

# Transforming Clinical Neurophysiology Diagnostic Services to Deliver 18 Weeks

A Good Practice Guide

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# **Transforming Clinical Neurophysiology Diagnostic Services to Deliver 18 Weeks**

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August 2007

# Foreword

The NHS is currently being challenged to ensure that patients move from referral to treatment in end to end clinical pathways within a maximum of 18 weeks. This is a tough challenge and puts significant pressure on diagnostic services where patients have previously experienced “hidden waits”.

Clinical neurophysiology diagnostics are an integral part of many clinical pathways for patients with problems and conditions that affect the functioning of the brain, nervous system and muscles. The contribution of clinical neurophysiology services in end to end patient pathways has been poorly understood to date and long waits have been uncovered, which are contributing to elongated patient pathways.

This document aims to provide commissioners with information about where clinical neurophysiology needs to fit into their local 18 weeks strategy and providers with innovative ways in which services can be delivered in order to meet the diagnostic milestones and the December 2008 18 weeks targets. It sets out how the levers of health reform can be brought to bear to improve quality, efficiency and access to clinical neurophysiology services.

The models of service outlined in this document have been developed by a small group of experts. A national group is being formed which will report in to the National Physiological Measurement Programme Board, taking forward the implementation of this document and the continued development of service improvement.

Overall, this document has been designed to both stimulate discussion and to introduce new ways of working aimed at reducing waits and increasing access to clinical neurophysiology services. New ways of working will be essential if sustainable improvements are to be delivered and the patient's experience enhanced.



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# Executive Summary

Clinical Neurophysiology involves the diagnosis of a wide range of conditions affecting the central and peripheral nervous systems. It is concerned with testing the electrical function of the brain, spinal cord and nerves in the limbs and muscles. It is principally diagnostic, but can also be necessary for ongoing management decisions, directly involving therapy for conditions.

Clinical neurophysiology services will play an important part in the delivery of the 18-week patient pathway in a number of major specialties and are critical in the diagnosis and understanding of common diseases such as epilepsy, carpal tunnel syndrome, neuropathy and diabetes. Taking these conditions alone there is a significant and increasing demand for clinical neurophysiology services.

This document provides good practice and the evidence to support the requirement for high quality, low wait clinical neurophysiology services and the mechanism for achievement and delivery using the three key components of systems and process, technology and workforce together with new service models summarised as:

- **System and process:** enabling efficient clearance of historical backlogs; introducing effective booking and schedule management systems; reducing the number of DNAs, and increasing the proactive use of available data to manage services.
- **Technology:** encouraging the use of remote reporting, multifunctional

equipment, leading edge technology and investment in IT support.

- **Workforce:** pioneering the development of multidisciplinary teams incorporating the development of the role of clinical physiologists and using existing resources more effectively by extension of working hours and ensuring that the right staff are available for the right task.
- **New service models:** introducing and making better use of one stop clinics and providing diagnostics earlier in the patient pathway associated with clearly defined referral criteria.

It is critically important to ensure that effective leadership is in place at senior levels to drive the management of large scale change. Change management success will be a major contribution to the delivery of 18-week patient pathways and a more effective and modern diagnostic service for patients.

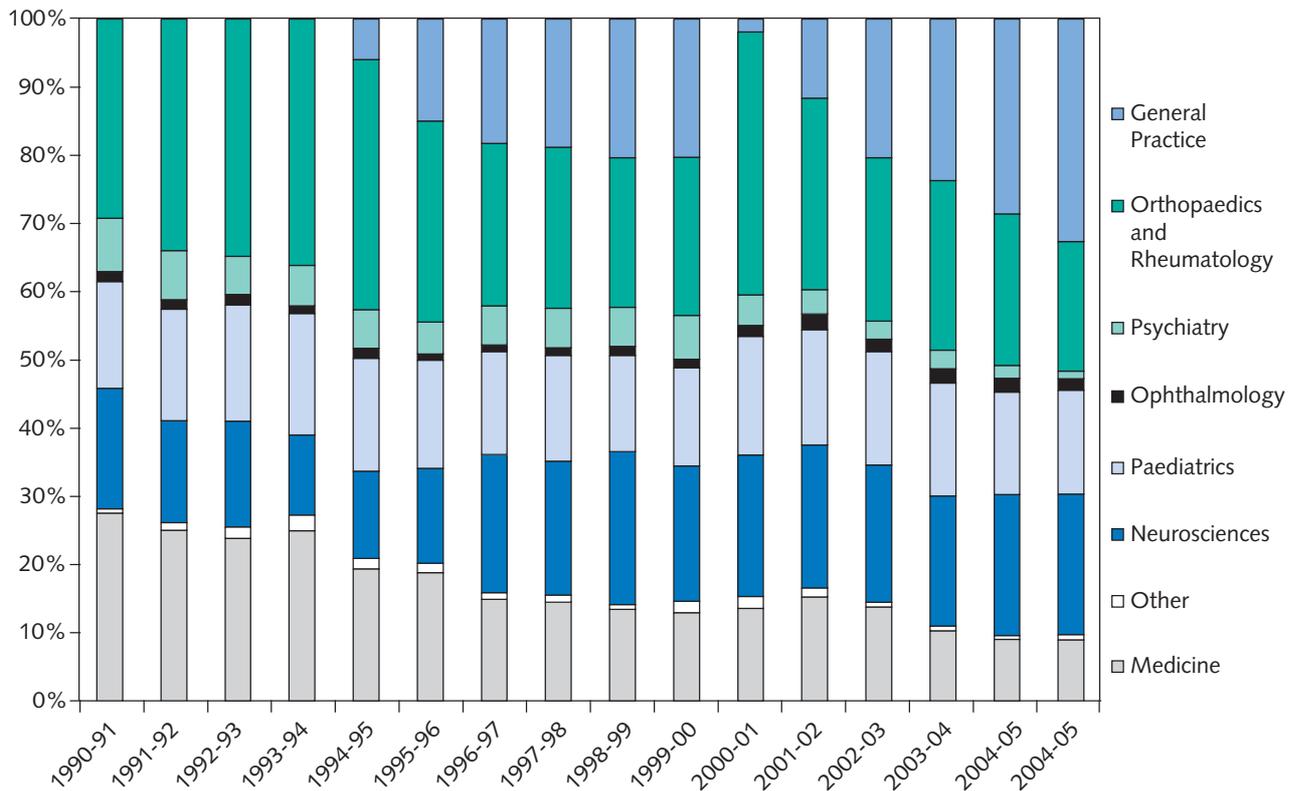
The levers and incentives introduced by the health reforms provide the opportunity for more effective commissioning and delivery of clinical neurophysiology services including the use of local tariffs and practice based commissioning. This is a transformational document to encourage each local clinical neurophysiology service to become self improving and deliver a quality service which results in a better experience for patients. It will be of interest to providers and commissioners alike.

# Vision and context for clinical neurophysiology services

1. Clinical Neurophysiology is one of eight diagnostic specialties recognised in the National 18 Week Physiological Measurement Programme together with:
  - Audiology
  - Cardiac Physiology
  - Gastrointestinal (GI) Physiology
  - Ophthalmic and Vision Science
  - Respiratory and Sleep Physiology
  - Urodynamics
  - Vascular Technology.
2. As outlined in the DH document 'What is Physiological Measurement?', the overall vision for the future of these diagnostic services, is that they should:
  - Be patient centred
  - Realise the benefits of new technology
  - Be streamlined and efficient within Referral to Treatment (RTT) pathways of 18 weeks by December 2008
  - Be delivered closer to home
  - Provide excellent patient information
  - Be accessible from primary as well as secondary care.
3. Understanding the role of diagnostics in the future delivery of low-wait healthcare is essential if the rate, flow and distribution of patients throughout the elective and non-elective systems is not to be compromised. By utilising appropriate diagnostic tests, sequenced correctly (in primary care if the quality of the test can be maintained and if it is appropriate for patients, or by making tests directly accessible and bookable by primary care practitioners), there will be potential to match demand with real capacity.
4. Clinical neurophysiology involves the diagnosis of a wide range of conditions affecting the central and peripheral nervous systems, with tests being utilised in patient pathways for a variety of specialties including neurology, orthopaedics, paediatrics, ophthalmology and rheumatology. The diagram in Figure 1 shows the changing proportion of workload since 1990/91 attributable to each referring specialty at Kent and Canterbury Hospital, which is typical of a medium sized District General Hospital (DGH).

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1 'What is Physiological Measurement? A guide to the tests and procedures conducted by Physiological Measurement diagnostic services' DH (May 2007) Located at [www.18weeks.nhs.uk](http://www.18weeks.nhs.uk) within the physiological measurement section.



**Figure 1: The changing contributions of referring specialties to clinical neurophysiology at Kent and Canterbury Hospital, a typical DGH. (Neurosciences include neurology, and may be referred to by the latter term in other trusts). Numbers of tests have increased over the period, so a smaller proportion of referrals does not necessarily imply a reduction in number of tests.**

5. The main tests undertaken in clinical neurophysiology diagnostic services are<sup>2</sup>:

- **EEG (Electroencephalography)** is a recording of the electrical activity of the brain and is used in the investigation of various neurological conditions such as epilepsy, cerebrovascular disease, intracranial infections, metabolic disorders, dementias and other neurodegenerative disorders.

- **Peripheral neurophysiology** has two aspects, which can be used together or independently to investigate, for example, the presence or absence of carpal tunnel syndrome or neuropathies:
  - **Nerve Conduction Studies (NCS)** involve electrical stimulation of peripheral nerves with recording of responses from nerves and muscles.

2 Further details can be found in Annex 1

It is used to investigate, for example, focal neuropathies such as carpal tunnel syndrome, or generalised neuropathies.

- **Electromyography (EMG)** is an invasive procedure, involving insertion of a specialised needle into muscle, which investigates the causes of muscle weakness and a variety of disorders affecting the nervous system.
- **Evoked Potentials (EP) Visual, Brainstem Auditory and Somatosensory** are potentials produced by the brain in response to specific stimuli, for example a flashing light, sound, or electrical

pulse. They are used to assess the function of nerve pathways, especially in some neurological disorders such as Multiple sclerosis and optic nerve disorders.

