



# **Acute Neurological Emergencies in Adults**

**2002**

Published by the Association of British Neurologists  
Ormond House, 27 Boswell Street, London WC1N 3JZ

**Association of British Neurologists**  
**Working Party**  
**On Care of Acute Neurological Emergencies**

Dr Peter Humphrey (Chairman)

Dr David Bateman

Dr Martyn Bracewell

Dr Hannah Cock

Professor Alastair Compston

Dr Philip Nichols

Dr David Thrush

Dr Graham Venables

Dr Stephen Wroe

Dr John Saunders

(Royal College of Physicians of London Representative)

**Writing Committee**

Dr Peter Humphrey

Dr David L Stevens

# Summary

- 1.** At the present time the majority of adult patients with acute neurological illnesses are cared for by non-neurologists (pages 6-7).
- 2.** There are too few neurologists in the United Kingdom to provide a comprehensive service to acutely ill patients. Currently there are about 350 Consultant Neurologists, which gives a ratio of 1:177,000 in the population. This ratio compares very unfavourably with other European countries (page 8).
- 3.** The Association of British Neurologists believes that acutely ill adult patients with neurological disorders, who do not require immediate intervention, should be seen by a neurologist within 24-48 hours. (page 17). Ideally, if the patient is critically ill then they should be seen immediately (pages 17-18) and, again ideally, if they are less seriously ill, they should be seen within 24 hours (pages 18-19).
- 4.** All such patients should be under the care of a neurologist (pages 17-19).
- 5.** In order to provide this service across the country, an expansion in the number of Consultant Neurologists and an enhancement of the necessary investigative and other facilities is required (pages 24-27).
- 6.** It is current Association of British Neurologists policy that we need about 600 neurologists nationally, or a ratio of 1:100,000 simply to cope with the out-patient workload (page 24). This number would be insufficient to give a comprehensive acute service.
- 7.** An acute service, given primarily from either a Neurology Centre or a Neurology and Neurosurgery Centre, would not be comprehensive, but it would permit the presence of a neurologist in all hospitals from 9am to 5pm during the week, which would ensure that all patients were seen within 24 hours and that expert advice was available outside those hours by telephone (pages 22-23). To provide such a service would require about 1,000 neurologists, which gives a national ratio of 1:63,000 (page 25).
- 8.** To provide a fully comprehensive on-site full time service in all District General Hospitals (pages 20-21) would require about 1400 neurologists nationally, which is a ratio of neurologists to the population of 1:43,000 (page 24).
- 9.** Despite the need for a substantial expansion in the number of neurologists, none of the suggested ratios are anywhere near the average European value of between 1:18,000 to 1:35,000 neurologists to population (page 8).
- 10.** There is an urgent need for a rate of expansion in the numbers of neurologists that is far greater than the current figure of between 5 and 7% (pages 26-27). To achieve a ratio of 1:43,000 in 10 years would require an expansion rate of 18% per annum. (page 26).

# Contents

|           |   |           |
|-----------|---|-----------|
| <b>1</b>  | Introduction                                      | <b>4</b>  |
| <b>2</b>  | What is acute neurology?                          | <b>5</b>  |
| <b>3</b>  | Availability of neurologists                      | <b>8</b>  |
| <b>4</b>  | Is advice from a neurologist helpful?             | <b>12</b> |
| <b>5</b>  | Should neurologists be doing more?                | <b>13</b> |
| <b>6</b>  | Essentials for acute care                         | <b>15</b> |
| <b>7</b>  | Proposed organisation for acute neurological care | <b>17</b> |
| <b>8</b>  | Implications of this system of care               | <b>20</b> |
| <b>9</b>  | Manpower calculations                             | <b>24</b> |
| <b>10</b> | Conclusions                                       | <b>28</b> |
|           | References  | <b>29</b> |

# Introduction

The care of adult patients in the United Kingdom who are acutely ill with neurological problems is unsatisfactory. More often than not such patients are admitted to hospital as general medical emergencies and the majority of their immediate and subsequent care is delivered by the physicians on call, who are not neurologists.

