

## BLUEPRINTING

### ASSESSMENT METHODS

B1: Trainers'/Educational Supervisor's/Independent Assessor's Reports

B2: Multi-source Feedback Assessment (MSF)

B3: Mini CEX: Clinical Examination

B4: DOPS: Observation by trainer &/or independent observer of technical ability during detailed procedures.

**B5: Specialist Examination using multiple-choice questions\*.**

**B6: Patient Survey\***

**\* These assessment methods are under development**

### Assessment Blueprint for Clinical Neurophysiology

Curriculum area	Competence	B1 Trainer's Report	B2 MSF	B3 Mini CEX	B4 DOPS	B5 Specialist Exam	B6 Patient Survey
<b>TRAINING SECTION</b>							
<b>S0</b>							
<b><u>MEDICAL PROFESSIONALISM AND GOOD MEDICAL PRACTICE</u></b>							
<b>Objective - To produce a doctor with the values, attitudes, behaviours and relationships with patients and colleagues that underpin medical professionalism and GMC guidelines on Good Medical Practice. In particular the trainee must:</b> <ol style="list-style-type: none"> <li>i. <b>Make the care of the patient their first concern</b></li> <li>ii. <b>Be honest and trustworthy</b></li> <li>iii. <b>Communicate effectively with patients and colleagues and respect their confidentiality</b></li> <li>iv. <b>Ensure personal beliefs do not prejudice the care provided and never discriminate unfairly</b></li> <li>v. <b>Recognise the limits of his/her professional competence</b></li> <li>vi. <b>Show leadership skills</b></li> <li>vii. <b>Be able to work as part of a multidisciplinary team</b></li> <li>viii. <b>Show a positive attitude to lifelong learning and professional development</b></li> </ol>							
Knowledge	Publications and Guidelines from GMC and Royal Colleges  Trust and departmental protocols	●	●	●	●		●
Skills	The trainee will be able to demonstrate compliance with GMC guidance on Good Medical Practice	●	●	●	●		●
Attitudes	The trainee will have values, attitudes, behaviours & relationships with patients & colleagues that underpin medical professionalism and GMC Guidelines on Good Medical Practice (as detailed above)	●	●	●	●		●

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Curriculum area	Competence	B1 Trainer's Report	B2 MSF	B3 Mini CEX	B4 DOPS	B5 Specialist Exam	B6 Patient Survey
<b>TRAINING SECTION S1</b>							
<b>TECHNOLOGY</b>							
<b>Objective - To understand and utilise the technology which underpins practice of Clinical Neurophysiology</b>							
Knowledge	Measurement techniques, electrodes and transducers  Analogue-to-digital and digital-to-analogue conversion, effects of time and voltage resolution, aliasing  Amplifiers and their characteristics Stimulators  Signal processing including: averaging; trigger and delay techniques; Fourier and spectral analysis; brain mapping  Component parts of recording systems used in Clinical Neurophysiology  Computer technology Information technology including Data Protection Act, general and specialised software used in departments, analysis and research tools  Simple testing and repair of equipment  Safety and legal issues surrounding equipment	●				●	
Skills	make rational purchasing decisions of recording and administrative systems  design, implement and monitor safety standards  recognise artefacts assess and utilise new technologies  supervise and train non medical and medical staff in basic technology  observe legal and professional requirements for safe use of technology	●				●	
Attitudes	The trainee will have the appropriate attitudes in using these technologies	●				●	

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<b>TRAINING SECTION S2</b>							
<b>HEALTH AND SAFETY</b>							
<b>Objective - To enable the trainee to be conversant with and implement measures that ensure the safe working of a Department of Clinical Neurophysiology for staff and patients</b>							
Knowledge	hazards relating to the use of medical equipment (electrical and magnetic)  hygiene and sterilisation procedures, procedures for prevention of cross infection including MRSA, Hepatitis B, HIV, prion diseases including CJD  Control of substances hazardous to health (COSHH regulations)  procedures relating to specific clinical situations: pacemakers, anti-coagulant therapy, theatre work, withdrawal of anti-epileptic medication  manual handling  Hepatitis B vaccination  needle stick injury - prevention and action on occurrence  policies for dealing with violent/abusive patients or relatives  employment policy: sick leave, abuse and victimisation, grievance procedures, alcohol/smoking/drug use etc	●				●	
Skills	The trainee will demonstrate knowledge of the above in ensuring safe practice in the neurophysiological investigation of patients in the workplace	●				●	
Attitudes	As detailed and assessed in Section 0	●			●		

