SPECIALTY TRAINING CURRICULUM

FOR

CLINICAL NEUROPHYSIOLOGY

MAY 2007

Joint Royal Colleges of Physicians Training Board

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CONTENTS

RATIONALE

The Purpose of this Curriculum is to inform trainers and trainees of the intended aims and objectives, content, experiences, outcomes and processes of the educational programme to train a specialist in Clinical Neurophysiology.

The Curriculum describes the competencies required to complete a Certificate in Training (CCT) and to be registered on the Specialist Register in Clinical Neurophysiology. The CCT specialist will be able to work as a consultant specialist within the National Health Service and will have the knowledge, skills and attitudes required to do this.

The Curriculum sets out the entry requirements, duration of training and structure of the programme and the methods of learning, teaching, assessment, feedback and supervision expected. It details entry routes and the potential for post-CCT fellowships in Neuromuscular Disease and Epilepsy.

The Curriculum was drawn up by the Clinical Neurophysiology Curriculum Working Party. This is a standing committee with broad representation within the Specialty, from the Clinical Neurophysiology Specialist Advisory Committee (SAC), Training & Educational representatives of the British Society for Clinical Neurophysiology (BSCN), as well as trainee representation and potential for lay members in the future.

Generic Curriculum

This specialty curriculum is complementary to the generic curriculum which applies to all 28 physicianly specialities. The generic curriculum follows the headings of good medical practice and runs through from core training to CCT (see fig 1). Trainees should read and understand both their specialty curriculum and the generic curriculum. Both curricula should be seen as integrated so that generic competencies are acquired at all stages of specialty training. Some generic components are also further expanded and deepened for some specialties (e.g. palliative medicine). When planning specialty programmes, deaneries and trainers should ensure that both specialty and generic competencies can be acquired and assessed.

Duration of Training

Although this curriculum is competency based, the duration of training must meet the European minimum of 4 (four) years for post registration in full time training adjusted accordingly for flexible training (EU directive 93/16/EEC requires that flexible training can be no less than 50% whole time equivalent). The SAC has advised that training from ST1 will usually be completed in 6 (six) years in full time training.

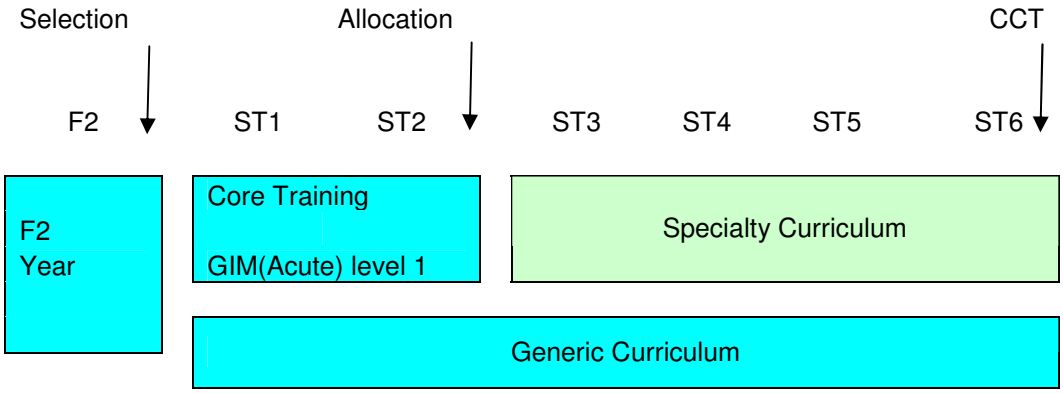
Dual Accreditation

Trainees may wish to dually train and accredit in clinical neurophysiology and neurology to achieve two CCTs. In this case they must have applied for and successfully entered a training programme which was advertised openly as a dual training programme. This programme will need to achieve the competencies as described in both curricula and there must be jointly agreed assessments (proposed by both SACs in clinical neurophysiology and neurology, and approved by PMETB). Postgraduate deans wishing to advertise such programmes should ensure that they meet the requirements of both SACs.

CONTENT OF LEARNING

The trainee will follow both the Generic Curriculum and Specialist Training Curriculum. Adherence to Good Medical Practice is detailed, as recommended by the General Medical Council. The content of the Specialist Curriculum is set out in detail to include Core and Specialist areas of Electroencephalography, Evoked Potentials and Peripheral Neurophysiological techniques, as well as a supporting framework of basic neuroscience, health and safety, information, management and Clinical Neurology. The Speciality Curriculum outlines required competencies to be acquired by the trainee, expressed in terms of knowledge, skills, attitudes and behaviour.

Fig.1
Diagrammatic representation of specialty and generic curricula with GIM (acute) level 1 curriculum



MODEL OF LEARNING

Neurological competencies will be achieved, often within the first year of Specialist Training, in the setting of ward attachments and outpatient clinics supervised by Neurology Trainers.