6. Clinical neurophysiology services are commonly commissioned from the acute sector and most of the tests are provided for outpatients, although some are provided for patients from other Trusts and for patients directly referred from primary care, usually for suspected carpal tunnel syndrome. A range of services are also provided for inpatients. A typical division of workload is shown in Figure 2.

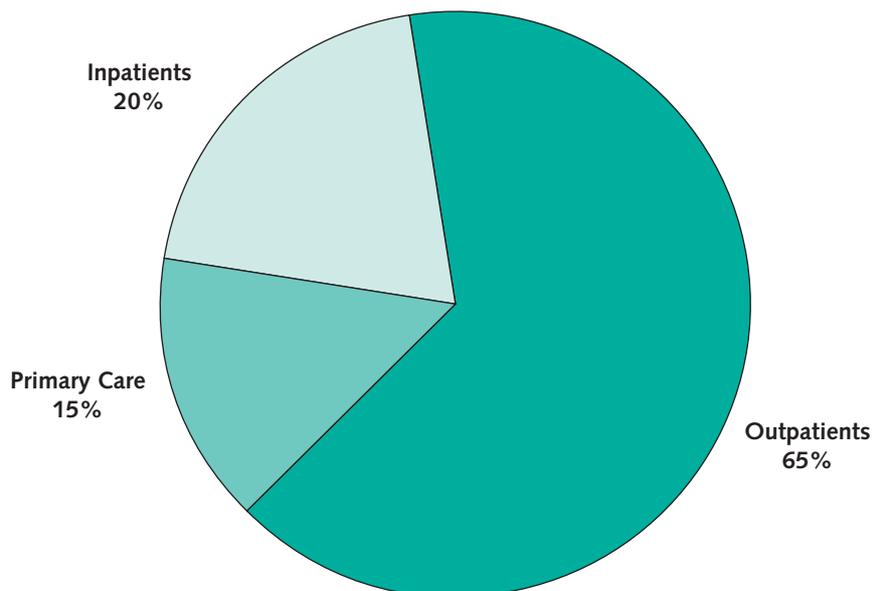


Figure 2: A diagram representing the division of workload in a typical clinical neurophysiology department in a DGH.

7. Demand for EMG and NCS has been steadily increasing over the past 10 years, whereas the number of requests for EEG and Evoked potentials has not changed significantly over the same period<sup>3</sup>. Currently there is variable accessibility to clinical neurophysiology services, evidence of long patient waits and variable outcomes.

8. To transform clinical neurophysiology services, there is a need to improve timely access to services of the highest quality, through innovative work practice in strong multidisciplinary teams based in a range of settings for the tests listed. Figure 3 shows an illustration of the relationship between request, diagnostic test and workforce, which are all interdependent.

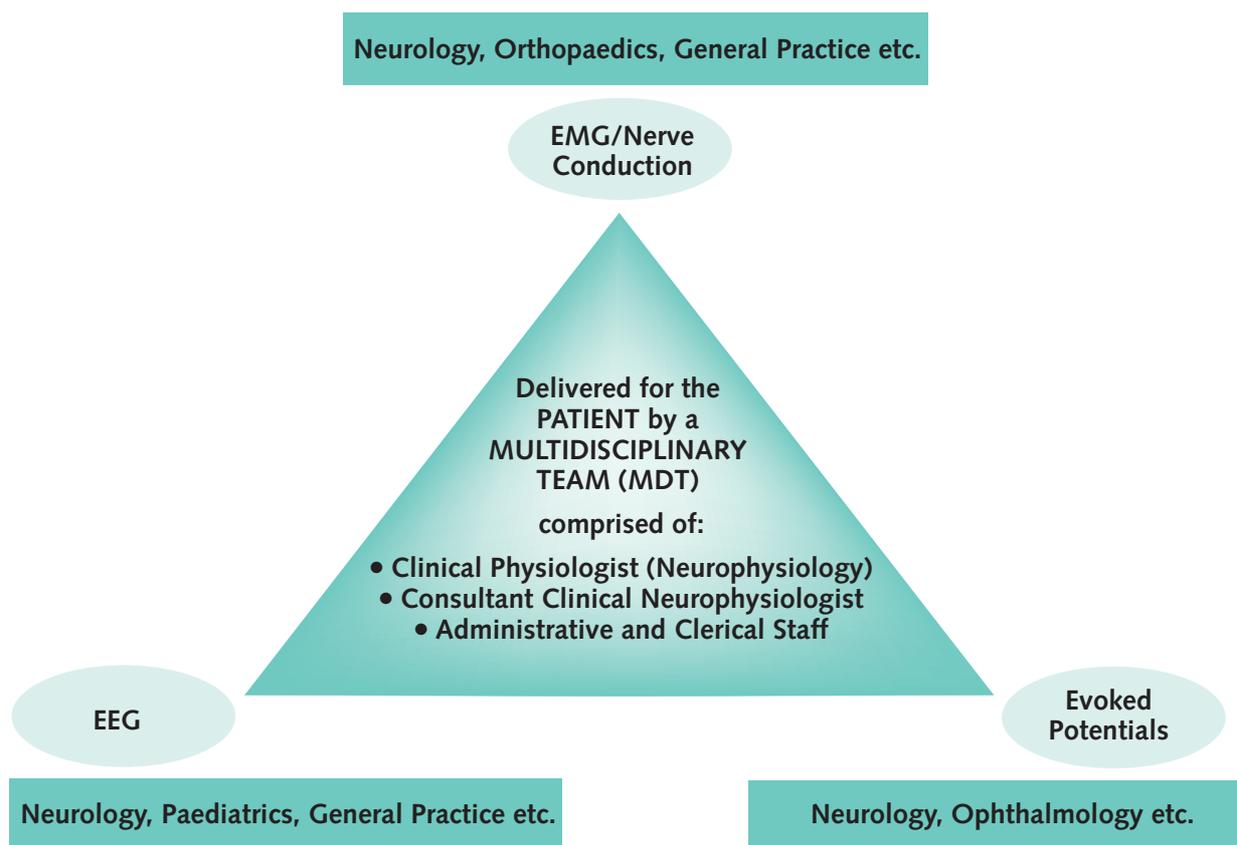


Figure 3: A diagram showing the relationship between requesting speciality, diagnostic test and workforce in a clinical neurophysiology department.

3 Data and indications from a number of NHS clinical neurophysiology departments

### Scale of the challenge

9. Clinical neurophysiology departments play a key role in the investigation of presenting symptoms in a number of disease areas and for a number of different specialities as outlined earlier. Details of incidence and prevalence of common conditions where clinical neurophysiology tests are utilised are shown in Figure 4 and imply that a total of over 2 million people in England have a condition which could potentially benefit from investigation with approximately 400

new cases per 100,000 population incident each year. Service providers and commissioners should draw on this information to develop an understanding of the needs of their local populations and to enable them to plan appropriately. References for this data in this table can be found in Annex 2.

10. Although the demand for clinical neurophysiology services has been increasing, the 2006-7 intervention rate (number of tests per 1,000 population) for peripheral neurophysiology in England is

Condition	Incidence (New cases per year per 100,000 population)	Prevalence (Cases per 100,000 of population)	Approximate Total Numbers (UK)	Primary Test used for investigation of condition
<b>Carpal Tunnel Syndrome (1)</b>	Women – 193 Men – 88	7,000–15,000	600,000	NCS
<b>Ulnar mono-neuropathy (1)</b>	Men – 25 Women – 19	N/A	N/A	NCS/EMG
<b>Epilepsy (2,3)</b>	49	500	182,750–425,000	EEG
<b>Inherited Neuropathy (4)</b>	N/A	40	23,600	NCS/EMG
<b>Acquired Neuropathy (5,6)</b>	69	2,400	N/A	NCS/EMG
<b>Motor Neurone Disease (7,8)</b>	1-2	4-6	4,000	NCS/EMG
<b>Multiple Sclerosis (9)</b>	3.4	95	52,000–62,000	EPs
<b>Neurological Symptoms without defined disease (10)</b>	75	N/A	750,000	Any Test

Figure 4: A table showing the main drivers of demand for clinical neurophysiology services (references can be found in Annex 2).

only 2.7<sup>4</sup>, with other countries reporting rates of between 4 and 10. The reason for the international rates being higher can be related to a number of factors including a larger workforce in clinical neurophysiology, a greater proportion of private providers, the existence of a fee for service system and greater historical use of ambulatory diagnostics. However, to meet the changing prevalence and incidence of conditions where the investigations may play a useful role the current intervention rates may need to increase, based on the requirements of local populations and commissioning agreements.

### Clinical neurophysiology and 18 weeks

11. The 18 week access target is different from previous waiting time targets and will directly impact on clinical neurophysiology departments. Instead of focusing on a single stage of treatment (such as outpatients or inpatients), the 18 week pathway addresses the whole patient pathway from referral to the start of treatment. Diagnostic services in general and clinical neurophysiology services in particular have developed long waits and have had less attention placed on them, but the 18-week patient pathway shines a