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<b><u>TRAINING SECTION</u></b> <b>S3</b>							
<b>BASIC NEUROSCIENCE</b>							
<b>Objective - To acquire and reinforce knowledge of basic neuroanatomy, neurophysiology, neuropharmacology and neuropathology</b>							
Knowledge	<p><u>Neuroanatomy</u> Knowledge of the major subdivisions of the central and peripheral nervous systems. Fibre tracts and nuclei. Cortical subdivision and function. Visual, sensory, auditory and motor pathways. Basal ganglia. Cerebellum. Autonomic nervous system. Vascular supply to the brain. Maturation of the nervous system.</p> <p><u>Neurophysiology</u> Basic knowledge of nerve conduction from ion channel function to the massed responses of nerve trunks, fibre tracts and nuclei. Synaptic function (inhibitory and excitatory) and the neuromuscular junction. Different motor unit types. Motor control and the cerebellum. Visual, auditory and somatosensory physiology from receptor to cortex. Biophysics of nerve stimulation (electrical and magnetic) and recording</p> <p><u>Neuropharmacology</u> Central nervous system neurotransmitters and drugs which modulate them. Mode of action of drugs affecting the central and peripheral nervous systems</p>	●		●	●	●	

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	<p><u>Neuropathology</u>  Reactions of peripheral and central nervous systems to disease: tumours, infections, inflammation, infarction and immune mediated mechanisms. Demyelination and degeneration in the central nervous system; ephaptic transmission. Pathophysiology of epilepsy; mechanisms of excessive or hypersynchronous neural activity and of the generalised cortico-reticular epilepsies. Demyelination, degeneration and regeneration in the peripheral nervous system. How nerve conduction can be affected by pathology, particularly axonal degeneration and demyelination; how these two basic types of neuropathic abnormalities may be differentiated, and how they may overlap and inter-relate. Changes in nerve conduction and needle EMG in neuropathic and myopathic conditions. Temporal evolution of EMG and nerve conduction findings after complete and partial nerve injury. Different patterns of neuropathies and the ways in which peripheral neuropathies may present (diffuse sensori-motor, predominantly sensory, predominantly motor (with conduction block), multifocal. Patterns and distribution of myopathic disorders. Pre- and post-synaptic defects of neuromuscular transmission</p>	●		●	●	●	
Skills	To be able to interpret the findings of Clinical Neurophysiology investigations at their most basic level i.e. localisation in the nervous system and the mechanisms of pathogenesis	●			●	●	
Attitudes	As detailed and assessed in Section 0	●			●		

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<b>TRAINING SECTION S4</b>							
<b>NEUROLOGY</b>							
	<b>Objective - To provide the trainee with the knowledge and skills to be able to:</b> <b>i. Examine, investigate, diagnose, treat and evaluate the effects of treatment in a range of neurological disorders</b> <b>ii. Ensure a consistently compassionate approach to patients and their carers.</b> <b>iii. Be aware of current clinical trials and evidence based medicine</b>						
Knowledge	Knowledge of the disorders amenable to clinical neurophysiological study (see list):  Application of basic neuroscience to clinical disease.  key symptoms and signs, natural history, incidence differential diagnoses  role of neurophysiological and complementary investigations in diagnosis and prognosis  key principles of treatment  role of neurophysiology in determining or monitoring treatment	●		●		●	
Skills	Take a clinical history  Perform a neurological examination  Formulate a diagnostic plan  Plan appropriate investigations and interpret results  Initiate treatment as appropriate involving a multidisciplinary approach  Assess outcome of treatment  Counsel patient/carers concerning diagnosis, prognosis and treatment	●		●		●	
Attitudes	As detailed and assessed in Section 0	●		●			●