Specialist Neurophysiological competencies will be delivered within the setting of one (or preferably several) Clinical Neurophysiology Departments, under the supervision of accredited Clinical Neurophysiologists, mostly within Neuroscience Centres within the UK. Trainees will observe and subsequently undertake with increasing autonomy as their competency allows, Peripheral Neurophysiology Clinics, EEG & Evoked potential recording and reporting sessions, both within the Department and as necessary on wards, intensive care and theatre.

LEARNING EXPERIENCES

The major form of learning is work-based and experiential, including bedside learning. This is supported by personal study and training meetings at Regional and National level, including those arranged by the Association of Trainees in Clinical Neurophysiology (ATCN) and BSCN. The recommended learning methods and experiences for each of the core and specialist areas are described in turn in the curriculum.

Where it is clear from trainees' experience that parts of the curriculum are not being delivered within their work place, appropriate education or rotations to other work places will be arranged, within other centres within the Regional training scheme or elsewhere in the UK or abroad. This may include a 1 year subspecialty attachment in for example neuromuscular disease or epilepsy.

RESEARCH

Trainees who wish to acquire extensive research competencies, in addition to those specified in the generic element of the curriculum, may undertake a research project as an ideal way of obtaining those competencies, all options can be considered including taking time out of programme to complete a specified project or research degree. Time out of programme needs prospective approval from the SAC and the support of the Postgraduate Dean. Funding will need to be identified for the duration of the research period. A maximum period of 3 years out of programme is allowed.

SUPERVISION AND FEEDBACK

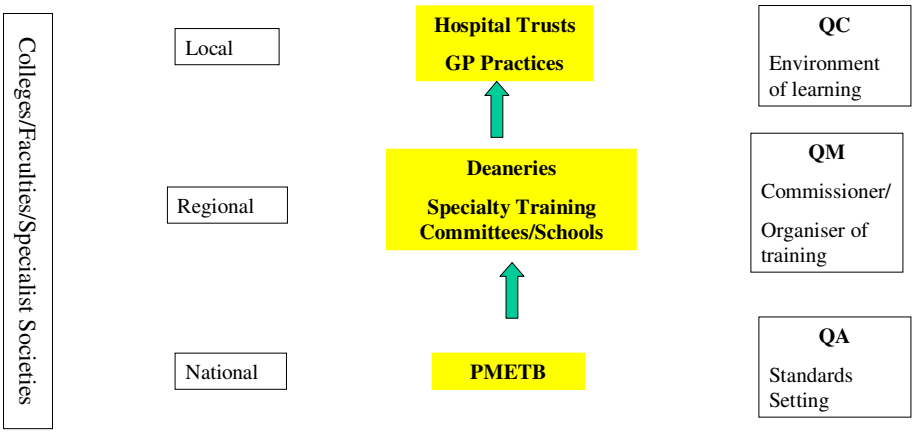
Proper supervision of clinics, theatre monitoring and reporting sessions is essential to safe clinical practice during training with, at each stage, an increase in responsibility being dependent upon evidence of competence as set out in detail in the curriculum. Furthermore feedback is crucial both during training and from regular assessment and at the annual RITA meetings.

- DOPS & Mini-CEX will provide regular opportunity for feedback on specific areas of the Curriculum.
- Educational Supervisors will undertake an annual appraisal & more formal feedback will occur within the framework of the RITA process.

CURRICULUM IMPLEMENTATION

Deaneries are responsible for quality management, PMETB will quality assure the deaneries, and educational providers are responsible for local quality control, to be managed by the deaneries. The role of the Colleges in quality management remains important and will be delivered in partnership with the deaneries. The College role is one of quality review of deanery processes and this will take place within the SACs on a regular basis.

The Organisation and Quality Assurance of PG Training



The curriculum will be issued to the trainee once they enrol with JRCPTB. All the educational supervisors and trainers will be given the up to date curriculum and be expected to use this in their discussions with trainees. All the speciality curricula are available on the JRCPTB & BSCN websites, as are the performance assessment methods. Both the trainers and trainees are expected to have a good knowledge of the curriculum and use it as the blueprint for their training.

The educational supervisor will meet regularly with the trainee to ensure that progress and coverage of the curriculum takes place. They will discuss outcomes of assessment, learning opportunities and learning development opportunities.

Regional Specialty Advisors, Deaneries (and specialty deans) along with programme directors will together ensure local delivery of the curriculum.

Trainees are expected to be aware of the curriculum and should be proactive in ensuring they are making appropriate progress through the stages of the curriculum. Additionally they are responsible for ensuring that they are appraised regularly, and that the appropriate assessments are completed.

Curriculum management in posts and attachments wtihin programmes are the responsibility of the educational supervisor and the trainee. If there are any difficulties these will be referred to the dean and the programme director.

