions attended Yr 1_____ Yr2_____

_____ _____ _____

Clinical Neurophysiology Supervisor (EEG) **Signature** **Date:**

Syllabus for Level 1 EEG & EMG Tutorials

List of topics to be covered by didactic tutorials during core advanced training

EEG Syllabus

1. **Technical Basics**
   - **1.1. Generators/Physiological basis of EEG**
   - 1.2. Definition - voltage/time/space
   - 1.3. Amplifiers
     - 1.3.1. Differential
     - 1.3.2. Polarity convention
     - 1.3.3. Common mode rejection
   - 1.4. References
     - 1.4.1. Non-cephalic
     - 1.4.2. Common scalp electrode
     - 1.4.3. Average
     - 1.4.4. Source derivation
     - 1.4.5. Balanced neck-chest
   - 1.5. AC recording v DC
   - 1.6. Filters
     - 1.6.1. What they do
     - 1.6.2. Phase shift
     - 1.6.3. High pass (LFF)
     - 1.6.4. Low pass (HFF)
     - 1.6.5. Band pass
     - 1.6.6. Band reject (Notch)
     - 1.6.7. Traps
       - 1.6.7.1. Conversion of EMG to beta or spike
       - 1.6.7.2. Concealment of slowing
       - 1.6.7.3. Concealment of useful artefacts
   - 1.7. Electrodes and Impedances
     - 1.7.1. 10-20 system
     - 1.7.2. Sphenoidal
     - 1.7.3. Non EEG
       - 1.7.3.1. EOG
       - 1.7.3.2. Surface EMG
       - 1.7.3.3. Movement
       - 1.7.3.4. ECG
       - 1.7.3.5. Repiratory
   - 1.8. Digital EEG
     - 1.8.1. Analogue to digital conversion
     - 1.8.2. Sampling rate
     - 1.8.3. Montage reformatting

2. **A. Normal EEG Awake Adults and elderly**
   - 2.1. Alpha
   - 2.2. Beta
     - 2.2.1. Frequency
     - 2.2.2. Distribution
     - 2.2.3. Amplitude
     - 2.2.4. Medication effects
   - 2.3. Theta
   - 2.4. Delta
   - 2.5. Posterior background rhythm
     - 2.5.1. Frequency range
     - 2.5.2. Distribution
     - 2.5.3. Reactivity, squeak, paradoxical alpha
     - 2.5.4. Amplitudes and asymmetries
     - 2.5.5. Alpha variants

2.5.6. Elderly
2.5.6.1. Temporal slowing
2.5.6.2. Low voltage EEG
2.6. Lambda
2.7. Mu
2.7.1. Frequency range
2.7.2. Distribution
2.7.3. Asymmetry
2.7.4. Reactivity
2.7.5. Morphology
2.7.6. Polarity
2.8. Hyperventilation
2.9. Photic stimulation
2.9.1. Following v spikes
2.9.2. Harmonic patterns
2.9.3. On/Off responses

B. Normal EEG Awake Children

2.10. 3 months to 12 years
2.11. Posterior background rhythm
2.11.1. (Importance of holding eyes closed if necessary)
2.11.2. Ontogeny
2.11.3. Reactivity
2.11.4. Posterior slow waves of youth
2.11.5. Rhythmic posterior delta
2.12. Theta, delta background
2.12.1. What is abnormal? How much is too much?
2.12.2. When should it disappear?
2.13. Mu
2.14. Beta
2.15. Lambda, shut eye waves
2.16. Hyperventilation
2.16.1. Posterior, frontal
2.16.2. Can slowing be excessive?
2.17. Photic stimulation
2.17.1. Driving v spikes
2.18. Teenage EEG

3. Normal Drowsiness and Sleep

3.1. Adults
3.1.1. Drowsiness
3.1.1.1. Stages
3.1.2. V waves, Spindles, K complexes, POSTS (v spikes)
3.1.3. Sleep stages
3.1.4. Arousals
3.2. Children (excluding neonates)
3.2.1. Hypnagogic hypersynchrony
3.2.2. Frontal theta, posterior theta
3.2.3. Ontogeny of sleep transients in children
3.2.3.1. Asymmetry
3.2.4. V waves, Spindles, K complexes, POSTS
3.2.5. Sleep stages
3.2.6. Arousals