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<b><u>TRAINING SECTION S5</u></b>							
<b><u>ELECTROENCEPHALOGRAPHY</u></b>							
<b>Objective - To provide the trainee with the knowledge and skills to be able to record and report on EEGs across all age groups and medical conditions</b>							
Knowledge	Use and limitations of EEG in a range of medical disorders EEG technology Physiological basis of EEG signals Requirements of specific recording environments e.g. intensive care unit	●			●		
Skills	Record EEGs and recognition of artefacts Recognition of normal components of the EEG and evolution of maturational changes Recognition of normal variants and abnormalities Write a factual report Interpretation of EEG in clinical setting Comment on EEG findings to referring clinician Care of patient during recording, with particular reference to disorders of consciousness including epilepsy	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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Curriculum area	Competence	B1 Trainer's Report	B2 MSF	B3 Mini CEX	B4 DOPS	B5 Specialist Exam	B6 Patient Survey
<b><u>TRAINING SECTION S6</u></b>							
<b>SPECIALISED EEG TECHNIQUES</b>							
<b><u>I. EEG Telemetry and Ambulatory Monitoring</u></b>							
<b>Objective - To acquire competence to: i. supervise and report on video EEG telemetry. ii. supervise and report on ambulatory EEG recordings</b>							
Knowledge	Semiology and classification of epileptic seizures and epilepsies. EEG correlates of different seizure types Indications for long-term EEG monitoring and the limitations of these techniques Technology of video EEG telemetry and ambulatory monitoring, including the setting up and operation of equipment and fault finding Differential diagnosis of epileptic and non-epileptic seizures Common antiepileptic drugs, their uses, dosage and side effects Management of status epilepticus Role of EEG in presurgical assessment of epilepsy	●			●		
Skills	Assessing seizure histories and proposing differential diagnosis. Evaluating video recordings of seizures of epileptic and non-epileptic origin Reading ictal and interictal EEGs in persons with epileptic and non-epileptic attacks Setting up telemetric and ambulatory recordings, selection of montages, polygraphy etc; changing media (tapes etc); identification of common faults Managing initial stages of status epilepticus Management of seizures and acute psychotic episodes in telemetry unit Explaining procedures to patients and carers and obtaining their co-operation Co-ordinating and leading the telemetry team	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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<b>TRAINING SECTION S6</b>							
<b>SPECIALISED EEG TECHNIQUES</b>							
<b><u>II. Clinical Neurophysiological Support for Epilepsy Surgery</u></b>							
<b>Objectives - To acquire competence to:</b> <b>i. supervise and report on sub-acute electrophysiological recordings with intracranial electrodes.</b> <b>ii. supervise and report on acute electrocorticograms</b> <b>iii. participate in functional brain mapping</b> <b>iv. participate in carotid amygdala tests</b>							
Knowledge	Role of scalp and monitoring EEG techniques in pre-surgical assessment of epilepsy Strategies of epilepsy surgery and multidisciplinary presurgical assessment Invasive EEG correlates of different seizure types Understand the uses, interpretation and limitations of electrocorticography Use of functional brain mapping in presurgical assessment Procedure, uses and interpretation of carotid amygdala test and simultaneous EEG recording Risks and benefits of epilepsy surgery and its associated procedures	●			●		
Skills	Setting up sub-acute intracranial recordings, selection of montages, identification and correction of common faults. Interpretation of intracranial recordings Assisting surgeon and supervising technician in setting up and performing acute electrocorticographic recordings and in identification correction of common artefacts and faults Assisting at carotid amygdala tests Assisting at functional brain mapping Explaining these procedures accurately and comprehensibly to patients and carers	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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<b><u>TRAINING SECTION</u></b> <b><u>S6</u></b>							
<b>SPECIALISED EEG TECHNIQUES</b>							
<b><u>III. Polysomnography and Multiple sleep Latency Tests</u></b>							
<b>Objective - To acquire competence to:</b> <b>i. supervise and report on polysomnography</b> <b>ii. supervise and report on Multiple Sleep Latency Tests</b>							
Knowledge	Classification and semiology of sleep disorders.  Normal EEG and polygraphic findings in sleep  Indications for polysomnography and MSLT and the limitations of these techniques  Rechtschaffen & Kales' sleep staging criteria; manual and automated methods of staging  Technology and procedures for polysomnography and Multiple Sleep Latency Tests	●			●		
Skills	Eliciting and assessing histories of possible sleep disorders and proposing differential diagnosis.  Sleep staging and recognising polygraphic features of common sleep disorders  Setting up polygraphy both in the laboratory and using ambulatory recordings, selection of montages, transducers etc; changing media; identification of common faults  Explaining procedures to patients and carers and obtaining their co-operation  Co-ordinating and leading the sleep studies team	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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<b><u>TRAINING SECTION</u></b> <b><u>S7</u></b>							
<b>NERVE CONDUCTION STUDIES + ELECTROMYOGRAPHY</b>							
<b>Objective - To enable the trainee to understand the indications for nerve conduction studies and electromyography (EMG); to perform these investigations; and to report on the findings</b>							
Knowledge	<p>Physiology of nerve conduction, neuromuscular transmission and excitation -contraction mechanisms in muscle</p> <p>Clinical presentation and pathophysiology of diseases of the peripheral nerves, neuromuscular junction and muscles</p> <p>Anatomy of peripheral nerves and muscles with regard to electrode placement and needle insertion</p> <p>Techniques for study of peripheral nerves including sensory, motor, and F wave studies, H reflex, repetitive nerve stimulation and blink reflex. Adaptations necessary in particular patient groups or difficult recording situations</p> <p>Techniques of electromyography including at least one quantitative method for recognition of neurogenic and myopathic disorders. Adaptations necessary in particular patient groups or difficult recording situations</p> <p>Normal values, including anatomical variants; effects of age, temperature, height and co-morbid conditions. Use of internal controls e.g. the opposite limb in contralateral conditions</p>	●			●		