The responsibility for curriculum management across programmes as a whole lies with the programme directors for the specialty, who will liaise with educational supervisors, other trainers and the Deanery, to whom they are accountable.

When a trainee joins a programme they will meet with their educational supervisor as soon as possible, who will ensure that they have an appropriate learning agreement which identifies objectives are reviewed at appraisal. Additionally trainees will be inducted into their local specialty department. Each trust that the trainee works at will ensure there is an induction into the whole trust in line with specific recommendations regarding clinical governance.

Annual meetings are undertaken to update Regional Speciality Advisors and Programme Directors to cascade information on the curriculum and supporting assessment to regional and local level.

CURRICULUM REVIEW AND UPDATING

Curriculum review will be informed by a number of different processes. For instance the SAC will be able to use information gathered from specialty heads, specialty deans and the National Health Service. It will have available to it results of the trainee survey, which will include questions pertaining to their specialty. Interaction with the NHS will be particularly important to understand the performance of specialists within the NHS and feedback will be required as to the continuing need for that specialty as defined by the curriculum. It is likely that the NHS will have a view as to the balance between generalist and specialist skills, the development of generic competencies and, looking to the future, the need for additional specialist competencies and curricula.

EQUALITY AND DIVERSITY

In the exercise of these powers and responsibilities, the Royal Colleges of Physicians will comply, and ensure compliance, with the requirements of relevant legislation, such as the:

- Race Relations (Amendment) Act 2000;
- Disability Discrimination Act 1995 and Special Educational Needs and Disabilities Act 2001;
- The Disability Discrimination Act 1995 (amendment) (further and higher education) regulations 2006
- Age Discrimination Act in October 2006

The Federation of the Royal Colleges of Physicians believes that equality of opportunity is fundamental to the many and varied ways in which individuals become involved with the Colleges, either as members of staff and Officers, as advisers from the medical profession, as members of the Colleges' professional bodies or as doctors in training and examination candidates. Accordingly, it warmly welcomes contributors and applicants from as diverse a population as possible, and actively seeks to recruit people to all its activities regardless of race, religion, ethnic origin, disability, age, gender or sexual orientation.

STATUTORY RESPONSIBILITIES

The Royal Colleges of Physicians will comply, and ensure compliance, with the requirements of legislation, such as the:

- Human Rights Act 1998
- Freedom of Information Act 2001
- Data Protection Acts 1984 and 1998

OVERVIEW OF SPECIALITY

Clinical Neurophysiology is a diagnostic specialty, which encompasses the use of electroencephalography (EEG), electromyography (EMG), nerve conduction studies (NCS), and evoked potentials (EP) to assess function in the nervous system. The Training Programme in Clinical Neurophysiology will equip trainees with the necessary knowledge and skill to become Consultants providing the highest standards of service to patients who require neurophysiological investigations. Implicit in the educational process is the need to develop positive attitudes towards lifelong learning, such that the practising Consultant can adapt to technological advances and clinical developments.

The Trainee will be taught how to apply neurophysiological investigations in clinical practice and in clinical context, and the interaction of these investigations with procedures used by other disciplines, such as neuroradiology, neuroimmunology and neuropathology, to evaluate nervous system structure and function. Competence in Clinical Neurophysiology is underpinned by understanding of a wide range of relevant clinical conditions, as well as basic science, technology, electronics and data processing. Many medical and surgical specialities utilise Clinical Neurophysiology, and background knowledge/experience of neurology, paediatrics, neurosurgery, orthopaedics, rheumatology and ophthalmology is particularly desirable. Acquisition of good communication and reporting skills is essential.

The ability to work in a multidisciplinary team with clinical physiologists, clinical scientists, medical engineers and other ancillary staff, and to provide leadership where appropriate, is fundamental to the Clinical Neurophysiologist. Additionally, the Trainee will need to develop teaching skills, which encompass this broad range of health care professionals, as well as undergraduates and postgraduates in medicine.

ENTRY REQUIREMENTS

1. Following 2 years of foundation training, trainees will be eligible to apply for run-through specialist training.

2. For Clinical Neurophysiology this will normally include a 2-year period of Core Training (core medical training – CMT or acute care common stem – ACCS, or core paediatric training), followed by a 4-year programme of Specialist Training, as detailed below.

3. Clinical Neurophysiology welcomes applications with other training backgrounds, eg surgery. These applicants will need to have achieved acute medical level one competencies prior to entry to ST3.

GENERAL DESCRIPTION OF TRAINING PROGRAMME

Accreditation in Clinical Neurophysiology

The Specialist Training Programme comprises 4 years:

- 12 months training in Neurology
  This may be completed as a single attachment of 12 months, or in blocks to a total of 12 months through the 4 year training programme, depending on local opportunities or preference.
- 24 months training in Clinical Neurophysiology (all age groups)
- 12 months for research or specialised training
  Trainees wishing to spend a longer period in research will be encouraged to do so, but the time credit will be limited to 12 months. Credit for clinical work undertaken during research will be granted at the discretion of the SAC.