The number of consultant neurologists in the United Kingdom has increased from 250 in mid 1995 to 358 in 2000, which has allowed a greater number of these acutely ill patients to be seen as ward referrals. However, there is no doubt that many patients with acute neurological problems are never seen by a neurologist, with the consequence that they are denied the opportunity to be seen by a specialist who could make a significant contribution to their management<sup>1,2</sup>. It is not only our view that such patients should be seen by a neurologist, but it is also the view of an affiliation of most of the neurological charities, the Neurological Alliance<sup>3,4,5</sup>, that expert opinions are vital when patients have neurological disease.

Clinical neurology is now primarily an out-patient service, with most consultants carrying out three to four clinics a week. In recent years planning has been focussed on long out-patient waiting lists and this has taken time away from patients on the wards. The pendulum has probably swung too far towards out-patients and away from in-patients. The expertise of the neurologist is likely to be as useful in contributing to the management of acutely ill patients rather than, as is the case at the moment, in seeing increasing numbers of out-patients with symptoms that rarely signify serious illness.

In the past all hospitals in the United Kingdom were staffed by general physicians who were true generalists, and it was expected that these physicians would have had a broad knowledge of all medical sub-specialties, including neurology. The training of physicians nowadays is very much more orientated towards the acquisition of sub-specialty skills, with the consequence that there are now few newly appointed physicians who have received any neurological training at all. This means that fewer patients, acutely ill with neurological conditions, are being cared for by physicians who have been trained to deal with such problems. The Royal Colleges of Physicians in both London and Scotland have addressed this issue of the neurological services in the District General Hospital and the acute medical take<sup>6,7,8,9</sup> and the general conclusion is that currently neurological services are patchy and that there are too few consultant neurologists to provide a comprehensive service throughout the country.

This document attempts to consider the relevant issues and consider methods of improving the care of people with acute neurological emergencies.

## 2

# What is Acute Neurology?

Clinical Neurology is the medical speciality that is concerned with the diagnosis, treatment and, in some instances, the continuing assessment and care of adult patients with diseases of the central and peripheral nervous systems and the muscles. The primary function of the neurologist is to care for such patients. For some, the neurologist is the principal provider of specialist care, but for a much larger number, care is provided in collaboration with other physicians, surgeons and family doctors.

We regard acute neurology as encompassing all those neurological illnesses that are severe enough to warrant urgent admission to hospital. This definition is very simple, and it is important to appreciate that not all of the conditions defined in this way are necessarily life threatening. However, within this category there are some conditions that are life threatening and these are the disorders which concern us most. If the service for patients with acute neurological conditions is generally inadequate, then some patients with life threatening illnesses may die if their condition is not managed appropriately.

There are relatively little data available on the magnitude of the problem posed by patients with acute neurological conditions, but a small number of studies have been done which are helpful. Some patients with acute neurological illnesses arrive at hospital via the Accident and Emergency Department and others are referred by their family doctors. Some data are available on the presentation of neurological patients in the Accident and Emergency Department and rather more data are available on the sum total of patients with neurological disease who are in hospital as in-patients.

### **Accident and Emergency**

Craig et al (1997)<sup>1</sup> studied new patient attendances at the Accident and Emergency Department at the Royal Victoria Hospital, Belfast and noted that in one week 75 of 972 (8%) had a neurological illness. Headache comprised 55%, loss of consciousness 15%, balance difficulties 7%, power loss 5%, sensory difficulties 5%, acute visual failure 5% and convulsions or seizures 4%. Headaches and loss of consciousness made up 74% of these Accident and Emergency attendances and most of these patients had a diagnosis within 24-48 hours, so they could have been dealt with in an observation ward without needing admission to a "neurological" bed.

Of the neurological patients, 27 (36%) were admitted, although it was decided later that 10 were probably admitted unnecessarily. The final diagnoses in the 11 serious neurological illnesses were epilepsy (4), acute hydrocephalus (2), transient ischaemic attack (2), bacterial meningitis (1), temporal arteritis (1) and toxic confusional state (1). Other serious problems in this group of patients included fractured neck of femur (1), pacemaker malfunction (1) and sphenoidal sinus mucocoele (1).