4. Localisation, Artefacts

- 4.1. Localisation Principles
  - 4.1.1. Bipolar montage – phase reversal
  - 4.1.2. Common referential montage
  - 4.1.3. Source derivation
- 4.2. Montages
  - 4.2.1. Standard montages
  - 4.2.2. Custom montages
  - 4.2.3. Advantages and disadvantages of various montages
- 4.3. Artefacts
  - 4.3.1. Pulse
  - 4.3.2. Electrode
  - 4.3.3. Eyes
    - 4.3.3.1. Eye blink
    - 4.3.3.2. SEMs
    - 4.3.3.3. Nystagmus
    - 4.3.3.4. Eyelid flutter
  - 4.3.4. ECG
  - 4.3.5. Respiratory
  - 4.3.6. Glossokinetic
  - 4.3.7. Movement
  - 4.3.8. 50Hz
  - 4.3.9. EMG
  - 4.3.10. Lateral rectus spikes
  - 4.3.11. Photomyogenic (photomyoclonic) response
- 4.4. Skull defects
  - 4.4.1. Beta
  - 4.4.2. Breech
  - 4.4.3. Amplitude asymmetry
  - 4.4.4. Sharp transients

5. Non-epileptiform abnormal patterns

- 5.1. Asymmetries
- 5.2. Intermittent slow wave activity
  - 5.2.1. Focal
  - 5.2.2. Diffuse
- 5.3. Intermittent rhythmic slow wave activity
  - 5.3.1. FIRDA
  - 5.3.2. OIRDA
  - 5.3.3. TIRDA
- 5.4. Continuous slow wave activity
  - 5.4.1. Focal
  - 5.4.2. Generalised
- 5.5. Periodic patterns
  - 5.5.1. SSPE
  - 5.5.2. CJD
  - 5.5.3. Triphasic waves
  - 5.5.4. Burst suppression
  - 5.5.5. Generalised periodic patterns
  - 5.5.6. PLEDs, biPLEDS
- 5.6. Coma patterns
  - 5.6.1. Alpha
  - 5.6.2. Theta
  - 5.6.3. Beta
  - 5.6.4. Spindle
  - 5.6.5. Burst suppression

6. Generalised epileptiform patterns & normal variants

6.1. 3Hz spike and wave, Rhythmic posterior delta
6.2. Slow spike and wave
6.3. Polyspike and wave
6.4. Secondary bilateral synchrony
6.5. Generalised paroxysmal fast activity
6.6. Photosensitivity
6.7. 6 Hz spike-wave (phantom spike-wave)

7. Focal epileptiform patterns & normal variants

7.1. Definition of sharp waves and spikes
7.2. Occipital
7.3. Centro-temporal, including dipole
7.4. Midline (differentiation from vertex waves of sleep)
7.5. Temporal
7.6. Multifocal spikes
7.7. PLEDS, BIPLEDS
7.8. Traps in the interpretation of spikes and sharp waves
- 7.8.1.1. Normal Variants
  - 7.8.1.1.1. 14 and 6 per sec positive spikes
  - 7.8.1.1.2. BETS/BSSS
  - 7.8.1.1.3. Psychomotor variant/RTTD
  - 7.8.1.1.4. Wicket spikes
  - 7.8.1.1.5. SREDA
- 7.8.2. Normal phenomena easily mistaken for abnormal
  - 7.8.2.1. V waves
  - 7.8.2.2. POSTS
  - 7.8.2.3. Spiky alpha

8. <u>How to read and report an EEG</u>

8.1. Reading EEG
- 8.1.1. It is only a sample
- 8.1.2. Vary montages, sensitivity, filters
- 8.1.3. Re-display abnormalities
- 8.1.4. Consider alternative explanations for unexpected abnormalities
  - 8.1.4.1. Normal variants
  - 8.1.4.2. Unusual normal transient
  - 8.1.4.3. Fragment of a normal rhythm
  - 8.1.4.4. Artefacts

8.2. Clinical correlation
- 8.2.1. Sensitivity
- 8.2.2. Specificity

8.3. Reporting EEG
- 8.3.1. Structure of the report
- 8.3.2. What to include
- 8.3.3. What not to say

8.4. Optimal use of the EEG
- 8.4.1. Initial diagnosis of epilepsy
- 8.4.2. Follow up of epilepsy
- 8.4.3. Psychiatric symptoms
- 8.4.4. Acute confusion
- 8.4.5. Dementia
- 8.4.6. Coma
- 8.4.7. Pseudoseizures