Though programmes may vary in the sequence in which the above training is obtained, in general:

1. Neurological training is often completed in Year 1.
2. Most Core Techniques should have been completed in Year 2 and certainly by Penultimate Year Assessment.
3. Specialist Techniques and any Research are generally undertaken in years 3 & 4.

Dual accreditation in Clinical Neurophysiology and Neurology

Currently trainees seeking dual accreditation will need to complete a total of 6.5 years, comprising 4.5 years in Neurology and 2 years in Clinical Neurophysiology. There is a very small number of training posts specifically for dual accreditation; otherwise, the Trainee will need to organise his/her own programme within separate approved training posts.

In future Neurology trainees may similarly wish to acquire general competence in clinical neurophysiology by way of an additional 2 years' training in clinical neurophysiology or they may undertake specific training in a sub-specialty of Clinical Neurophysiology relevant to, for example Neuromuscular disease or Epilepsy by way of a 1 year specialist Fellowship programme.

Similarly Clinical Neurophysiology trainees may wish to undertake specific training in a sub-specialty of Neurology relevant to, for example Neuromuscular disease or Epilepsy by way of a 1 year specialist Fellowship programme.

Assessment:

Methods have been developed to provide more objective evidence to inform the RITA process on a trainee's competence to practice in Clinical Neurophysiology.

Competence is to be judged against the Specialist Curriculum for Clinical Neurophysiology, which is repeatedly updated and published on the JRCPTB website. A broad range of assessment tools is to be used (see Appendix B) to evaluate knowledge base, practical and behavioural skills.

1. Attitude and behaviour are assessed by Multi-Source Feedback – a questionnaire submitted to working colleagues. The process is generic across specialities and details as to how to undertake it, together with supporting documentation are available on the JRCPTB website. A minimum

of two assessments are required – one around the end of Year 1 and another prior to PYA. In due course a patient questionnaire is also envisaged.

2. Clinical Competence in respect of the Neurology component of the curriculum will be assessed by the mini Clinical examination (Mini-CEX) undertaken by Neurology trainers.

3. Specialist competence in Clinical Neurophysiology is to be assessed primarily by Direct Observation of Procedural Skills (DOPS) – either by observing a trainee undertaking a technique such as an EMG or the reporting of a study as in the case of an EEG. Six areas of competence are to be assessed over the whole training programme (Core EEG, Specialist EEG, Core EMG, Specialist EMG, Core EPs and Specialist EPs) - each 3 times. A single Clinical Neurophysiology DOPS test form, for use in all techniques is published on the JRCPTB website; for simplicity this one form is to be utilised for all techniques, though clearly some testable domains will not be relevant to every technique and should be recorded as not applicable. Assessments are to be undertaken in as near normal a clinical setting as possible to reflect normal practice.

4. In due course it is also envisaged that knowledge base will be assessed by way of an MCQ.

It is the trainee's responsibility to organise these assessments with their trainers, so that the relevant documentation is available to RITA assessments. This process will inform annual review and the penultimate year assessment through the RITA process.

These methods will be gradually incorporated within the RITA process and it is not envisaged that doctors already in training should undertake a comprehensive programme of assessment. However, we do expect the assessment process gradually to become increasing important to the trainee's successful completion of the RITA process. By way of guidance it would be reasonable to expect trainees during 2005 to have undertaken one MSF questionnaire and 6 DOPS assessments over a range of the Clinical Neurophysiology Curriculum.

SPECIFIC TRAINING AIMS OF THE CLINICAL NEUROPHYSIOLOGY CURRICULUM

The educational process in Clinical Neurophysiology aims to produce physicians who:

1. Execute core neurophysiological techniques competently, as well as more specialised techniques (see summary of syllabus).

2. Are able to act as independent practitioners who can make a clinical assessment where necessary; formulate a differential diagnosis; choose relevant techniques appropriate to the clinical context; and interpret and report on the results.

3. Understand basic relevant science including physics and electronics, and are competent in information technology.

4. Have managerial and leadership skills appropriate to administration of a department of Clinical Neurophysiology, including evaluation of equipment and preparation of bids for funding.

5. Have the values, behaviours and relationships with patients and colleagues that underpin medical professionalism and good medical practice.

SUMMARY OF SYLLABUS

1. GMC Guidelines on Medical Professionalism & Good Medical Practice.

Trainees must demonstrate Medical Professionalism and conform to GMC guidelines on Good Medical Practice.

2. Investigative Techniques in Clinical Neurophysiology.

Trainees must attain competence in all core Clinical Neurophysiological techniques and a number of additional specialist techniques (at least one in each of the following domains:

i. Specialised Electroencephalography (EEG) – S6
ii. Specialised Nerve Conduction Studies (NCS) & Electromyography (EMG) – S8 and
iii. Specialised Evoked Potential Studies (EPs) – S10.