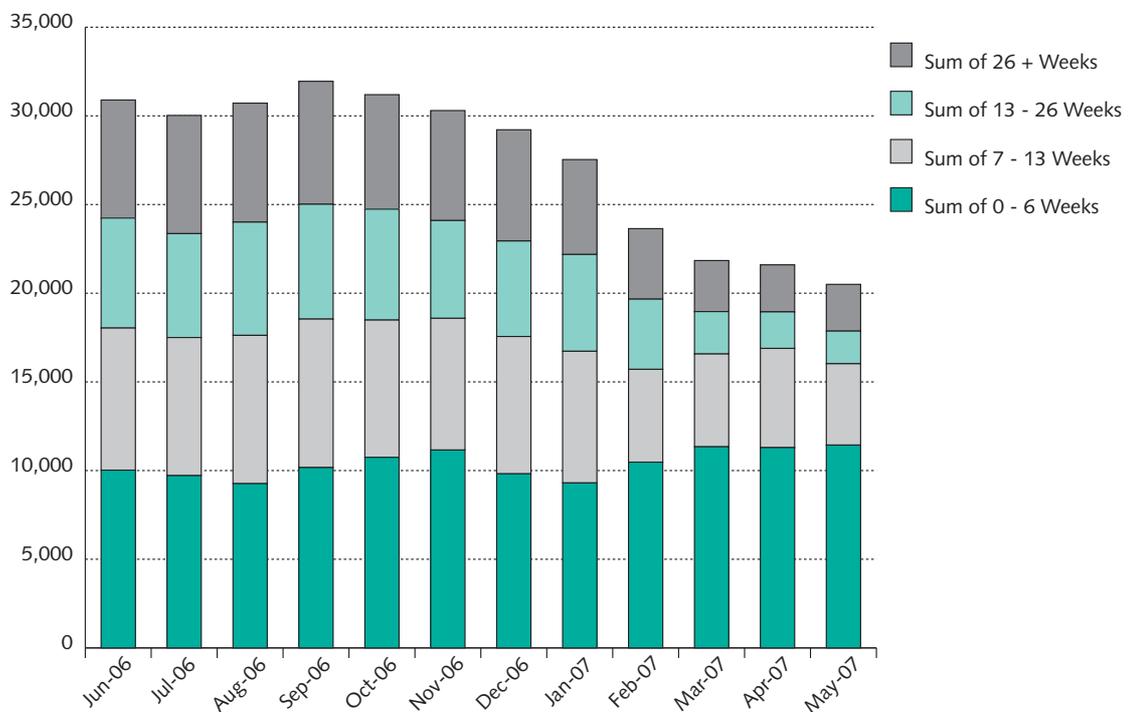
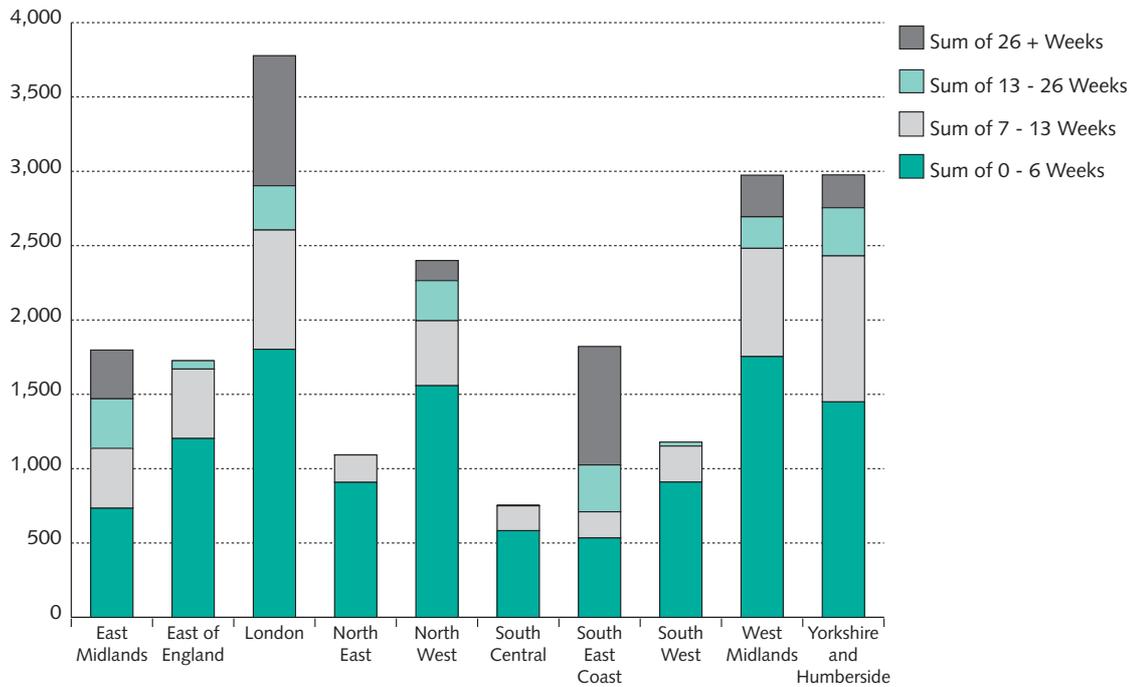


Figure 5: A chart showing the change in the number of waiters for peripheral neurophysiology tests between June 2006 and May 2007<sup>5</sup>.

4 Department of Health Diagnostics Census Data from 2006

5 Monthly Diagnostic Census from June 2006 to May 2007 – Department of Health



**Figure 6: A chart showing the regional variation, by SHA, in the number of waiters for peripheral neurophysiology tests in May 2007.**

light on this so called “hidden wait” requiring service providers and commissioners to think and act differently.

- In January 2006 a monthly diagnostic data collection was introduced for all peripheral neurophysiology tests (NCS and EMG) which revealed the extent of the waits. Over the last year, there has been a reduction in the number of long waiters in clinical neurophysiology, but there remain over 20,000 people on waiting lists, with 4,000 of those waiting over 26 weeks. Figure 5 shows the waiting list profile over the last year for peripheral neurophysiology tests, and Figure 6 breaks the number of waiters in May 2007 down

by SHA, demonstrating the extent of the variation across the country.

- The quarterly diagnostic census also collects waiting time data on a greater range of clinical neurophysiology tests and reveals that there are also long waits in other parts of the service, particularly EEG (with 1,250 patients waiting over 6 weeks in March 2007).
- The Operating Framework for the NHS for 2007/08 set milestones for provider organisations to achieve in advance of the December 2008 target, which re-emphasise the need for continued and sustained improvement in clinical neurophysiology diagnostic services.

**15.** The key milestones to be achieved by the end of March 2008:

- >85% of pathways where patients are admitted for hospital treatments should be completed within 18 weeks
- 90% of pathways that do not end in an admission should be completed within 18 weeks
- 6 weeks maximum wait for all diagnostic tests (whether as part of 18 week pathways or provided as direct access services).

**16.** These milestones will require a significant reduction in the current long waits in the system and are a significant challenge to the NHS as a whole. Clinical neurophysiology departments will need to undertake appropriate planning to make sure capacity is available both to clear current backlogs and to operate a sustainable low wait service in the future.

### *Purpose of this document*

**17.** This good practice guidance document is largely based on the experiences of DH NHS Physiological Measurement Development Sites<sup>6</sup> and other NHS sites and services that have demonstrated improvements and tested innovative

delivery models and solutions to improving access and reducing waits for clinical neurophysiology services during 2006/07, together with the work of a Clinical Neurophysiology Leadership Group (CNLG)<sup>7</sup>.

**18.** Good practice in clinical neurophysiology services as outlined in this document will:

- Challenge existing practice and pathways so that patient outcomes and experience are improved
- Maximise transformational change opportunities within provider units so that service meets patient needs
- Minimise risks to patients and staff in taking forward change
- Utilise service improvement techniques
- Support commissioners to deliver 18 weeks across all care pathways.

**19.** Implementing good practice models will help to deliver a high quality service, in which staff are competent to undertake investigations appropriately in differential diagnosis. Results are interpreted correctly and the workforce is equipped and competent to deliver services in a variety of settings, with clinical leadership driving innovation, redesign and sustainability.

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<sup>6</sup> A list of the Development Sites, the ideas they tested and sources of other ideas is provided in the Acknowledgements. Full case studies from each development site are available on the 18 weeks website.

<sup>7</sup> A group of representatives from the British Society of Clinical Neurophysiology (BSCN) and the Electrophysiological Technologists Association (EPTA)

# How to achieve the vision and context

20. Clinical neurophysiology services may be transformed by using existing knowledge about improving NHS *systems and process*, bringing together evidence about *innovative technology* and providing the training to enable a competent productive *workforce to deliver the right processes at the right skill level* (all shown in Figure 7). Each of these key themes is covered separately in the following paragraphs.

## Systems and processes

21. A substantial amount of additional capacity can be realised by improving systems and processes within clinical

neurophysiology departments. The following paragraphs detail how benefits can be gained from collecting data, understanding capacity, managing demand, booking patients and carrying out lean analysis.

## Collect data about clinical neurophysiology services

22. Providers and commissioners are required to submit data to the Department of Health on a monthly basis for all peripheral neurophysiology tests<sup>8</sup> and on a quarterly basis for all other clinical neurophysiology tests<sup>9</sup>.

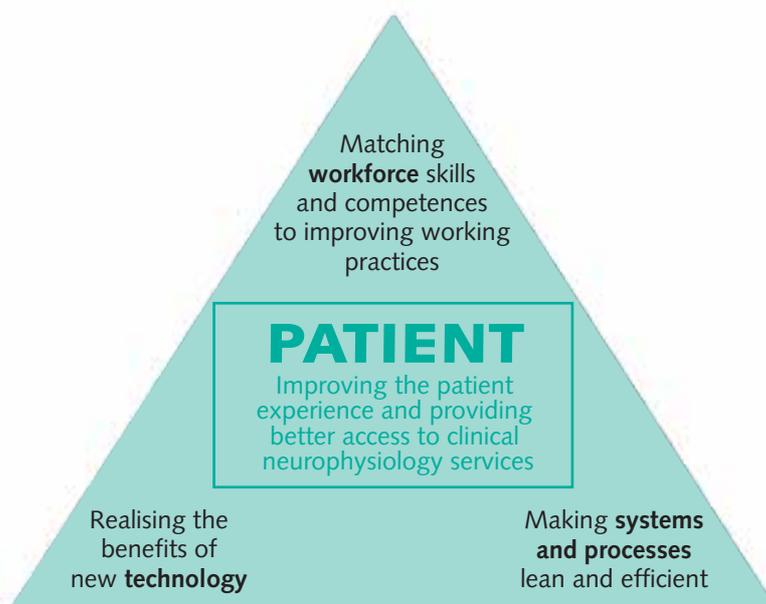


Figure 7: The key delivery levers for achieving the vision for clinical neurophysiology services.