Of these patients attending the Accident and Emergency Department, 27% presented between 9am and 5pm on Monday to Friday, so 73% presented outside these normal working hours. It

is clear; therefore, that a neurological consultation service available during a standard 9 am to 5 pm five-day week would only see about a quarter of the neurological patients that present to an Accident and Emergency Department. In this study 23% of the patients seen outside the normal working hours had serious neurological illnesses.

### **In-patients**

There are two studies which illustrate how many patients with neurological disease are in hospitals in the United Kingdom at any one time. Morrow and Patterson (1987)<sup>10</sup> studied the adult medical admissions to a District General Hospital in Northern Ireland and Playford et al (1994)<sup>11</sup> reviewed adult in-patients in all the wards of a London teaching hospital. Neither of these hospitals had neurological or neurosurgical beds. The results are similar; for in both studies 19% of the in-patients had neurological disease. The details of diagnoses are given in Table I:

**Table I. In-patients with neurological disease.**

|   | <b>Morrow and Patterson<br/>(1987)<sup>10</sup></b> | <b>Playford et al<br/>(1994)<sup>11</sup></b> |
|---|---|---|
| <b>Total In-patients</b>                | <b>925</b>  | <b>1288</b>                                   |
| Number with neurological disease        | 180 (19%)   | 242 (19%)                                     |
| Cerebrovascular disease                 | 36%   | 50%   |
| Epilepsy/loss of consciousness          | 28%   | 7%  |
| Dementia                                | 6%  | 10%   |
| Degenerative disease                    | 2%  | 10%   |
| Demyelination (Multiple Sclerosis)      | 2%  | 4%  |
| Headache                                | 7%  | -   |
| Head injury/persistent vegetative state | 1%  | 3%  |
| Neuropathies                            | 2%  | 3%  |
| Infection                               | 3%  | 3%  |
| Muscle disease                          | -   | 2%  |
| Drug and alcohol problems               | 3%  | -   |
| Other - including tumours               | 10%   | 8%  |

## Discharges and deaths

In the Royal College of Physicians of London (1996) report entitled "The District General Hospital as a Resource for the provision of Neurological Services"<sup>6</sup>, data are presented on hospital discharges and deaths of patients with neurological disease for the years 1989-1990 (Hewer,1996)<sup>12</sup>. These data reveal that in the era being studied, the majority of patients with serious neurological disease were under the care of physicians (and sometimes surgeons) in disciplines other than neurology. Patients with some of these diagnoses would have been admitted urgently and would, therefore, come into the category of acute neurology that we are addressing in this report. The disciplines that cared for most of these patients were general internal medicine and geriatric medicine. These data are summarised in Table II:

**Table II. The hospital services from which patients with neurological illnesses were discharged or who died in 1989-1990 (England and Wales)**

|                  | Transient ischaemic attacks | Stroke    | Sub-arachnoid haemorrhage | Tumour     | Epilepsy  | Parkinson's Disease | Anterior horn cell disease (MND) | Multiple sclerosis |
|------------------|-----------------------------|-----------|---------------------------|------------|-----------|---------------------|----------------------------------|--------------------|
| <b>Neurology</b> | <b>4%</b>                   | <b>3%</b> | <b>4%</b>                 | <b>11%</b> | <b>8%</b> | <b>12%</b>          | <b>40%</b>                       | <b>43%</b>         |
| Neurosurgery     |                             | 2%        | 34%                       | 32%        |           |                     |                                  |                    |
| Medicine         | 48%                         | 38%       | 49%                       | 22%        | 48%       | 15%                 | 22%                              | 22%                |
| Geriatrics       | 36%                         | 44%       | 7%                        |            | 9%        | 58%                 | 13%                              | 9%                 |
| Paediatrics      |                             |           |                           |            | 19%       |                     |                                  |                    |
| Surgery          | 2%                          |           |                           |            |           |                     |                                  |                    |
| Rheumatology     |                             |           |                           |            |           |                     | 5%                               | 10%                |
| Radiotherapy     |                             |           |                           | 13%        |           |                     |                                  |                    |
| A&E beds         |                             |           |                           |            | 5%        |                     |                                  |                    |
| GP beds          | 5%                          | 7%        |                           |            |           | 9%                  | 6%                               | 8%                 |
| Other            | 5%                          | 6%        | 6%                        | 22%        | 11%       | 6%                  | 14%                              | 8%                 |