CORE TECHNIQUES

Trainees must attain competence in all of the following:

- **Electroencephalography (EEG)** - in adults, children and neonates; in waking and sleeping states; with application of activation procedures (hyperventilation, photic stimulation).

- **Nerve conduction studies (NCS) and electromyography (EMG)** - in adults and children (recognising that paediatric NCS and EMG accounts for a small proportion of Clinical Neurophysiology practice outside specialised units); assessment of peripheral nerves; evaluation of the neuromuscular junction; EMG investigation of neurogenic and myopathic conditions.

- **Evoked potential studies** - visual, auditory and somatosensory modalities.

SPECIALISED TECHNIQUES

Trainees are expected to spend about 20% of training becoming proficient in up to 5 specialised techniques. Trainees should select at least one technique from the 3 major categories (S6, S8 & S10), though they may still select several procedures specific to their expected sub-specialisation.

- **Specialised EEG** - some of the following: video EEG; telemetry; ambulatory monitoring; pre-operative assessment for epilepsy surgery including invasive EEG studies; electrocorticography; cortical stimulation; cerebral function monitoring; polygraphy; sleep studies and multiple sleep latency tests.

- **Specialised NCS and EMG** - some of the following: quantitative EMG (single fibre EMG; turns/amplitude analysis; motor unit potential analysis; EMG frequency analysis, macro EMG); quantitative sensory testing; autonomic nervous system assessment; uroneurophysiology; application of botulinum toxin therapy.

- **Specialised evoked potential studies** - some of the following: intraoperative monitoring; magnetic stimulation studies; detailed investigation of visual system including electroretinography; event related potentials.

DISORDERS AMENABLE TO CLINICAL NEUROPHYSIOLOGY STUDY
(Adults and children)

1. Congenital and hereditary disorders of the nervous system
2. Degenerative disorders of the nervous system
3. Vascular disorders of the nervous system
4. Metabolic disorders of the nervous system
5. Infective disorders of the nervous system
6. Traumatic disorders of the nervous system
7. Inflammatory and immunological disorders of the nervous system
8. Demyelinating disorders of the nervous system
9. Neoplastic disorders of the nervous system
10. Epilepsy and other disorders of consciousness
11. Sleep disorders
12. Cranial nerve disorders including diseases of the eye and ear
13. Peripheral neuropathy, focal and generalised
14. Radicular disorders
15. Diseases of motor neurones
16. Muscle disease
17. Neuromuscular transmission disorders
18. Psychiatric disorders

TRAINING SECTIONS

S0. MEDICAL PROFESSIONALISM & GOOD MEDICAL PRACTICE

S1. TECHNOLOGY

S2. HEALTH AND SAFETY

S3. BASIC NEUROSCIENCE

S4. NEUROLOGY

S5. ELECTROENCEPHALOGRAPY

S6. SPECIALISED EEG TECHNIQUES

- Video EEG, telemetry and ambulatory monitoring
- Clinical Neurophysiology support for epilepsy surgery
- Polysomnography and multiple sleep latency tests

S7. NERVE CONDUCTION STUDIES AND EMG

S8. SPECIALISED NERVE CONDUCTION STUDIES AND EMG

- Quantitative EMG
- Quantitative sensory testing
- Uroneurophysiology
- EMG guided botulinum toxin therapy

S9. EVOKED POTENTIAL STUDIES

S10. SPECIALISED EVOKED POTENTIALS

TRAINING SECTION S0

MEDICAL PROFESSIONALISM AND GOOD MEDICAL PRACTICE

Objective

To produce a doctor with the values, attitudes, behaviours and relationships with patients and colleagues that underpins medical professionalism and GMC guidelines on Good Medical Practice. In particular the trainee must:

i. Make the care of the patient their first concern
ii. Be honest and trustworthy
iii. Communicate effectively with patients and colleagues and respect their confidentiality
iv. Ensure personal beliefs do not prejudice the care provided and never discriminate unfairly
v. Recognise the limits of his/her professional competence
vi. Show leadership skills
vii. Be able to work as part of a multidisciplinary team
viii. Show a positive attitude to lifelong learning and professional development.

Subject matter

(i) Knowledge

- Publications and Guidelines from GMC and Royal Colleges
- Trust and departmental protocols

(ii) Skills

The trainee will be able to demonstrate compliance with GMC guidance on Good Medical Practice.