8 Data can be accessed at <http://www.performance.doh.gov.uk/diagnostics/index.htm>

9 DH Review of Central Returns (ROCR) reference number: ROCR/OR/0168/FT6/001

23. Many clinical neurophysiology departments have poor data management systems and are not designed to capture the information required to inform the 18 week diagnostic collection. Improvement in this key area is likely to make a significant difference to delivery and also to the ability of individual departments to understand their service and plan for the future, although relatively simple software solutions can be introduced which would improve the current situation.
24. In order to understand the scale of the challenge for NHS services, commissioners should work with providers to ensure they:
- Collect and analyse demand data, against agreed lists, in order to determine the rate of referral, and to be aware of demand changes
  - Maintain data sets, which record the type of referral, referral source including speciality, referral date, appointment date, attendance record, and waiting/clearance times.
- Understand capacity*
25. Commissioners and providers should have an understanding of the capacity of their departments. Choose and Book will require clinical neurophysiology departments to understand their “production function” – i.e. the number of tests they can theoretically carry out, related to specific numbers of slots in a booking schedule.
26. In order to fully understand a service capacity and how it relates to demand for clinical neurophysiology services, providers need to:
- Understand demand for the service and where it comes from
  - Know the number of diagnostic sessions and slots available for each test
  - Utilise and analyse data to inform service redesign and models of provision to ensure that access is improved and that patient flow is balanced into and out of the service.
27. A *Physiological Measurement 18 Weeks Productivity Tool*<sup>10</sup> has been made available (a screenshot is shown in Figure 8), which uses a number of simple inputs to allow an estimate to be made of departmental capacity. It then calculates clearance times based upon the services' current waiting list and an estimate of potential efficiency gains to be made. The tool assists with the two stage process of:
- Clearance of current backlog
  - Maintenance of a stable schedule for a “low wait” diagnostic service.

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10 The tool can be found at:  
<http://www.18weeks.nhs.uk/public/default.aspx?main=true&load=ArticleViewer&ArticleId=945>

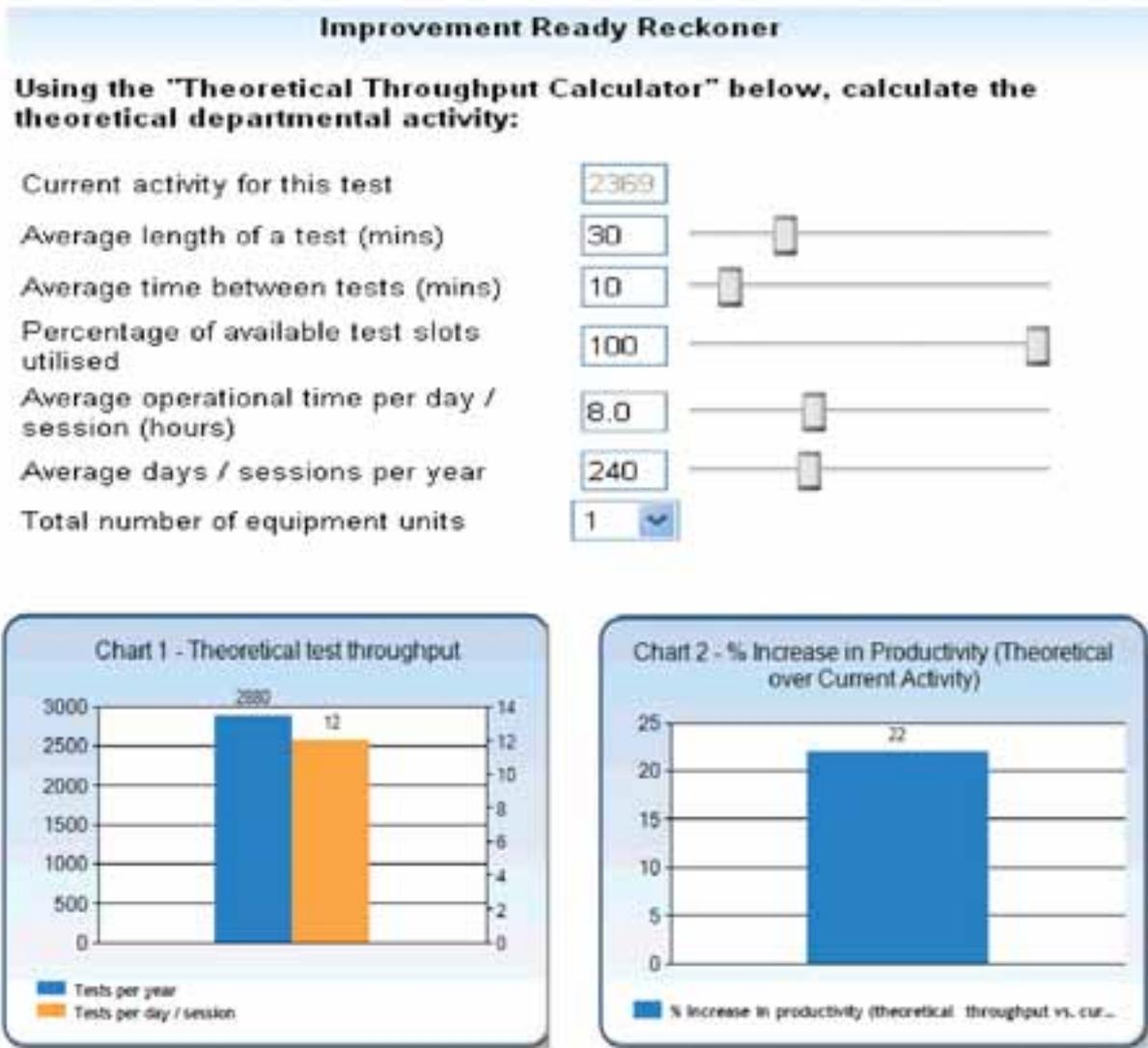


Figure 8: The Physiological Measurement 18 Weeks Productivity Tool: Simple inputs are entered regarding the length of each test and operational time available. Chart 1 shows the theoretical throughput in terms of tests using this information. Chart 2 shows a percentage increase from current activity. Both charts update automatically as inputs are altered, to model how extra capacity could be released.

**28.** If there is insufficient capacity to see the required number of patients in the time available, contingency measures may need to be implemented. These could include:

- Creating additional capacity by increasing the hours of operation – this is the most effective way of increasing capacity for marginal cost and also potentially provides appointment slots when it is more convenient for patients (i.e. evenings and weekends)
- Validation to exclude duplicates e.g. those that have been seen, no longer need care or have died
- Pooling of patients into single lists where possible
- Agreements with neighbouring trusts
- Exploring options with the independent sector.

### *Manage demand, including introducing referral criteria*

**29.** Patients are likely to present to primary care with a range of symptoms, which may suggest a possible condition that could be determined by carrying out a clinical neurophysiology test. The table in Figure 9 sets out a summary of common presentations and associated tests and may be used by primary care practitioners

to inform patient assessment and referral. Standardised referral criteria across a network can assist with consistency and ensuring best use of valuable resources. This could be built into local referral documentation which includes other relevant information relating to the patient which will further help to establish the range of tests that may need to be undertaken and the requirement for input by different members of the multidisciplinary team in clinical neurophysiology.

**30.** From the end of July 2007, primary care providers are able to select clinical neurophysiology tests via the Choose and Book Directory of Services. The Choose and Book form for clinical neurophysiology is included at Annex 3 and demonstrates the type of information that can help to make an effective referral. The forms can also be found on the Choose and Book website<sup>11</sup>.

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11 <http://www.chooseandbook.nhs.uk/staff/implementation>

PRESENTATION	LIKELY CONDITIONS	USEFULNESS OF CLINICAL NEUROPHYSIOLOGY	APPPROPRIATE TESTS TO USE
Tingly Fingers	Carpal Tunnel Syndrome (CTS)	High	NCS
	Ulnar Neuropathy	High	NCS/EMG
	Radiculopathy	Medium	NCS/EMG
Sensory Loss	Neuropathy	High	NCS/EMG
	Inherited Neuropathy	Medium/High	NCS/EMG
	Acquired Neuropathy	High	NCS/EMG
	Elderly Patients Neuropathy	Low/Medium	NCS/EMG
	Diabetic Patients Neuropathy	Low	NCS/EMG
Weakness	Motor Neurone Disease	High	NCS/EMG
	Myopathy	High	NCS/EMG
	Myasthenia	High	EMG/sfEMG*
	Spinal Disease	Medium	EMG/SSEP**
Disorders of Consciousness	Epilepsy	High	EEG
	Non-Epileptic Attack Disorder	High	EEG
	Sleep	Medium	EEG
	Coma	Medium	EEG
	Migrane	Low	EEG
	Syncope	Low	EEG

\* sf: Single Fibre

\*\* SSEP: Somatosensory Evoked Potential

*Note. Patients' present with symptom complexes [column 1]; diagnoses are made on the basis of the test as above and a clinical opinion*

**Figure 9: A table showing the usefulness of clinical neurophysiology for common symptom groups to provide a guide for primary care.**

31. Most clinical neurophysiology diagnostics are provided following an outpatient consultation with a specialist within the acute Trust setting, and a significant amount of acute inpatient work also occurs on a daily basis. Improved access to diagnostic tests directly from primary care is also essential, assuming agreed referral criteria are in place. Effective referral criteria will support the management of these various sources of demand and are a key element of service transformation processes. They help to support not only equitable provision, but also ensure that patients with defined symptoms flow into the most appropriate service.
32. The Royal Free Hampstead NHS Trust have developed and implemented a referral protocol with local GPs, encouraging direct access into services, as detailed in the following case study.

### **CASE STUDY: THE ROYAL FREE HAMPSTEAD NHS TRUST**

#### **“One stop clinic for ‘tingly fingers’”**

The Royal Free Hampstead NHS Trust developed, tested and agreed referral criteria, with ten GP’s, which enable patients with tingly fingers to be referred into a one stop clinic. In the clinic, nerve conduction studies are performed by CPN’s, reported by the CCN and a treatment plan made. An appointment with an orthopaedic surgeon in his outpatient clinic (moderate or severe CTS) or provision of splints (mild CTS) occurs on the same day as the test.

The key benefit of this model of care is that patients only have one appointment at the hospital instead of three, providing a superior patient experience and less administration and a reduction in waiting times from 26 weeks to 13 weeks for the Trust, enabling more effective use of capacity and lower waiting times.

The referral form for this clinic is reproduced in Annex 4

33. The information in the case study above shows what it is possible to achieve and needs to be used with the existing referral criteria developed for specific tests to ensure the development of appropriate thresholds for referral into clinical neurophysiology departments.