EMG Syllabus

Technical

- Basics of the EMG Machine
  - Recording and stimulating apparatus, Ground, Filters, Sensitivity, sweep duration settings, averaging.
- Motor Nerve Conduction Studies
  - Technique, interpretation. i.e. Supramaximal stimulus, recording sites, stimulation technique, pitfalls (e.g. virtual cathode, temperature effects). Latency, Amplitude, Duration, Area, CV measurements. Demyelination vs. axonal pathology
- F waves
  - Technique, interpretation.
- Reflexes (H & Blink)
  - Technique, interpretation.
- Mixed Nerve Studies
  - Technique, interpretation.
- Sensory Nerve Conduction Studies
  - Technique, interpretation. Recording sites, stimulation technique. Pitfalls, antidromic vs. orthodromic techniques. Temperature effects. Latency, Amplitude, Duration, Area, CV measurements. Demyelination vs. axonal pathology
- Effects of limb temperature on recordings
- Small Fibre function studies (if available)
  - Sympathetic skin responses, QSART
- Repetitive Nerve Stimulation
- Electromyography-Basic principles:
  - Needle types
  - Surface anatomy, neuroanatomy
  - Selecting which muscles to test
  - Involuntary activity
  - Voluntary activity
  - Neuropathic changes
  - Myopathic changes
  - Myotonia, Myokymia etc.

Neuromuscular Pathology

- Normal muscle and nerve
- Denervation- muscle
- Dystrophy-muscle
- Inflammatory Myositis
- Axonal vs. Demyelinating Neuropathy
- Critical care neuropathy/myopathy

Individual Nerve studies-motor/sensory

- Ulnar Nerve
  - Deep Motor Branch
  - Lesions at Wrist
  - Lesions at Elbow
- Median Nerve
  - Lesions at Wrist
  - Proximal lesions
- Radial Nerve
  - Vs. Posterior Interosseous Nerve lesions
  - Lesions at Spiral Groove
- Posterior Tibial Nerve
- Sural Nerve
- Common Peroneal Nerve
  - Lesions at Fibula Head
  - Differentiating from L5 lesion as cause of footdrop

NEUROMUSCULAR CONDITIONS

- **Neuropathies**
  - Inherited
    - Axonal vs. Demyelinating
  - Axonopathies
    - Length dependant axonal neuropathies
    - Neuronopathies
    - Sensory, motor, mixed
    - Vasculitis
  - Demyelinating Neuropathies
    - GBS
    - CIDP
    - HNPP
    - IgM MUGUS
- **Plexopathies**
  - Brachial
  - Lumbar
- **Radiculopathies**
  - Cervical
  - Lumbar
- **Anterior Horn Cell Disorders**
  - MND
  - SMA
  - Others- e.g. Kennedy's, polio
- **Myopathy**
  - Inherited
    - Dystrophy
    - Channelopathy
    - Mitochondrial
    - Metabolic
  - Acquired
    - Inflammatory
    - Drug Induced
    - Autoimmune
    - Endocrine
    - Metabolic
- **Critical Illness Neuropathy/Myopathy**
- **Neuromuscular Junction Disorders**
  - Myasthenia Gravis
  - Lambert-Eaton Syndrome
- **Hyperexcitable Nerve disorders**
  - Neuromyotonia,
  - Cramp-Fasciculation Syndrome
  - Benign Fasciculations

SINGLE FIBRE EMG

- Basic principles
- Jitter, Fibre Density
- Voluntary vs. Stimulated single fibre studies

EVOKED POTENTIALS

- Visual Evoked Potentials
- Somatosensory Evoked Potentials
- Brainstem Evoked Potentials
- Motor Evoked Potentials

MISC

- Urogenital EMG
- Respiratory EMG

D. Level 2 and Level 3 Clinical Neurophysiology Training

ANZAN Requirements for Level 2 and Level 3 Advanced Training In Clinical Neurophysiology:

Electroencephalography (EEG)

&

Electromyography/Electrodiagnostic medicine (EMG*)

* EMG is used as a synonym for electrodiagnostic medicine, incorporating EMG, nerve conduction studies, evoked potentials and related techniques.

D. Level 2 and 3 Clinical Neurophysiology Training

Accreditation of Participating Sites and Teaching Personnel

Participating sites requesting accreditation from ANZAN must:

1. Identify the faculty who will assume both educational and supervisory responsibilities for fellows, and who will be supported by the host institution:

   (i) Clinical Neurophysiology Supervisor/s

   • Qualifications

      1. Provide evidence of the requisite advanced subspecialty training in the accredited subspecialty areas (EEG, EMG or both) equivalent to *at least* the Level being supervised (Level 2 for Level 2; Level 3 for Level 3) with documentation of this specific training or credentialing sent to and approved by the is EEGCNC. (i.e. To offer Level 3, supervisors should have at least 1 year of subspecialty training or its equivalent in the subspecialty (EEG or EMG).