Teaching / learning method

Self directed learning (A1)
Apprenticeship Learning (A2)
Formal training in National training days, postgraduate courses (A3)

Assessment

Trainer's report (B1)
DOPS: Observation by trainer &/or independent observer of technical ability during detailed procedures (B4)
Multi-source Feedback Assessment (B6)

Evidence of competence

Satisfactory trainer's report (C1)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4).
Satisfactory Multi-Source Feedback Assessment (C6)

TRAINING SECTION S1

TECHNOLOGY

Objective

To understand and utilise the technology which underpins practice of Clinical Neurophysiology

Subject matter

(i) 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

(ii) Skills

The trainee will be able to:

1. make rational purchasing decisions of recording and administrative systems
1. design, implement and monitor safety standards
2. recognise artefacts
3. assess and utilise new technologies
4. supervise and train non medical and medical staff in basic technology
5. observe legal and professional requirements for safe use of technology

Teaching / learning method

Self directed learning (A1)
Formal training on study days, post-graduate courses (A3, A4)

And

Practical experience during supervised recording sessions with technologists, physicists and Clinical Scientists

Assessment

Trainer's report (B1)
Training record (B2)
Multiple-choice questions (B5)

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
Appropriate score on MCQ (C5)

TRAINING SECTION S2

HEALTH AND SAFETY

Objectives

To enable the trainee to be conversant with and implement measures that ensures the safe working of a Department of Clinical Neurophysiology for staff and patients.

Subject matter

- 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

Teaching / learning method

Self directed learning (A1)
Formal training on study days, post-graduate courses (A3, A4)

And

Departmental and Trust protocols and procedures
National guidelines from Dept of Health, Medical Devices Agency, COSHH, specialist and professional bodies

Assessment

Trainer's report (B1)
Training record (B2)
Multiple-choice questions (B5)

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
Appropriate score on MCQ (C5)

TRAINING SECTION S3

BASIC NEUROSCIENCE

Objectives

To acquire and reinforce knowledge of basic neuroanatomy, neurophysiology, neuropharmacology and neuropathology

Subject matter

(i) Knowledge

- Neuroanatomy
  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.
- Neurophysiology
  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.
- Neuropharmacology
  Central nervous system neurotransmitters and drugs which modulate them. Mode of action of drugs affecting the central and peripheral nervous systems.
- Neuropathology
  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.

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.

Teaching / learning method

Self directed learning (A1)
Formal training on study days, post-graduate courses (A3, A4)

And

Clinico-pathological conferences

Assessment

Trainer's report (B1)
Training record (B2)
Multiple-choice questions (B5)

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
Appropriate score on MCQ (C5)

TRAINING SECTION S4

NEUROLOGY

Objectives

To provide the trainee with the knowledge and skills to be able to:

i. Examine, investigate, diagnose, treat and evaluate the effects of treatment in a range of neurological disorders

ii. Ensure a consistently compassionate approach to patients and their carers.

iii. Be aware of current clinical trials and evidence based medicine

Subject matter

1. Take a clinical history
2. Perform a neurological examination
3. Formulate a diagnostic plan
4. Plan appropriate investigations and interpret results
5. Initiate treatment as appropriate involving a multidisciplinary approach
6. Assess outcome of treatment
7. Counsel patient/carers concerning diagnosis, prognosis and treatment

Teaching / learning method

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

And

Grand rounds and case conferences

Assessment

Trainer's report (B1)
Training record (B2)
Mini Clinical Examination (B3)
Multiple-choice questions (B5)

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
Satisfactory Mini Clinical Examinations (C3)
Appropriate score on MCQ (C5)

TRAINING SECTION S5

ELECTROENCEPHALOGRAPHY

Objectives

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.

Subject matter

(i) 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

(ii) Skills

Record EEGs and recognition of artefacts

1. Recognition of normal components of the EEG and evolution of maturational changes
2. Recognition of normal variants and abnormalities
3. Write a factual report
4. Interpretation of EEG in clinical setting
5. Comment on EEG findings to referring clinician
6. Care of patient during recording, with particular reference to disorders of consciousness including epilepsy

Teaching / learning method

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

And
EEG reporting sessions (multidisciplinary)

Assessment

Trainer's report (B1)
Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

And
Quality of EEG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S6

SPECIALISED EEG TECHNIQUES

I. EEG Telemetry and Ambulatory Monitoring

Objectives

To acquire competence to:
i. supervise and report on video EEG telemetry.
ii. supervise and report on ambulatory EEG recordings

Subject Matter

(i) 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.

(ii) Skills

1. Assessing seizure histories and proposing differential diagnosis.
2. Evaluating video recordings of seizures of epileptic and non-epileptic origin.
3. Reading ictal and interictal EEGs in persons with epileptic and non-epileptic attacks.
4. Setting up telemetric and ambulatory recordings, selection of montages, polygraphy etc; changing media (tapes etc); identification of common faults.
5. Managing initial stages of status epilepticus.
6. Management of seizures and acute psychotic episodes in telemetry unit.
7. Explaining procedures to patients and carers and obtaining their co-operation.
8. Co-ordinating and leading the telemetry team.

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

And

Attendance at ward rounds and case conferences on telemetric and ambulatory investigations.
Setting up, supervision and reporting of telemetric and ambulatory recordings.