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Skills	<p>Liase with referring colleagues and advise on appropriate investigations.</p> <p>Describe and interpret findings of the investigation in the report</p> <p>Take a history from and examine the patient to formulate the problem for investigation. Select and perform the appropriate tests, with modification as required during neurophysiological examination</p> <p>Care for the patient throughout the consultation by explaining the procedure, obtaining co-operation, and minimising discomfort. Provide appropriate information to the patient after the examination</p> <p>Supervise training and practice of physiological measurement technicians in performance of basic nerve conduction studies and report on their findings</p>	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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Curriculum area	Competence	B1 Trainer's Report	B2 MSF	B3 Mini CEX	B4 DOPS	B5 Specialist Exam	B6 Patient Survey
<b>TRAINING SECTION S8</b>							
<b>SPECIALISED NERVE CONDUCTION STUDIES AND EMG</b>							
<b><u>I. QUANTITATIVE EMG</u></b>							
<b>Objective - To acquire knowledge of and technical competence in two or more specialised EMG techniques which include single fibre EMG, macro EMG, scanning EMG, EMG frequency analysis, turns/amplitude analysis and motor unit potential analysis</b>							
Knowledge	Basic principles of EMG quantification, including frequency analysis Indications for quantitative methods Technical aspects: needles, EMG filtering, statistical analysis on data generated Single fibre EMG using voluntary activation and axonal stimulation Principles of jitter, blocking and fibre density measurement Principles of quantification of recruitment patterns; turns/amplitude analysis; frequency analysis Principles of quantification of motor unit potentials; amplitude, duration and phase measurement	●			●		
Skills	Liase with referring colleagues and advise on appropriate investigations. Take a history from and examine the patient to formulate the problem for investigation. Select and perform the appropriate tests, with modification as required during neurophysiological examination Care for the patient throughout the consultation by explaining the procedure, obtaining co-operation, and minimising discomfort. Provide appropriate information to the patient after the examination Describe and interpret findings of the investigation in the report	●			●		
	Supervise training and practice of physiological measurement technicians in performance of basic nerve conduction studies and report on their findings	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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<b>TRAINING SECTION S8</b>							
<b>SPECIALISED NERVE CONDUCTION STUDIES AND EMG</b>							
<b>II. QUANTITATIVE SENSORY TESTING</b>							
<b>Objective - To acquire understanding of the pathophysiological concepts of sensory perception relating to the peripheral and central sensory nervous systems; and to obtain technical competence in different methods of quantitative sensory testing</b>							
Knowledge	Anatomy, physiology and pathology of sensory receptors, and of peripheral and central sensory neural pathways Biochemistry of molecules involved in mediating sensation in health and disease Principles of different available methods and paradigms of quantitative sensory testing for warm and cool thresholds; heat and pain and cold as pain thresholds. Limitations of psychophysical techniques Principles of methods of quantitative sensory testing for touch thresholds Principles of other indirect methods of quantitative testing such as measurement of reflex vasodilatation using laser Doppler, and nicotine and acetylcholine induced sweating quantified by an evaporimeter Interaction between the autonomic nervous and sensory systems. Use of autonomic function tests in assessment of patients with neuropathic disorders	●			●		
Skills	Liaise with referring colleagues and advise on appropriate investigations. Take a history from and examine the patient to formulate the problem for investigation. Select and perform the appropriate tests, with modification as required during neurophysiological examination Care for the patient throughout the consultation by explaining the procedure, obtaining co-operation, and minimising discomfort. Provide appropriate information to the patient after the examination Describe and interpret findings of the investigation in the report	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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<b><u>TRAINING SECTIONS8</u></b>							
<b><u>SPECIALISED NERVE CONDUCTION STUDIES AND EMG</u></b>							
<b><u>II1. URONEUROPHYSIOLOGY</u></b>							
<b>Objectives - To enable the trainee to understand the indications for uro-neurophysiological investigations; to perform these procedures; and to report on the findings</b>							
Knowledge	Anatomy and normal function and control of the urological system. Neural innervation and control of urethral and anal sphincters. Normal characteristics on motor neurones in Onuf's nucleus Consequences for urological and sexual function in neurological and general medical disorders, including endocrine disease such as polycystic ovary syndrome. Clinical presentation and underlying pathology of these conditions Technique of needle EMG examination of sphincters; normal and abnormal findings. Use of EMG recording as part of urodynamic assessment Adaptations of technique necessary in particular patient groups or difficult recording situations Use and limitations of other techniques to assess bladder and sexual function, such as pudendal nerve conduction studies, sacral reflexes and cortical sensory/motor evoked responses	●			●		
Skills	Liase with referring colleagues and advise on appropriate investigations. Take a history from and examine the patient to formulate the problem for investigation. Select and perform the appropriate tests, with modification as required during neurophysiological examination Care for the patient throughout the consultation by explaining the procedure, obtaining co-operation, and minimising discomfort or anxiety. Provide appropriate information to the patient after the examination Describe and interpret findings of the investigation in the report	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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<b>TRAINING SECTION S8</b>							
<b>SPECIALISED NERVE CONDUCTION STUDIES AND EMG</b>							
<b>IV. EMG GUIDED BOTULINUM TOXIN THERAPY</b>							
<b>Objective - To enable the trainee to understand the indications for botulinum toxin therapy, methods of administration and effects of therapy</b>							
Knowledge	<p>Pharmacology of Botulinum toxin, including dosage and dilution schedules related to different strains of toxin and different manufacturers.</p> <p>Clinical conditions where its use is indicated</p> <p>Method of delivery using EMG guidance</p> <p>Anatomy of muscles with regard to site of needle insertion</p> <p>Complications of therapy</p>	●			●		
Skills	<p>Liaison with doctor or team referring patient for treatment</p> <p>Take a history and examine the patient with a view to setting out a treatment plan</p> <p>Explanation of the procedure to the patient in a manner which is understandable and gain patient's consent. Establish patient co-operation to minimise discomfort during the procedure</p> <p>Perform EMG guided toxin therapy in a range of disorders, including focal limb dystonia, diffuse dystonic disorders, spasmodic torticollis, spasticity</p>	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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<b><u>TRAINING SECTION</u></b> <b><u>S9</u></b>							
<b>EVOKED POTENTIAL STUDIES</b>							
<b>Objective - To understand the technical basis and methods of recording visual, somatosensory and auditory brain stem evoked potentials; appreciate when these tests may be used, and the expected changes from normal in a variety of pathological conditions</b>							
Knowledge	<p>technical aspects of stimulation using pattern reversal and flash visual, electrical peripheral nerve and auditory methods</p> <p>technical aspects of recording, including averaging methods technical difficulties of recording from children and adults in a variety of circumstances, including the intensive care unit anatomical generators of evoked potentials, and the basis for determining these generators measurement of latency, amplitude and polarity in normal subjects, and the effect of altering stimulus parameters physiological basis for alteration in evoked potential response amplitude and latency in demyelinating and degenerative pathological processes affecting the central and peripheral nervous system sensitivity and specificity of evoked potential abnormalities for the diagnosis of multiple sclerosis, and changes expected in other demyelinating, degenerative, traumatic or vascular nervous system diseases</p>	●			●		
Skills	<p>Competency in setting up stimulus and recording apparatus to elicit reproducible visual, somatosensory and brain stem auditory evoked potentials Performance of each modality on adults and children Analysis of main evoked potential components Recognition of limits of normality and interpretation of alterations due to nervous system disease</p>	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