### Implement booking systems

**34.** Having built an understanding of capacity and demand and implemented clear referral criteria, clinical neurophysiology departments may benefit from implementing booking systems, which could consist of:

- A booked in advance service to outpatients, rather than an ad hoc on demand service, which is an inefficient use of staff time
- Improved management of DNAs through a clear and consistently applied DNA policy and booking at short notice into cancelled slots
- Innovative ways of calling patients for appointment and reminding them of the date.

**35.** Effective booking will be achieved if adequate patient information is included on the referral form. This will help to speed up processing and ensure any tests that are required can be completed without delay, including reporting and interpretation, to support informed clinical decision making.

**36.** Booking systems can also be improved by:

- a) Reviewing existing internal paper-based referral systems and redesigning them to enable all bookings to be made

chronologically by date of referral and not date received by the department

- b) Validating all waiting lists to eliminate any duplicate entries, to free up capacity which otherwise would be lost.

**37.** Scheduling or booking arrangements should be as efficient as possible and all available capacity appropriately managed and utilised where possible by dedicated administrative staff, as outlined in the case study below.

#### **CASE STUDY: PENNINE ACUTE TRUST (NORTH MANCHESTER GENERAL HOSPITAL)**

**“Use of administrative and clerical staff to manage waiting lists on a day to day basis and drastically reduce DNA rates”**

Pennine Acute Trust transferred responsibility for waiting list management from clinical physiologists to suitably trained administration staff; this allowed more productive use of clinical physiologist time. Partial booking and strict rules on DNAs were also introduced, which resulted in a decrease in the DNA rate from 18% to between 3-5%, and a measured increase in clinical capacity.

**38.** Clinical neurophysiology services are encouraged to introduce a patient tracking list (PTL) to manage reductions in current waiting lists, and to work towards a

complete pathway approach from GP referral to start of treatment. Guidance on the implementation of PTLs is available on the 18 weeks website<sup>12</sup>.

### *Implement lean solutions*

- 39.** There are advantages in the use of “Lean” process methodology. Lean is an approach to improve flow and eliminate waste that was developed by Toyota. Lean is about getting the right things to the right place, at the right time, in the right quantities, while minimising waste and being flexible and open to change. Service model improvement stems from adopting a lean system design approach and fully using the resources that are available in clinical neurophysiology departments. A major way to achieve improved use of resources is to undertake a local process mapping exercise<sup>13</sup>. This could lead to improved workflow, better understanding and use of patient management systems and greater efficiency of all staff, with better team working<sup>14</sup>.
- 40.** Lean solutions may hinge on more effective ways of working, for example by implementing measures to maximise use of clinician time, as illustrated in the following case study.

#### **CASE STUDY: THE ROYAL FREE HAMPSTEAD NHS TRUST**

##### **“Process mapping of patient journeys for Carpal Tunnel Syndrome (CTS)”**

The Royal Free Hampstead carried out process mapping of the patient journey for CTS. This enabled staff to identify where delays occurred and to improve both administration of appointments, referral criteria and offer direct access to GP’s. The patient pathway was reduced to one hospital visit, including an outpatient consultation with an orthopaedic surgeon and NCS for the investigation of Carpal Tunnel Syndrome.

### *Technology*

- 41.** Embracing the benefits of new technology is critically important in delivering services for 21st century healthcare as highlighted by the Health Industries Taskforce<sup>15</sup>.

#### *IT Solutions for Clinical Neurophysiology*

- 42.** Clinical neurophysiology departments utilise a range of IT systems and there is no consistent approach across sites. Some departments have developed innovative approaches to managing information, such as in the case study below:

12 Full details about the PTL methodology can be found at <http://www.18weeks.nhs.uk/public/default.aspx?load=ArticleViewer&ArticleId=947>

13 Several development sites have undertaken this exercise

14 <http://www.institute.nhs.uk/ServiceTransformation/Lean+Thinking/>

15 DH Strategic Implementation Group, Health Industries Taskforce ‘Innovation for health: making a difference

## CASE STUDY: EAST KENT HOSPITALS NHS TRUST

### “Electronic diary and record keeping database”

The clinical neurophysiology department at Kent & Canterbury Hospital has developed and run an electronic diary and record keeping database since 1989. In developing these, clear distinctions were made between the two types of computer systems used in clinical neurophysiology.

- Administrative system used for appointment scheduling, report writing, record storage, management audit and research
- Technical software embedded in the equipment which performs the tests.

The administrative system is the hub and links to other hospital IT systems and the equipment in the department as illustrated in Figure 10, which shows the system links enabling all recordings made in the department to be accessed directly from within the administrative database (by loading whichever software is appropriate to the recording and retrieving the actual data from storage and passing it to the viewer software). The need for specialist software, for the viewing of EEG for example, restricts the availability of this facility elsewhere in the trust, though EEGSYS itself can be accessed from anywhere on the network by staff with the appropriate rights.

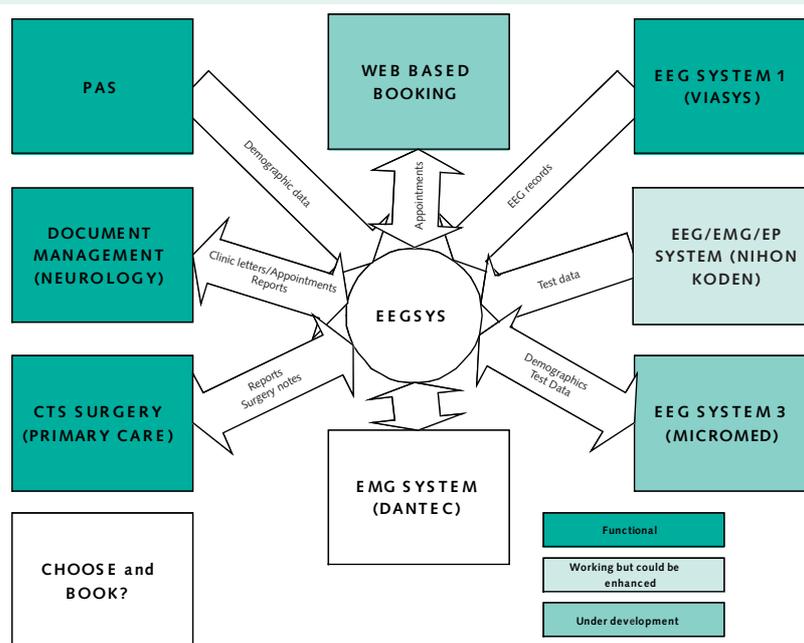


Figure 10: Diagram to illustrate the electronic system in use in the clinical Neurophysiology department at Kent and Canterbury Hospital and how this is linked to other systems.

The benefits of this system include:

- Immediate access from the neurology clinic to clinical neurophysiology reports
- Clinical neurophysiology investigations can be requested directly from the clinic, an appointment offered, agreed with patient and a subsequent follow up appointment made
- The clinical neurophysiology department can access clinic letters if more clinical information is needed at the time of the investigation
- Monitoring activity levels in department
- Referral management
- Service development
- Manpower planning
- Audit and research.

While this case study demonstrates the value of an IT hub for streamlining systems and processes, the diagram illustrates that more work is required to provide the functionality to enable test results to be directly obtained from the equipment it is generated on and for this information to be uploaded in the form of a clinical and technical report for use in differential diagnosis.

### *New technology*

43. There are several areas where new technology has the potential to improve clinical neurophysiology services.
44. New multifunctional digital equipment that combines nerve conduction studies, electroencephalography and evoked potentials allow distinct flexibility in service. Each clinical neurophysiology test

requires a specific function from the equipment and an appropriately located or screened room to undertake the test, therefore, only one investigation can be performed at a time. The ability to carry out multiple investigations in the same room has the potential to increase throughput and efficiency. Figure 11 shows a combined NCS/EEG/EP system.



**Figure 11: An example of multifunctional equipment used for NCS/EEG and EP.**

45. Use of computer technology to record the results of EEGs and video clips of clinical events have allowed the interpretation of the results at a remote site, enabling faster interpretation of results, leading to speedier diagnosis and treatment for the patient. Benefits of this technology include:

- Faster reporting
  - Records forwarded to competent neurophysiological interpreter rather than waiting for him/her to visit location
  - Ability to audit across wider areas/regions
  - Improved access for patients' since EEGs can be recorded outside usual departments closer to patient.
46. The bandwidth requirements for this technology are significant, so it is necessary to ensure that the appropriate provision of IT hardware and support for users and receivers are present.
47. The widespread use of inexpensive digital video with EEG and the advent of cheap digital storage for large volumes of data have greatly aided the analysis of clinical events during recording. Some of the latest advances include the introduction of portable equipment built around a laptop computer. This equipment can be used in a variety of locations, including close to the patient by appropriately trained and competent practitioners. An example of an interface is shown in Figure 12.



**Figure 12: An example of a digital EEG interface.**

**48.** There has been a distinct trend over past years for medical equipment to become smaller and more portable, increasing the ease of use in community or mobile care settings. Specifically in clinical neurophysiology (particularly in the USA) several hand held devices for quick and simple carpal tunnel testing have recently

been marketed. Some have been validated against conventional NCS and give reasonable results<sup>16</sup>. However, they are limited in the range of measurements they can make, and their absolute accuracy and clinical utility is still being fully evaluated. The technology requires further assessment, but should be kept under

16 Detail of the Mediracer device can be found in: Acta. Neurol. Scand 2007: 115: 390-397

review given its potential use in primary care. For other types of equipment used in clinical neurophysiology there is likely to be a limited improvement in portability due to the technical complexity of the equipment involved.

### *Implementation of new technology*

**49.** Challenges faced within organisations include the need to break with tradition/culture and apply a way of working that continues to look for a better way to deliver services to patients. This means keeping abreast of changing technology, not only for its potential to transform patient care but also for the opportunities and challenges it raises for workforce development. Associated with the introduction of all new technology is the need for standards and protocols for tests and reporting to ensure that high quality and safe services are provided for patients. Specifications for clinical neurophysiology tests will be published in the near future on the 18 weeks website.