Assessment

Trainer's report (B1)
Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

And
Quality of EEG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S6

SPECIALISED EEG TECHNIQUES

II. Clinical Neurophysiological Support for Epilepsy Surgery

Objectives

To acquire competence to:

i. supervise and report on sub-acute electrophysiological recordings with intracranial electrodes.
ii. supervise and report on acute electrocorticograms
iii. participate in functional brain mapping
iv. participate in carotid amytal tests

Subject Matter

(i) 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 amytal test and simultaneous EEG recording.
- Risks and benefits of epilepsy surgery and its associated procedures.

(ii) Skills

1. Setting up sub-acute intracranial recordings, selection of montages, identification and correction of common faults.
2. Interpretation of intracranial recordings.
3. Assisting surgeon and supervising technician in setting up and performing acute electrocorticographic recordings and in identification correction of common artefacts and faults.
4. Assisting at carotid amytal tests.
5. Assisting at functional brain mapping.
6. Explaining these procedures accurately and comprehensibly to patients and carers.

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

And

Attendance at ward rounds, outpatient clinics and case conferences on presurgical patients with epilepsy.
Attendance at insertion of intracranial electrodes.
Attendance and assisting at carotid amytal tests and at functional brain mapping.
Setting up, supervising and reporting of sub-acute intracranial recordings using foramen ovale, subdural and intracerebral electrodes.

Assessment

Trainer's report (B1)
Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

And
Quality of EEG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S6

SPECIALISED EEG TECHNIQUES

III. Polysomnography and Multiple sleep Latency Tests

Objectives

To acquire competence to:

i. supervise and report on polysomnography
ii. supervise and report on Multiple Sleep Latency Tests

Subject Matter

(i) 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.
- Rechschaffen & Kales' sleep staging criteria; manual and automated methods of staging.
- Technology and procedures for polysomnography and Multiple Sleep Latency Tests.

(ii) Skills

1. Eliciting and assessing histories of possible sleep disorders and proposing differential diagnosis.
2. Sleep staging and recognising polygraphic features of common sleep disorders.
3. Setting up polygraphy both in the laboratory and using ambulatory recordings, selection of
   montages, transducers etc; changing media; identification of common faults.
4. Explaining procedures to patients and carers and obtaining their co-operation.
5. Co-ordinating and leading the sleep studies team.

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

And

Attendance at ward rounds and case conferences on sleep studies
Attendance at sleep clinic

Assessment

Trainer's report (B1)
Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

And
Quality of EEG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S7

NERVE CONDUCTION STUDIES + ELECTROMYOGRAPHY

Objectives

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.

Subject matter

(i) Knowledge

- Physiology of nerve conduction, neuromuscular transmission and excitation - contraction mechanisms in muscle
- Clinical presentation and pathophysiology of diseases of the peripheral nerves, neuromuscular junction and muscles
- Anatomy of peripheral nerves and muscles with regard to electrode placement and needle insertion
- 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
- 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
- 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

(ii) Skills

1. Liase with referring colleagues and advise on appropriate investigations.
2. Describe and interpret findings of the investigation in the report
3. 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
4. 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
5. Supervise training and practice of physiological measurement technicians in performance of basic nerve conduction studies and report on their findings

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

And

Specialised anatomy and physiology textbooks for less commonly encountered techniques

Assessment

Trainer's report (B1)
Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

And

Quality of EMG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S8

SPECIALISED NERVE CONDUCTION STUDIES AND EMG

I. QUANTITATIVE EMG

Objectives

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.

Subject matter

(i) 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

(ii) Skills

1. Liase with referring colleagues and advise on appropriate investigations.
2. 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
3. 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
4. Describe and interpret findings of the investigation in the report
5. Supervise training and practice of physiological measurement technicians in performance of basic nerve conduction studies and report on their findings

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

And

Specialised anatomy and physiology textbooks for less commonly encountered techniques

Assessment

Trainer's report (B1)
Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

And

Quality of EMG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S8

SPECIALISED NERVE CONDUCTION STUDIES AND EMG

II. QUANTITATIVE SENSORY TESTING

Objectives

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.

Subject matter

(ii) 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 ands 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 a measurement f 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.

(ii) Skills

1. Liaise with referring colleagues and advise on appropriate investigations.
2. 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
3. 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
4. Describe and interpret findings of the investigation in the report

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

And

Specialised anatomy and physiology textbooks for less commonly encountered techniques

Assessment

Trainer's report (B1)

Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

And

Quality of quantitative sensory testing technique and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S8

SPECIALISED NERVE CONDUCTION STUDIES AND EMG

II1. URONEUROPHYSIOLOGY

Objectives

To enable the trainee to understand the indications for uroneurophysiological investigations; to perform these procedures; and to report on the findings.