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<b><u>TRAINING SECTION S10</u></b>							
<b>SPECIALISED EVOKED POTENTIAL STUDIES</b>							
<b>Objectives - To understand the technical basis, methods of recording and clinical application of specialised evoked potentials; acquire proficiency in performance of these studies, and expertise in the interpretation of clinical significance of findings</b>							
Knowledge	Technical and physiological basis, methods of recording, clinical applications for one or more of the following: <ul style="list-style-type: none"> <li>• Intra-operative monitoring <ul style="list-style-type: none"> <li>a. multimodality stimulation</li> <li>b. peripheral/sub-cortical/cortical recordings</li> <li>c. multispeciality applications, including orthopaedics, neurosurgery and ophthalmology</li> </ul> </li> <li>• Magnetic stimulation studies: cortical and peripheral stimulation techniques</li> <li>• Visual physiology, including electroretinography, electronystagmography, electrooculography: evaluation of function of rods and cones, retinal pigment, epithelium and ganglion cells</li> <li>• Intra-operative functional mapping of cerebral cortex</li> <li>• Event and movement related cortical potentials</li> </ul>	●			●		
Skills	Proficiency in performance and clinical interpretation of designated technique for each selected category	●			●		
Attitudes	As detailed and assessed in Section 0	●			●		●

**N.B. Trainees should become competent in at least 3 Specialist areas.**

**It is recommended, but not prescriptive, that one should be in each of S6, S8 and S10.**