      2. Teaching experience

   • Supervisor responsibilities

      • Monitors fellowship progress, including mental or emotional conditions inhibiting performance. Situations with excessive service commitment that regularly disrupt clinical neurophysiology training or that consistently produce undesirable stress on fellows must be recognised and resolved.
      • Should attend at least one national supervisor meeting per 2 years.

   (ii) Other teaching faculty

   •There must be a sufficient number of faculty with subspecialty qualifications to instruct and supervise all fellows.

      For other consultants to assist in teaching, they also require at least ANZAN Level 2 (or its equivalent) for assisting with Level 2 or Level 3 training in EEG, EMG or both, providing documentation of this specific training or credentialing to the EEGCNC.

   •A faculty-to-fellow ratio of at least 1:1 must be maintained in programs with two or more fellows. The neurophysiology supervisor may be counted as one of the faculty members in determining the ratio.

   • The teaching faculty must devote sufficient time to the educational program to fulfil their supervisory and teaching responsibilities.
   • Teaching faculty members must participate regularly in clinical discussions, rounds, journal clubs, mentoring of fellows in scholarly activity.
   • While not all members of a teaching staff need to participate, clinical neurophysiology research should be conducted at the centre, with opportunities for trainees to participate.

2. Provide documentation of Institutional Support to the EEGCNC.

   (i) The institution (hospital or medical school) and the program must jointly ensure the availability of adequate resources for the specialty program requirements, including all necessary professional, technical, and clerical personnel for the effective administration of the program.
   (ii) The Supervisor must have sufficient protected time to support his or her educational and administrative responsibilities. At a minimum, the sponsoring institution must allocate at least 0.2 FTE time and funding specifically for clinical neurophysiology teaching, supervision, and formal evaluation of fellows.

(iii) The training program should not be compromised by excessive reliance on fellows to fulfil service obligations.

3. Provide documentation of Institutional activities to the EEGCNC.

(i) Adequate clinical neurophysiology laboratory activity (EEG, video-EEG, EMG, EP appropriate for the field and level of study) is necessary for trainees to acquire requisite skills and experience. Training may be provided at one site or with a cooperative arrangement across several sites.
The annual number and type of clinical studies performed in the neurophysiology laboratory/ laboratories relevant to the training being offered are to be provided. (At a minimum 500 EEGs for Level 2 EEG training, and 500 EMG studies for Level 2 EMG training. For Level 3 EEG training a minimum of 50 video-EEG studies per annum is also required, and for Level 3 EMG training and optional Level 2 training in EPs 50 EP's per annum is required.)

(ii) Patient numbers must be sufficient to provide a sound educational program with diversity related to age, sex, acute or chronic neurological problems, inpatients and outpatient population as considered appropriate for the field of study (see below).

4. Provide detailed documentation to the ANZAN Committee of delivery of the training program syllabus.

The institution must provide details of the structures in place that fulfil training requirements for each level being offered. Training may be provided at one site or with a cooperative arrangement across several sites/institutions.
The neurophysiology supervisor must, with assistance from the members of the teaching faculty, develop and implement the clinical education and academic program, and submit this for approval by the EEGCNC, including:

(i) a comprehensive curriculum, which includes the presentation of core subspecialty knowledge, and that covers the relevant ANZAN training syllabus at least.
(ii) the roles of specific clinical neurophysiology supervisors and other teaching staff, documenting their relevant subspecialty training and role in the teaching timetables.
(iii) details of supervised patient care responsibilities, clinical teaching, and didactic educational schedules:

- trainee goals, objectives, and responsibilities
- trainee's timetable (confirming adequate allocation of supervised training time)
- periodic reporting procedure of progress and milestones in the areas:
    - patient care
    - technical ability/procedural skills
    - medical knowledge
    - quality of reporting and interpretation
    - practice-based learning and improvement
    - Interpersonal and communication skills
- procedure for discussion of progress with the trainees.

(iv) demonstrate that the appropriate level of supervision is in place for all fellows who care for patients

Accreditation remains in place for five years then must be renewed. If the training environment changes the EEGCNC must be notified immediately.