## Conclusion

*From the foregoing it is clear that every hospital in the country with an Accident and Emergency Department and all of those which admit seriously ill medical patients, will be required to deal with patients with acute neurological disease and, it follows from this that many will have serious and potentially life threatening conditions.*

# 3

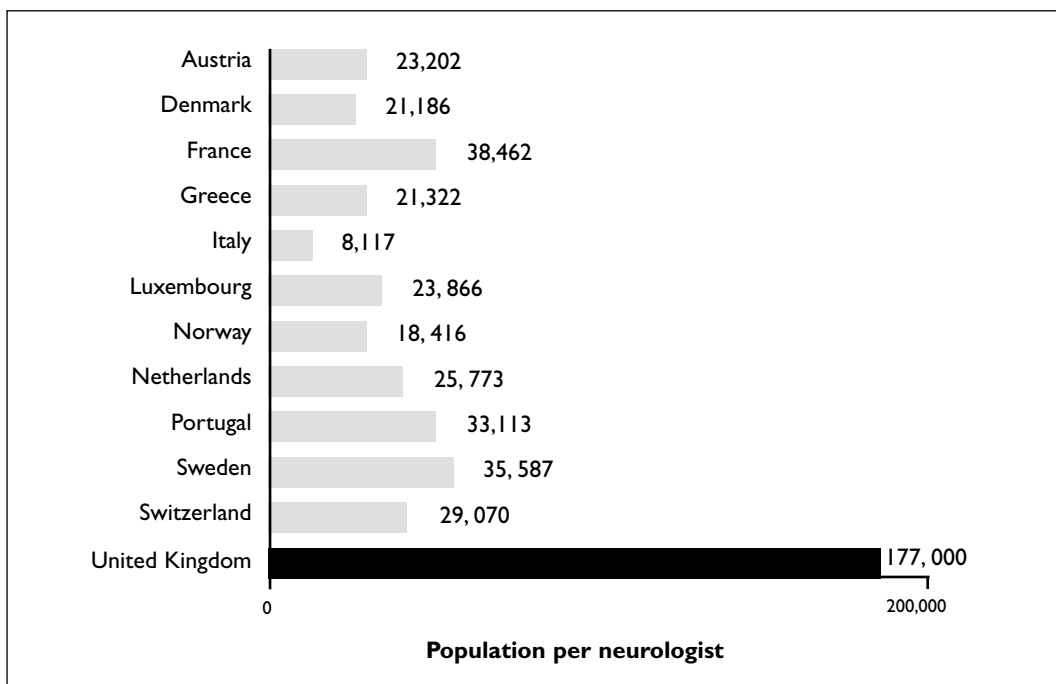
## Availability of neurologists

We have established already that the majority of adult patients with acute neurological disease are admitted to hospital under the care of specialists who are not neurologists. If all of those patients who needed the advice of a specialist neurologist were able to obtain that advice shortly after admission, then it is likely that the quality of their care would be improved. Thus, it is appropriate next to review data on the availability of neurologists in the hospitals where such patients are likely to be admitted.