Subject matter

(iii) 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

(ii) Skills

1. Liase with referring colleagues and advise on appropriate investigations.
2. 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
3. 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
4. Describe and interpret findings of the investigation in the report

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

Assessment

Trainer's report (B1)
Training record (B2)

DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

And

Quality of EMG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S8

SPECIALISED NERVE CONDUCTION STUDIES AND EMG

IV. EMG GUIDED BOTULINUM TOXIN THERAPY

Objectives

To enable the trainee to understand the indications for botulinum toxin therapy, methods of administration and effects of therapy.

Subject matter

(i) Knowledge

- Pharmacology of Botulinum toxin, including dosage and dilution schedules related to different strains of toxin and different manufacturers.
- Clinical conditions where its use is indicated.
- Method of delivery using EMG guidance.
- Anatomy of muscles with regard to site of needle insertion.
- Complications of therapy

(ii) Skills

1. Liaison with doctor or team referring patient for treatment
2. Take a history and examine the patient with a view to setting out a treatment plan.
3. 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.
4. Perform EMG guided toxin therapy in a range of disorders, including focal limb dystonia, diffuse dystonic disorders, spasmodic torticollis, spasticity.

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

And

Specialised anatomy textbooks for needle insertion techniques.

Assessment

Trainer's report (B1)
Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

Quality of EMG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S9

EVOKED POTENTIAL STUDIES

Objectives

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

Subject matter

(i) Knowledge

- technical aspects of stimulation using pattern reversal and flash visual, electrical peripheral nerve and auditory methods
- 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

(ii) Skills

1. Competency in setting up stimulus and recording apparatus to elicit reproducible visual, somatosensory and brain stem auditory evoked potentials
2. Performance of each modality on adults and children
3. Analysis of main evoked potential components
4. Recognition of limits of normality and interpretation of alterations due to nervous system disease

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

Assessment

Trainer's report (B1)
Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures(B4)

Quality of EMG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

TRAINING SECTION S10

SPECIALISED EVOKED POTENTIAL STUDIES

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

Subject matter

(i) Knowledge

Technical and physiological basis, methods of recording, clinical applications for one or more of the following:

- Intra-operative monitoring
  - a. multimodality stimulation
  - b. peripheral/sub-cortical/cortical recordings
  - c. multispeciality applications, including orthopaedics, neurosurgery and ophthalmology
- Magnetic stimulation studies: cortical and peripheral stimulation techniques
- Visual physiology, including electroretinography, electronystagmography, electrooculography: evaluation of function of rods and cones, retinal pigment, epithelium and ganglion cells
- Intra-operative functional mapping of cerebral cortex
- Event and movement related cortical potentials

(ii) Skills

Proficiency in performance and clinical interpretation of designated technique for each selected category

Teaching / Learning Methods

Self directed learning (A1)
Apprenticeship learning (A2)
Formal training on study days, post-graduate courses (A3, A4)

Assessment

Trainer's report (B1)
Training record (B2)
DOPS: Observation by trainer/independent observer of technical ability during detailed procedures (B4)

Quality of EMG recording and reporting

Evidence of competence

Satisfactory trainer's report (C1)
Satisfactory Training Record (C2)
DOPS: Detailed procedures observed by independent observer and judged to be satisfactory (C4)

APPENDIX A

TEACHING AND LEARNING METHODS

A1: Self directed learning (textbook, journal and internet sources)

A2: Apprenticeship learning

A3: Formal training in national study training days, post-graduate courses

A4: Attendance at approved conferences and scientific meetings

A5: Simulated patients

A6: Video based case material (EMG, EEG)

*Some training areas may involve additional methods of teaching/learning; these are identified in specific sections

APPENDIX B

ASSESSMENT METHODS

B1: Trainer's Report

B2: JRCPTB training record including log book

B3: Mini CEX: Clinical Examination

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

B5: Multiple-choice questions.

B6: Multi-source Feedback Assessment

B7: Patient Survey

B8: Case Presentations

B9: Case oriented problem-solving exercises

B10: Independent Assessor's report

* Some training areas may include additional methods of assessment; these are identified in specific sections

* Some assessment methods are under development

APPENDIX C

EVIDENCE OF COMPETENCE FOR INCLUSION IN RECORD

C1: Satisfactory Trainer's report

C2: Correctly maintained and up-to-date JRCPTB Training Record/log book

C3: Mini CEX: Mini Clinical Examinations judged to be satisfactory

C4: DOPS: Detailed procedures observed by independent observer and judged to be satisfactory

C5: Appropriate score on MCQ

C6: Satisfactory Multi-source Feedback assessment

C7: Satisfactory Patient Survey assessment.

C8: Satisfactory case presentations to peers and teachers

C9: Satisfactory case orientated problem-solving exercises

C10: Satisfactory report by Independent assessor.

C11: Documented attendance at national training days, approved conferences and scientific meetings.

C11: Documented attendance at other approved conferences and scientific meetings.