Eligibility Requirements for Trainees

Trainees must be RACP advanced trainees in Neurology or hold an FRACP-Neurology. All must have successfully completed all Level 1 clinical neurophysiology training requirements in the relevant area/s (EEG & EMG), or aim to concurrently complete any outstanding Level 1 requirements with more advanced levels in an elective year, if their training institution offers this option.

Duration of Training Program

Level 2

At least 6 months full-time supervised training (or its equivalent part-time) is required for trainees to develop adequate basic skills in clinical neurophysiology (EEG or EMG; or dual training with 6 months in each).
This training need not be continuous, but should at all levels include adequate supervision and staff interaction and gradually increasing responsibility for the trainee.

Level 3

At least 12 months full-time supervised training (or its equivalent part-time) is required to allow progression into a subspecialty practice, research or teaching career in clinical neurophysiology (EEG or EMG; or dual training with 12 months in each).

Leave: Trainees are entitled to 4 weeks annual leave and 2 weeks conference leave (pro rata) each year to attend relevant neurological meetings approved by the supervisor.

EEG & Clinical Neurophysiology Advanced Training (Levels 2 & 3)

A: General Goals

The learning objectives must be accomplished through an appropriate blend of supervised patient care responsibilities, clinical teaching, and didactic educational events. The general goals are:
1. Proficiency in knowledge and recognition of the normal physiology of the nervous system; normal and abnormal findings of electrophysiologic testing.
2. Competence in selection and use of appropriate neurophysiology tests in the outpatient and acute care settings.
3. Procedural skills: Proficiency in performing and interpreting clinical neurophysiologic tests, and understanding the relevance of tests in the diagnosis and treatment of neurologic disease.
4. Communication skills: with patients, and in reporting results to other professionals and to patients in a clinically relevant and understandable way.
5. Recognition of personal limitations and knowledge in patient evaluation and management of patients' disorders, and when to seek guidance.
6. Patient Care that is compassionate, appropriate and effective.
7. Clinical research. Fellows should be strongly encouraged to participate in clinical or basic research under the mentorship of faculty members to enhance the educational experience provided by the training program.

EEG Level 2 & 3: Required clinical activity and procedures

1. Proficiency can be accomplished by a combination of supervised clinical experience - performing and interpreting EEGs on a broad range of patients, plus lectures/tutorials, meetings and discussions.
2. The clinical neurophysiology faculty supervises patient management and EEG/video EEG reading.
    - The neurophysiology supervisor, or another faculty member with required qualifications and experience, should directly observe trainees early in training.
    - Fellows are given an opportunity to review EEGs/ video-EEGs on their own and arrive at a provisional diagnosis and report.
    - Each record is then reviewed by the fellow and clinical neurophysiology faculty together, and a final interpretation is generated and then signed by the fellow and supervising staff.
3. The trainee maintains a logbook to record the extent of experience and for review by the supervisors, with numbers of studies as one guideline for adequate experience.

EEG – Level 2 - Required Competencies

1. Diagnostic EEG
    - Able to read and interpret diagnostic EEG studies across all relevant age groups. Defining the relevant age groups is an integral part of a each trainee's goal setting: whether neonatal, paediatric, and/or adult EEG will be relevant to their practice.
    - Able to independently identify the EEG phenomena in the syllabus

- Able to report EEG studies and interpret findings in clinical context
- Correctly localise focal epileptiform and non-epileptiform activity
- Interpret and report ambulatory EEG
- Supervise EEG technicians
- Contribute to the training of EEG technicians
- Able to supervise an EEG service for a private practice/district hospital

The training should have a detailed working knowledge of:

- Physiological basis of EEG
- EEG recording technology
- Montages and EEG localization
- Activation procedures
- Requirements of specific recording environments e.g. intensive care
- EEG and maturational changes
- Normal EEG during wakefulness and sleep
- Normal variants
- Artifacts and technical issues
- Use and limitations of EEG in a range of medical disorders
- Non-epileptiform EEG abnormalities (generalized and focal)
- Interictal epileptiform patterns (generalized and focal)
- Ictal patterns
- EEG reading and reporting; interpretation of EEG in clinical setting

(**See Full EEG Syllabus: Appendix 2**)

2. Diagnostic video-EEG monitoring studies

- Understands indications for long-term EEG monitoring, its limitations, and safety issues.
- Video-EEG technology, including setup, operation and fault finding.