## **Workforce**

### *Clinical neurophysiology workforce profile*

**50.** In every part of the NHS, the workforce is critical in implementing effective services with plans needing to be affordable and supported by significant role redesign, skill mix and productivity gains. There is a large variation in clinical neurophysiology staffing per unit population and per unit productivity. This leads to wide ranging

service models, with different levels of care for patients.

- 51.** Clinical neurophysiology diagnostics are performed by a small multidisciplinary team comprising of medical staff, clinical physiologists and support workers and administrative and clerical staff with variation in the level of staff who undertake specific functions within an individual department. There are variations nationally in staffing levels and workforce profiles and even departments with similar staffing levels and case mix do not all deliver the same level of activity.
- 52.** Reducing waits in clinical neurophysiology in a sustainable way to meet the milestones and achieve the access targets for 2008 will require a fundamental change in the way the multidisciplinary team work together. Multidisciplinary working in clinical neurophysiology has traditionally involved Clinical Physiologists in Neurophysiology [CP(N)s] performing EEGs and EPs, with Consultant Clinical Neurophysiologists [CCNs] interpreting results in relation to the clinical problem, as well as performing nerve conduction studies and EMG
- 53.** Opportunities for development of CP(N)s and other members of the non-medical workforce team in clinical neurophysiology need to be fully exploited in a multidisciplinary approach (where CCNs are often the clinical lead) for a number of reasons:

- CCNs are limited in number (with only low levels of growth expected in the coming years), requiring their specialist skills to be used effectively.
- CP(N)s have extensive skills and knowledge that could be further developed, enhancing their role and the tasks they can perform as part of a multidisciplinary team.
- Current capacity issues (and long waiting times) in clinical neurophysiology are often cited to be workforce related rather than a lack of suitable equipment or clinic space.

#### **CASE STUDY: IPSWICH HOSPITAL NHS TRUST**

##### **“Increase throughput by maximising clinician time for NCS clinics”**

To utilise Consultant time effectively staff at Ipswich Hospital ran parallel clinics for peripheral neurophysiology with 2 CP(N)s performing nerve conduction studies and one CCN supervising and performing EMG if indicated. One clinic was for CTS screening and one clinic for complex NCV, which may need EMG. This allowed 10 patients instead of 5 to be seen in a session. If the CCN was free, they reported on EEG's in any available time between patients. This enabled maximum use of valuable but scarce CCN time in a department with no full time consultant cover.

#### **New Roles**

54. A range of new and extended workforce roles have emerged recently in clinical neurophysiology, many of which have been tested within the development sites and other hospitals to support innovative solutions to address the long waits. These are summarised in Figure 13 and are related to some of the pathways developed around peripheral neurophysiology but do not cover the whole pathway. However they demonstrate the use of developing and expanding the roles of the workforce and utilising skill mix to achieve a more streamlined service.
55. The introduction of assistant and associate practitioner and other support roles means CP(N)s can be freed up from routine duties to undertake other specialist procedures such as ulnar nerve neuropathy and peripheral neuropathy nerve conduction studies, and intra-operative monitoring (IOM).

Neurophysiological investigation	New/extended role	Impact	Sites tested	Other sites using this model
<b>Administration and patient care</b>	Administration & Clerical Staff Assistant/Senior Assistant Clinical Physiologists (Neurophysiology)	Improved waiting list management Removing administration duties from more senior staff Preparing rooms and patients for tests Patient care within dept	Norfolk & Norwich University Hospital NHS Trust Pennine Acute NHS Trust	Ipswich Hospital NHS Trust
<b>NCS</b> Carpal Tunnel Screening (CTS)	Band 5 Clinical Physiologists (Neurophysiologists)	Focus provision of CTS NCS by clinical physiologists freeing up time for the CCN Increased capacity Decrease waiting times	UHB NHS Foundation Hospital Trust East Kent Hospitals NHS Trust	Majority of Clinical Neurophysiology depts are now using this model
<b>NCS</b> Ulnar and Peripheral nerve Screening	Band 6/7 Clinical Physiologists (Neurophysiology) <i>In conjunction with CCN</i>	Focus provision of NCS by clinical physiologists CCN involved only if EMG required Increased capacity Decrease waiting times	University Hospital of North Staffs NHS Trust Poole Hospital NHS Trust	e.g. City Hospital Birmingham Hammersmith Hospital NHS Trust
<b>EP and IOM Investigations</b>	Band 7/8a Clinical Physiologists perform low risk and routine cases	Freeing up time for the CCN to focus on more complex cases	Norfolk & Norwich University Hospital NHS Trust	Royal Free Hampstead NHS Trust University Hospital of North Staffs NHS Trust
<b>Reporting of EEG and NCS</b>	Band 7 Clinical Physiologists (Neurophysiologists) <i>In conjunction with CCN</i>	Provision of clinical reports for EEG/EP's and NCS for CTS in simple, routine cases Reduced waiting times for routine reports	University Hospital of North Staffs NHS Trust	e.g. City Hospital Birmingham Hammersmith Hospitals NHS Trust

**Figure 13: Table showing extended roles of the clinical neurophysiology workforce as tested by physiological measurement development sites.**

**CASE STUDY: NORFOLK AND NORWICH UNIVERSITY HOSPITAL NHS Trust**

**“A review of workforce functions to increase productivity”**

At Norfolk and Norwich, general housekeeping duties, patient care and administrative tasks are performed by an Assistant Clinical Physiologist (ACP) at Agenda for Change Band 2 or 3. This releases time for other staff to carry out tests and has resulted in increased throughput of patients by 10 per week.

56. The impact of developing extended roles for CP(N)s, for example in clinical reporting of EEGs and carrying out peripheral neurophysiology examinations, can be clearly demonstrated in the following two case studies:

**CASE STUDY: POOLE HOSPITAL NHS TRUST**

**“Clinical Physiologist (Neurophysiology) led ulnar neuropathy clinics”**

Poole hospital has implemented a CP(N) led ulnar neuropathy clinic since July 2006 with a period of clinical physiologist training provided by the consultant clinical neurophysiologists. Standards are constantly monitored with consultant re-examination available if requested by the CP(N). Waiting times for a consultant led clinic dropped from a maximum of 26 weeks to 10 weeks over a 9 month period and waits for a CP(N) led ulnar clinic are now 6 weeks.

**CASE STUDY: UNIVERSITY HOSPITALS OF NORTH STAFFORDSHIRE NHS TRUST**

**“Introduction of new and extended workforce roles”**

North Staffordshire Trust's Clinical Governance Board approved CP(N) to autonomously report NCS carpal tunnel syndrome studies, normal EEGs and evoked potential (EP's) investigations.

In addition a further extension to the CP(N) role is to perform NCS in ulnar neuropathies and peripheral nerve studies. There is no routine input from the consultant although clinical opinion is being provided by medical staff in the early stages of the project.

Use of Senior Assistant Clinical Physiology staff since 2003/4 to manage bookings and day to day coordination of the department further releases specialist staff to concentrate on more complex work and the development of extended role practitioners.

57. Integral to these two case studies is the need for CP(N)s to acquire the right skills and competences via appropriate education and training that underpins the knowledge required and which progresses consistent clinical governance. This education needs to be similar to the level and type of training undertaken by medical staff who may have traditionally undertaken these roles.

58. Extended and new roles for CP(N)s will need to continually evolve and develop further to include more complex peripheral neurophysiology as outlined in Figure 14. The skills to perform these extended roles will require the attainment of the necessary competencies developed in collaboration with CCNs who provide a clinical opinion based on both clinical neurophysiological data and the patient's clinical presentation. Through the creation of a truly multidisciplinary team, based on skills and comparable competences, there will be the opportunity to deliver the required range of tests and an enhanced, high quality service for patients.
59. Creative approaches to training and development will need to be developed in order to achieve flexibility in the workforce, which may include use of e-based learning opportunities and a network wide approach to training. In addition, clinical supervision and governance arrangements need to be put in place for all levels of staff.
60. There is strong evidence from the organisations cited in this document that one of the biggest success factors is due to inspirational leadership and a 'can-do' attitude. To achieve major change in workforce transformation, strong clinical and managerial leadership is essential.
61. Clinicians and managers play a key role in discussing how the service can be provided and it is important that all providers are involved in discussions relating to future provision.
62. Senior departmental staff have an opportunity to shape the local agenda by contributing to clinical neurophysiology network diagnostic groups to share good practice and agree locally negotiated solutions to current and future challenges.

### *Leadership*

60. There is strong evidence from the organisations cited in this document that one of the biggest success factors is due to inspirational leadership and a 'can-do' attitude. To achieve major change in workforce transformation, strong clinical and managerial leadership is essential.

Procedure	Stage of test	Associate Clinical Physiologists	Clinical Physiologists, CP(N)s	Advanced Practitioner
<b>Routine EEG</b>	Test and analysis Clinical opinion	routine practice	routine practice	development opportunity
<b>Prolonged/ complex EEG</b>	Test and analysis Clinical opinion	development opportunity	routine practice	development opportunity
<b>Telemetry</b>	Test and analysis Clinical opinion		routine practice*	routine practice* special interest development opportunity
<b>Intraoperative monitoring</b>	Test and analysis Clinical opinion		development opportunity	routine practice* special interest development opportunity
<b>Evoked potentials</b>	Test and analysis Clinical opinion	development opportunity	routine practice**	routine practice***
<b>NCS (CTS Only)</b>	Test and analysis Clinical opinion	development opportunity	development opportunity	development opportunity
<b>NCS</b>	Test and analysis Clinical opinion		routine practice	routine practice
<b>NCS/EMG</b>	Test and analysis Clinical opinion		development opportunity	development opportunity
	Test and analysis Clinical opinion		development opportunity	special interest development opportunity
	Test and analysis Clinical opinion			development opportunity
	Test and analysis Clinical opinion			special interest development opportunity

\* In departments that have this facility

\*\* Limited range of tests

\*\*\* Complete range of tests

Assistant Practitioners perform a range of tasks in support of other professionals including chaperoning, clearing up, electrode care, organisation of transport and so contributing to the patient experience.