3. Able to teach Neurology trainees at Levels 1& 2

Optional Level 2 EEG goals

Evoked potential studies and analysis:

Understand the technical basis and methods of recording visual, somatosensory and auditory brain stem evoked potentials; including averaging methods and technical difficulties in a variety of circumstances.

Waveform measurement of latency, amplitude and polarity in normal subjects, and the effect of altering stimulus parameters

Appreciate when these tests may be used, and the expected changes from normal in a variety of pathological conditions

Sensitivity and specificity of evoked potential abnormalities in diagnosis of various nervous system diseases

Able to alter evoked potential machine setup and troubleshoot technical issues in collaboration with head technician

Able to perform evoked potential studies

EEG-Level 3 /EEG fellowship

Additional training comprising:

1Able to supervise, interpret and report diagnostic video-EEG Studies.

Care for the patients throughout the procedure, including safety issues.

Video-EEG technology, including setup, operation and fault finding.

Differential diagnosis of epileptic and non-epileptic seizures.

Emergency care for inpatients, including ICU patients with seizures.

Semiology, EEG correlates and classification of epileptic seizures and epilepsies.

Understand the role of EEG in presurgical assessment of epilepsy.

Training and experience in intensive care monitoring

1. Knowledge about sleep disorders;
   Including sleep apnoea, narcolepsy, parasomnias, restless legs syndrome and periodic limb movements of sleep, other movement/motor disorders of sleep, and insomnia.
   Exposure to polysomnograms and multiple sleep latency tests and understand their role in clinical diagnosis and management.
   Understand ways in which sleep disorders and epilepsy overlap, as well as why/how diagnosing and treating both can enhance clinical care.

2. Able to teach Neurology trainees at all,levels
   The ontogeny of EEG between infancy and adulthood
   Demonstrate examples of normal and abnormal EEG from syllabus
3. Able to supervise training of EEG technicians in clinical aspects of EEG
4. Able to supervise an EEG service for an academic/teaching hospital
5. Able to alter EEG machine setup and troubleshoot technical issues in collaboration with head technician
6. Able to perform EEG (performing the role of the neurophysiology technician)

Optional Level 3 EEG goals

1. Evoked potential studies and analysis:
   Understand the technical basis and methods of recording visual, somatosensory and auditory brain stem evoked potentials; including averaging methods and technical difficulties in a variety of circumstances.
   Waveform measurement of latency, amplitude and polarity in normal subjects, and the effect of altering stimulus parameters
   Appreciate when these tests may be used, and the expected changes from normal in a variety of pathological conditions
   Sensitivity and specificity of evoked potential abnormalities in diagnosis of various nervous system diseases
   Able to alter evoked potential machine setup and troubleshoot technical issues in collaboration with head technician
   Able to perform evoked potential studies
2. Multidisciplinary epilepsy surgery assessment.
   Epilepsy surgery planning leading up to a definitive surgical procedure; including the indications for and planning of invasive monitoring, recommended neuroimaging procedures, and the integration of non-invasive data into decisions in the treatment of refractory epilepsy. This must include a minimum of 40 prolonged video-EEG studies as the primary reviewer, including responsibility for the report with the guidance of the Clinical Neurophysiology Supervisor; 5 intracranial monitoring studies, including subdural grid, depth, and/or intra-operative electrocorticography recordings, including responsibility for the report.
3. Exposure to intraoperative monitoring, including electrocorticography and functional cortical mapping.
   Understand the uses, interpretation and limitations of each of the intracranial EEG methods.
4. Sleep Disorders Medicine
   Exposure to clinical assessment and management of sleep disorders
   Knowledge of appropriate use of videopolysomnography, multiple sleep latency test, maintenance of wakefulness test
   Able to interpret videopolysomnography, multiple sleep latency test, maintenance of wakefulness test.

EMG Level 2 & 3: Required Competencies

The trainee should at conclusion have a detailed working knowledge of**:**

1. Anatomy of extremity, cranial, and trunk musculature and of the peripheral and central nervous systems relevant to performing and interpreting neurophysiologic studies.
2. Physiology of muscle and the peripheral and central nervous systems relevant to performing and interpreting neurophysiologic studies.
3. Clinical aspects of neurologic, neuromuscular, autonomic, and musculoskeletal disorders, including their diagnosis and treatment.
4. Electrodiagnostic instrumentation/equipment: applied electronics to include but not limited to basic circuit theory, filter parameters and function, safety, understanding concepts of both physiologic and non-physiologic electrical source generators, and recognition of technical considerations.
5. Development and use of reference values. Normal findings, including anatomical variants; effects of age, limb temperature, height and co-morbid conditions.
6. Evidence based knowledge of contra-indications and safety precautions as they relate to EMG testing, including appropriate infection control practices.
7. Obtaining a focused history and examination sufficient to guide subsequent neurophysiologic investigation.
8. Select and perform the appropriate tests, with modification as required during neurophysiological examination
9. Care for the patient throughout the consultation by explaining the procedure, obtaining consent and co-operation, and minimising discomfort.
10. Nerve conduction studies and EMG, including knowledge of:
    (i) Nerve conduction studies: motor, sensory, and delayed response studies. Identification of technical artifacts, effects of temperature and anatomical variants in the interpretation of NCS
    (ii) Needle electromyography (EMG), including normal and abnormal motor unit analysis, motor unit recruitment, firing rates, and recognition of spontaneous activity and identifying technical artifacts in the interpretation of EMG.
    (iii) Neuromuscular junction testing, including repetitive stimulation, and single fibre electromyography (SFEMG). Specific attention to ensuring proficiency in performing repetitive stimulation studies as well as understanding the concepts of repetitive stimulation studies.
11. EMG reporting and interpretation, in the clinical context.

Level 2 and Level 3 EMG Training: Required clinical activity and procedures:

1. Proficiency in the above areas can be accomplished by a combination of supervised clinical experience, lectures/tutorials, meetings and discussions.
2. Competency in EMG medicine can only be achieved by performing and interpreting EMG examinations on a broad range of neuromuscular diseases.
    - The neurophysiology supervisor, or an appropriate designee with similar qualifications on the teaching faculty, should directly observe trainees early in training.
    - Later, when the trainees are working more independently, the training program director or appropriate designee should be immediately available at all times to observe the studies should questions arise during the examination and must be available at the conclusion of the study to discuss the findings, conclusions, and prepare a report that is then signed by the fellow and supervising staff.

3. The trainee maintains a logbook to record the extent of experience and for review by the supervisors, with numbers of studies as one guideline for adequate experience.

EMG Advanced training – Level 2 - Required Competencies

1. The trainee is expected to develop technical proficiency in the performance of nerve conduction studies, needle electromyography, and repetitive stimulation studies.

   The trainee need not be proficient in SFEMG and autonomic testing, but should understand the principles and technical aspects of these tests and be able to interpret test data.

2. Ability to perform and interpret
   - EMG - sufficient to recognise active denervation, fasciculations, chronic denervation, myopathy, myotonic & myokymic discharges.
   - Nerve conduction study techniques - sufficient for identification of focal and generalised neuropathies and able to discriminate axonal from demyelinating pathophysiology.
   - Ability to discriminate between neuropathy, plexopathy and radiculopathy.
   - Repetitive Stimulation Studies for basic screening of muscle weakness, but with knowledge of the pitfalls and the need to refer patients for more complex repetitive stimulation and EMG studies (e.g. SFEMG) to fully evaluate possible disorders of neuromuscular transmission.

Each trainee should perform at least 200 "hands on" EMG evaluations during the training period.
It is recommended that trainees obtain the following experience during their training:

Straightforward Diagnosis – Approximately 100-150 patient encounters involving the identification of a simple diagnosis, such as any common entrapment neuropathy or radiculopathy
Moderate Complexity Diagnosis – Approximately 50-100 patient encounters involving the evaluation of a moderately complex diagnostic request, such as polyneuropathy or myopathy.
High Complexity Diagnosis – Approximately 10-25 patient encounters involving the evaluation of a complex diagnostic request, such as motor neuron disease, plexopathy, mononeuritis multiplex, or neuromuscular transmission disorder.

3. Able to teach Neurology trainees at Levels 1 & 2

Optional Level 2 EMG goals

Evoked potential studies and analysis:

Understand the technical basis and methods of recording visual, somatosensory and auditory brain stem evoked potentials; including averaging methods and technical difficulties in a variety of circumstances.
Waveform measurement of latency, amplitude and polarity in normal subjects, and the effect of altering stimulus parameters
Appreciate when these tests may be used, and the expected changes from normal in a variety of pathological conditions
Sensitivity and specificity of evoked potential abnormalities in diagnosis of various nervous system diseases
Able to alter evoked potential machine setup and troubleshoot technical issues in collaboration with head technician
Able to perform evoked potential studies