CCNs and Specialist Registrars offer clinical opinions on tests performed by CP(N)s (EEGs, Evoked Potentials and NCS) as well as performing and reporting all aspects of peripheral neurophysiology tests.

**Figure 14: Table showing the current and potential roles of the clinical neurophysiology workforce.**

# Symptom based pathways

63. A number of symptom based 18 week commissioning flow pathways have been published across a whole variety of specialties. All of these pathways are available to download from the 18 weeks website<sup>17</sup>. Pathways of relevance to clinical neurophysiology include Blackouts; Pins & Needles and Numbness in Fingers.

64. Three additional pathways are presented in Figures 15, 16 and 17, highlighting areas of particular concern for clinical neurophysiology departments. A number of service models that have been illustrated earlier in this document form key parts of these pathways. They highlight the way forward for developing a more streamline approach for providing an efficient patient pathway within clinical neurophysiology departments.

Key points in relation to each of these pathways are:

- CTS pathway (Figure 15) is based on a one stop clinic to investigate pain/tingling/numbness in the hand in either a primary or secondary care setting and is practitioner led with referrals directly to the clinical neurophysiology department/provider
- Other Neurological Symptoms (Figure 16), this is similar to the CTS pathway but is adapted to offer a wider screening service for other neurological

symptoms. Some of this may be related to peripheral neuropathies (in particular ulnar entrapment at the elbow) and various types of peripheral neuropathy (i.e. diabetes), but up to 50% of peripheral neurophysiology work can fall into categories outside these. Delivery could be in primary or secondary locations although volume may be restrictive and may need a CCN in addition to the CP(N)

- EEG pathway (Figure 17) provides an initial route for the investigation of blackouts/seizures, when a routine EEG would be performed and, if results are equivocal, a sleep deprived appointment offered straight away. This could be arranged with the patient before leaving the department, cutting out a referral back to the specialist consultant until a second EEG has been done.

65. The three pathways highlight innovative ways of delivering care to patients attending clinical neurophysiology departments. They emphasise a number of key changes that departments can make to improve the flow of patients:

- Introduce effective referral protocols
- Provide clinical neurophysiology diagnostic services that are tailored for specific groups of patients

17 <http://www.18weeks.nhs.uk/public/default.aspx?load=Pathways#>

## CTS Pathway Primary/Secondary Care

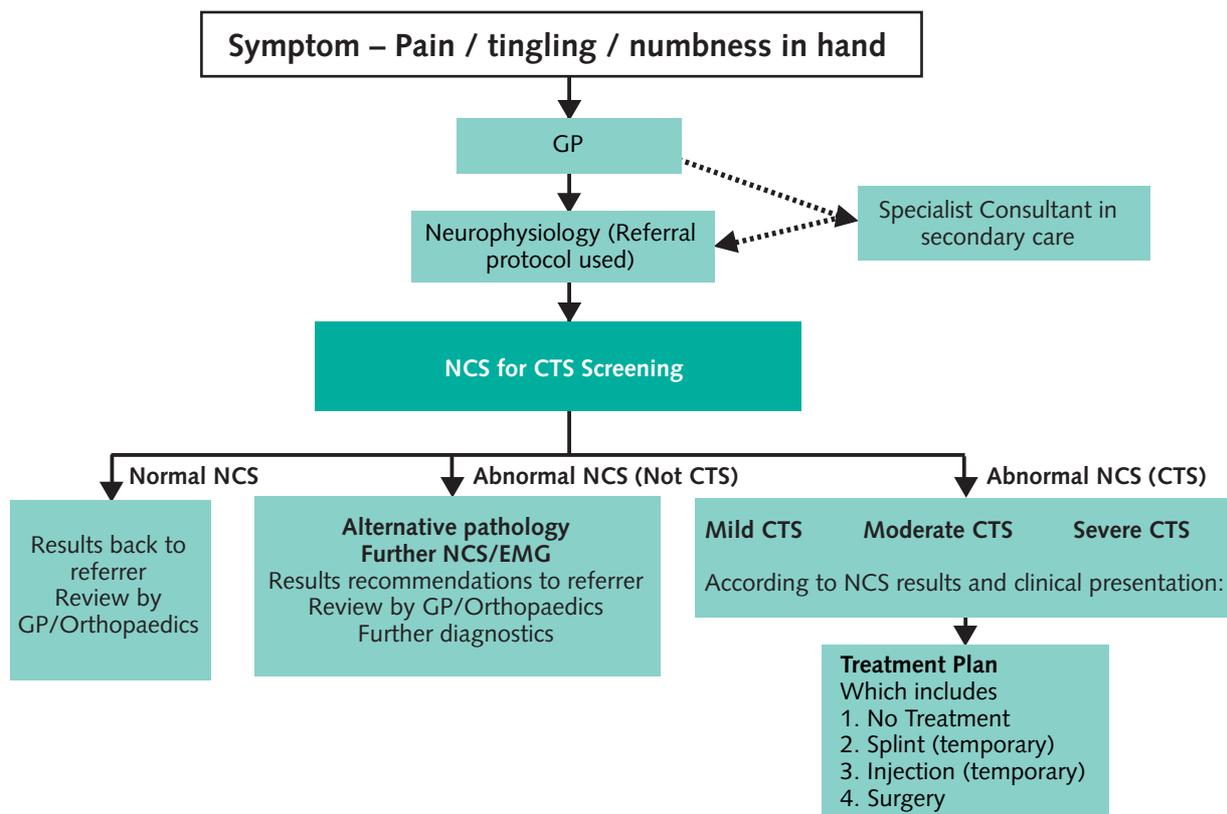


Figure 15: A diagram to illustrate a model pathway for CTS.

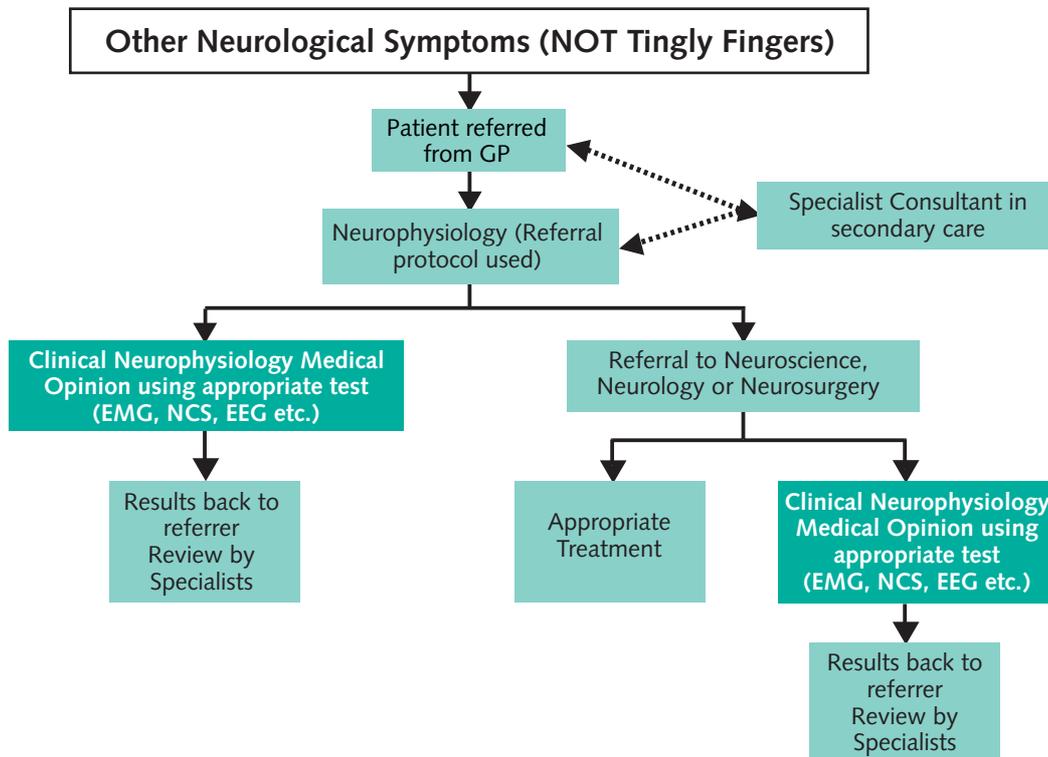
- Carry out assessments in advance of specialist consultant care where appropriate and perform further clinical neurophysiology tests if appropriate
- Provide treatment, where possible, at the same time as assessment.

These changes are covered in greater detail in paragraphs 66 to 69.

### 66. Introduce effective referral protocols:

- Referral protocols can be used to ensure appropriateness of referral and streamline patients with key conditions including those with suspected carpal tunnel syndrome and suffering from blackouts/seizures

## Other Neurological Symptoms Pathway Primary/Secondary Care



**Figure 16: A diagram to illustrate a model pathway for other Neurological Symptoms.**

- By using the Choose and Book directory of service referral form, primary care practitioners should be able to identify the pathway that the majority of patients will follow and choose the appropriate clinic slot.
  - An effective model is to establish clinics for groups of patients. This ensures that the most appropriate workforce is available to deliver the services required
  - An average of 50% of patients seen in clinical neurophysiology departments are attending for suspected CTS and they can be seen in a focused clinic. This could also apply to routine EEG and be run in conjunction with a specialist clinic (i.e. Neurology).
- 67.** Provision of clinical neurophysiology services that are tailored for specific groups of patients:



- 68.** Carry out patient assessments in advance of specialist consultant care where appropriate:
- A step can be taken out of a patient's journey by carrying out an assessment in a clinical neurophysiology department in advance of a specialist consultant appointment
  - Patients on each of the pathways detailed could benefit from a clinical neurophysiology assessment as a first step in their care pathway
  - Further clinical neurophysiology tests can be carried out without the need to refer back to specialist referrer, effectively cutting the time to treatment in some cases.
- 69.** Provide treatment, where possible, at the same time as assessment:
- Some pathways could end in clinical neurophysiology without the need for further investigation or care
  - For example, it will be appropriate to fit some patients with tingly fingers with a splint at the same time as their assessment which would be in conjunction with locally agreed protocols.

# Supporting commissioners and providers

70. Clinical neurophysiology can be provided and supported through a variety of models in addition to the current secondary care based service. This includes services in the community, including outreach sessions by clinical physiologists from the local hospital, and independent sector providers.