EMG Advance training/ Fellowship – Level 3: additional requirements

1. Moderate and higher complexity diagnostic EMG studies, including:
   - Phrenic nerve, blink reflex and small fibre neuropathy studies.
   - Comprehensive experience in repetitive stimulation studies
   - Single Fibre EMG
   - Exposure to advanced EMG (MUP analysis, quantitative EMG studies)

2. Evoked potential studies and analysis:
   - Understand the technical basis and methods of recording visual, somatosensory and auditory brain stem evoked potentials; including averaging methods and technical difficulties in a variety of circumstances.
   - Waveform measurement of latency, amplitude and polarity in normal subjects, and the

effect of altering stimulus parameters
    - Appreciate when these tests may be used, and the expected changes from normal in a variety of pathological conditions
    - Sensitivity and specificity of evoked potential abnormalities in diagnosis of various nervous system diseases
    - Able to alter evoked potential machine setup and troubleshoot technical issues in collaboration with head technician
    - Able to perform evoked potential studies
4. Understanding the role of autonomic nervous system testing.
5. Able to teach Neurology trainees at all levelsAble to supervise training of neurophysiology technicians
6. Able to supervise an EMG service for an academic/teaching hospital

Optional Level 3 EMG goals

- Specialised evoked potentials
- MEPs
- Working knowledge of intra-operative monitoring (multimodality stimulation; peripheral/sub-cortical/cortical recordings; limitations and applications)

Evaluation of trainee progress

Graduate medical education requires greater reliability and validity in the evaluation of trainee competence.

1. Ongoing Feedback

It is essential for faculty to give ongoing feedback to fellows about his or her increasing knowledge, skills and attitudes in all areas of training. Any concerns about fellow performance should be discussed with the fellow and with the neurophysiology supervisor.

2. Reporting of progress and milestones

The neurophysiology supervisor must provide objective assessments of competence in:

- patient care
- technical ability/procedural skills
- medical knowledge
- quality of reporting and interpretation
- practice-based learning and improvement
- interpersonal and communication skills

A simple grading will be sufficient for assessment, for example three grades in each category: Needs Improvement, Competent, or Exceeds Expectations. Competent is defined as meeting the goals and objectives of the service and able to function appropriately for his or her level of training.

3. Remediation

If a fellow's need for improvement is so significant that remediation is indicated, the neurophysiology supervisor should specify:

- the exact nature of the weakness
- the plan for remediation, i.e. goals and methods for assistance, a timetable specified for the specific deficiency to be improved. If there is a weakness, it should be identified early enough for ample opportunity to work with the fellow to improve performance
- Advise the ANZAN EEGCNC regarding fellow progress, including difficulties and remediation.

4. Evaluation upon completion

An exit assessment and grading is required for ANZAN endorsement of clinical neurophysiology credentials and competencies.

The neurophysiology supervisor must provide an evaluation for each fellow upon completion of the program.

- This evaluation is part of the fellow's permanent record, maintained by the institution to document the fellow's performance during their education; and, to verify that the fellow has demonstrated sufficient competence to enter practice without direct supervision.
- The record will include supervisor and other teaching faculty reports, a copy of the

fellow's logbook, and a final report verifying whether the fellow has successfully completed the program, and has demonstrated sufficient professional ability to practice competently and without direct supervision.

This report will be provided to the ANZAN EEG and Clinical neurophysiology Committee, and when approved, fellows will receive a written confirmation from ANZAN of the Level/s of clinical neurophysiology competency attained.

In future, the aim is for an objective exit assessment, such as an examination (EEG, EMG or both) like the American Neurophysiology Boards, to be developed. In the interim, Level 2 and 3 EEG fellows are expected to sit the ASEPA EEG Certification Examination and Level 2 and 3 EMG fellows to sit the AANEM Electrodiagnostic self-assessment examination.

Education program Assessment

1. A mechanism should be available for trainees to assess the effectiveness of the educational activities of the training program.
    - Fellows are to provide confidential evaluations of the overall Training Program to the ANZAN Committee upon completion of their training.
    - The form asks fellows to assess the clinical, didactic and administrative components of the Training Program, and the adequacy of teaching and supervision.
    - The fellow is asked to produce a formulation about the program, including its strengths and weaknesses.
2. At least annually, the educational program and curriculum must be evaluated using feedback of faculty, fellows, and others; with revision of competency-based curriculum goals and objectives, and addressing areas of non-compliance with ANZAN standards.

John Dunne
Chair
ANZAN EEG & Clinical Neurophysiology Committee
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