## CASE STUDY: UNIVERSITY HOSPITALS BIRMINGHAM

### “Provision of peripheral neurophysiology services in community outreach clinics”

One Birmingham PCT has funded the provision of a peripheral neurophysiology service within community outreach clinics. A triage protocol was agreed with GPs, enabling clinics to be booked at the PCT, therefore saving time and shortening the patient pathway. The service is provided by clinical physiologist practitioners of Agenda for Change Band 6 or above, fortnightly, in conjunction with a GP with a special interest in orthopaedics. Waiting lists reduced as 220 patients were seen in the first year, therefore helping the Trust to meet the 18 week target. Funding has now been secured to continue this service for 2 more years.

71. Clinical neurophysiology services should be commissioned to provide patients with services that are responsive to their needs and that empower patients to be good

partners in achieving those needs. Critical to this is ensuring that the guide to common symptoms investigated by clinical neurophysiology in Figure 9 and more detailed referral criteria are uniformly implemented across the main referral streams.

72. As part of the PCT commissioning cycle, all current and potential providers of clinical neurophysiology services (both NHS and independent sector) should be consulted in relation to adoption of the suggested referral criteria and new pathways outlined in this document.
73. Clinical neurophysiology tests currently do not have a separate tariff but are bundled in the out patient tariff. Access to tests and interpretation requires local agreement with a negotiated fee. Practice Based Commissioning together with the development of a local tariff for high volume tests, either by direct access to the hospital or providing the services in the community, are key levers to demonstrate the value of clinical neurophysiology services and facilitate their future development.
74. Development of a PCT and/or SHA wide network may be useful in helping to implement these pathways, spreading good practice and making best use of all available capacity.

**75.** Questions to ask when commissioning clinical neurophysiology diagnostic services include:

- Do we know that this service will provide the tests that we require?
- Does the service provider have a good clinical governance structure?
- How will quality assurance be carried out?
- Will there be a regular audit?
- How will the provider communicate with the referrer?
- Is there a way to ensure that the test report follows the patient on their pathway?

**76.** Suggested actions for SHA/18 week leads include:

- Understand the demand for local services (paragraphs 9 and 10 of this document can be used as a starting point)
- Know what the current gaps are in clinical neurophysiology for delivery of 18 weeks and the diagnostic milestones, for sustainable provision and to support organisations to close the gaps
- Commission education and training provision to deliver a workforce fit for the future to deliver the 18 week pathway.

**77.** Suggested actions for PCTs/Commissioners:

- Understand the demand in the local population to direct the right level of service to meet those needs
- Develop a clinical neurophysiology network to enable the sharing of ideas, development of standards for data collection and to support active clinical engagement in commissioning decisions
- Develop a robust quality governance framework for provision of clinical neurophysiology, including the community and independent sector
- Put mechanisms in place to commission appropriate workforce, including robust workforce planning for the future to deliver new models of care
- Provide a combination of service redesign and adequate capacity for the delivery of 18 weeks.

**78.** The models of service outlined in this document have been developed by a small group of experts. They have been designed both to stimulate discussion and to introduce new ways of working aimed at reducing waits and increasing access to clinical neurophysiology services.

# Acknowledgements

## Clinical Neurophysiology

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Peter Heath, University Hospital of North Staffordshire

David Allen, Southampton General Hospital

Jeremy Bland, Kent and Canterbury Hospital

The list below includes the Physiological Measurement Development Sites and ideas they tested, together with other organisations that have trialled best practice ideas.

### **East Kent Hospitals NHS Trust**

Committing to continuous service improvement

### **Norfolk & Norwich University Hospital NHS Trust**

Managing the clinical commitment to IOM surgery

### **Royal Devon & Exeter NHS Foundation Trust**

Extending the technologist/clinical physiologist role

### **Royal Free Hampstead NHS Trust**

Introducing direct access referral from primary care for patients with suspected carpal tunnel syndrome

Issuing splints directly to patients with mild carpal tunnel syndrome

### **University Hospital Birmingham NHS Foundation Trust**

Providing a peripheral neurophysiology service in primary care

### **University Hospital of North Staffordshire NHS Trust**

Introduce new and extended workforce roles

Other sites:

- Leeds Teaching Hospital NHS Trust
- Pennine Hospitals Acute NHS Trust
- Poole Hospital NHS Trust
- Ipswich Hospital NHS Trust
- Hammersmith Hospitals NHS Trust

# Annex 1:

## Further information on Clinical Neurophysiology Tests

### Overview of Electroencephalography (EEG)

The electrical activity of the brain (the EEG) can be recorded using either scalp (surface) or, in special circumstances, intracranial electrodes. The majority of studies are undertaken on an outpatient basis using scalp electrodes. Recordings may last from a half to several hours, particularly if a period of sleep is included. The principal indication for EEG is in the investigation and management of epilepsy and other disorders of consciousness. Since it is rare for brief recordings to capture a clinical attack, these EEGs are usually referred to as interictal recordings. Interictal EEG is used to support a clinical diagnosis of epilepsy and to classify the type of seizures and epilepsy syndrome, and include photic stimulation and hyperventilation with informed consent. EEG is also used in the diagnosis and management of other conditions such as coma, encephalitis and Creutzfeldt Jacob disease (CJD).

Specialised EEG investigations include ambulatory EEG and video EEG (telemetry) monitoring. These studies monitor the EEG for several days or weeks in an attempt to capture a clinical attack and characterise the associated EEG. Some patients, particularly those being considered for surgical treatment of intractable epilepsy, may require intracranial electrodes (depth or sub-dural electrodes) as part of video EEG studies.

### Overview of Nerve Conduction Studies and Electromyography (NCS/EMG)

The electrical activity of nerves and muscles can be recorded to assess their function, as a direct extension of the clinical history and neuromuscular examination. NCS/EMG studies provide useful information in the evaluation of motor and sensory nerves, from their nerve roots, through the brachial and lumbosacral plexi to the peripheral nerves, and in the case of motor nerves to the neuromuscular junction and muscles. The majority of NCS examinations are undertaken on an outpatient basis using surface stimulating and recording electrodes, whilst muscles are examined with invasive needle EMG electrodes. Recordings may last from a half to several hours. The principal indication for NCS/EMG is in the investigation of sensory symptoms (numbness, paresthesias and pain), weakness, muscle atrophy and fatigability. NCS/EMG studies are generally not helpful when such symptoms arise from disorders of the Central Nervous System, or when pain results from disease or injury that does not affect peripheral nerves.

## Annex 2:

# Complete references for incidence and prevalence information in paragraph 9

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# Annex 3: Choose and Book referral screen for clinical neurophysiology

## Choose and Book Neurophysiology Service Request Form

(N.B. Choose and Book referrals accompanied by incomplete forms may be rejected)

SECTION 1: PATIENT DEMOGRAPHIC DETAILS	
Patient NHS number:	UBRN:
Patient first names:	Patient last name:
Date of Birth (DD/MM/YY):	Gender: <input type="checkbox"/> Male <input type="checkbox"/> Female
Patient address (1 <sup>st</sup> line):	
Patient town / city:	Patient postcode:
Patient contact number:	Patient contact number 2:

SECTION 2: REFERRER INFORMATION	
First name:	Last name:
Referrer role:	<input type="checkbox"/> GP <input type="checkbox"/> On behalf of GP
GP Practice Code:	Referrer contact no:
GMC Registration No:	Referrer e-mail address:

SECTION 3: TEST SERVICE REQUEST	
Priority:	<input type="checkbox"/> Routine <input type="checkbox"/> Urgent
Is the patient currently on any medication? If yes, provide full details.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Does the patient have an infection or do they pose an infection risk to others?	<input type="checkbox"/> No <input type="checkbox"/> Yes
Test requested: (please tick one only)	
EEG <input type="checkbox"/>	
Nerve Conduction Studies <input type="checkbox"/>	<i>Please complete Section 4</i>
EMG <input type="checkbox"/>	<i>Please complete Section 4</i>
Provisional diagnosis (or symptoms and signs):	
Reason for request:	
Relevant clinical history:	

SECTION 4: COMPLETE FOR ALL NERVE CONDUCTION SCREENING OR EMG REQUESTS	
Does the patient have a cardiac pacemaker?	<input type="checkbox"/> No <input type="checkbox"/> Yes
Is the patient on Warfarin or any anti-coagulation medication?	<input type="checkbox"/> No <input type="checkbox"/> Yes

*If you have answered 'yes' to any of the questions above, please ensure that you include any relevant information in the clinical history section.*

# Annex 4: Royal Free referral form for one stop tingly fingers clinic

## ROYAL FREE HOSPITAL: REFERRAL FORM FOR ONE STOP CLINIC FOR TINGLY FINGERS

FAX DIRECTLY TO: [Phone #] [For attention of CP(N)]

Royal Free Hampstead NHS Trust

Department of Clinical Neurophysiology

Tel: [Phone #]

Referral Form – For Nerve Conduction Studies on Patients with Suspected Carpal Tunnel Syndrome

Patient's Name

DOB:

Phone number: (Home)

Address

Hospital Number

(Mobile)

Do you suspect that the patient is suffering from?

1. Carpal Tunnel syndrome?	Go to question 5
2. Ulnar neuropathy at the elbow?	Refer patient in the usual way
3. Generalised large fibre peripheral neuropathy?	Refer patient in the usual way
4. Is your referral for an alternative reason?	Refer patient in the usual way
5. Does the patient suffer from tingling/numbness of the whole hand(s), all the fingers or predominantly the outside of the hand?	
6. Is the tingling/numbness worse, or does it or wake the patient, during the night?	
7. Is the tingling eased by shaking the hand or by hanging it down?	
8. Does the patient have neck symptoms?	
9. Does the patient have permanent sensory loss or muscle wasting?	
10. Does the patient have neurological symptoms other than in the hand?	
11. Does the patient think that their occupation is responsible for their symptoms?	
12. Does the patient have Hand Arm Vibration Syndrome?	
13. Has the patient had an arm fracture in the past 6 months?	
14. Which hand is most affected?	

Referral form completed. Please sign and date. Fax directly to dept. [Fax #]









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