### Numbers of neurologists

There are 358 Consultant Neurologists in the United Kingdom, which gives a value of approximately 1:177,000 in the population. This figure contrasts with values for other European countries, as is shown from the data in Figure 1:

**Figure 1: Distribution of neurologists in various European Countries.**



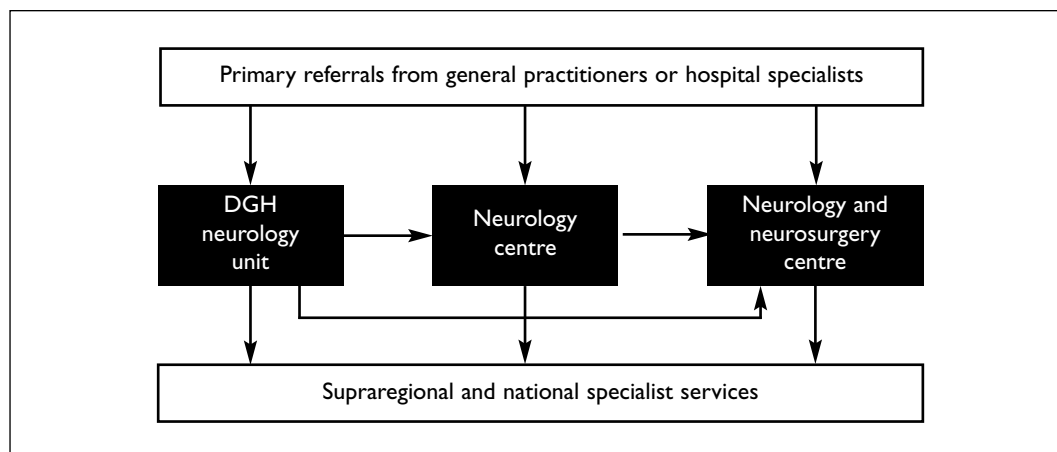
The data in Figure 1 were derived from Eurostat Annuaire 2000, a publication of the UEMS. (Union Européenne des Médecins Spécialistes)<sup>13</sup>, which is quoted in Livre Blanc de la Neurologie Française (2001)<sup>14</sup>. Figures have not been given for Belgium and Germany, because in those countries services are given partly by neurologists and partly by neuropsychiatrists, so the numbers are not strictly comparable. There are no data for Finland and Spain.

### Distribution of neurologists

Within the United Kingdom the figures vary greatly in different parts of the country, with some regions having one neurologist per 100,000 (mainly in the South East of the country), whilst the least well-served areas have ratios of approximately 1:250,000. Thus, there is at present a marked inequality of access to neurological services in different parts of the country.

Throughout the country there are three basic patterns to neurological services, although much overlap occurs. Care is provided by neurologists based in District General Hospitals, Neurology Centres or Neurology and Neurosurgery Centres (see figure II). It is important to analyse the strengths and weaknesses of each in the setting of acute neurology services.

**Figure II. The Neurology network (See reference 15)**



### District General Hospitals

The District General Hospital serves local communities of approximately 250,000, although this number can vary widely. Some have their own Consultant Neurologists, but most are visited by one or more neurologists who are based elsewhere. Such visits may be as infrequent as once a week (or even less). All will have access to CT scanning, some have MR scanning, but only a few have immediate access to clinical neurophysiology, specialist neuroradiology or other specialised neurological services.

Patients acutely ill with neurological conditions in such hospitals may or may not be seen by a Consultant Neurologist. If there is a neurologist who works full time at the hospital, then such advice is likely to be available, but if the hospital is only visited by a neurologist, then obtaining timely advice is likely to be much more difficult.

## **Neurology Centres**

Neurology Centres comprise groups of neurologists working together, providing care to their own and surrounding District General Hospitals. There is no neurosurgery on site. There are a small number of such centres in the country, such as those in Leicester and Norwich, but they are not yet commonplace.

These centres may be located at a District General Hospital or a teaching hospital. Because such centres are staffed by several neurologists, the range and depth of expertise is greater than that provided by any single neurologist. More specialised services are available than at a normal District General Hospital and there is likely to be a wider range of sub-specialist services for conditions such as epilepsy, multiple sclerosis, vascular disease, movement disorders and headaches. Expert neuroradiology, neurophysiology and neuro-rehabilitation services, with the appropriate facilities, may also be available. Patients acutely ill with neurological illnesses in such centres have access to ample specialised neurological advice and investigation.

## **Neurology and Neurosurgery Centres**

These centres are usually based in teaching hospitals and generally contain university departments (for example Birmingham and Glasgow). There are currently 27 such centres in the UK and they provide a comprehensive service. These centres are staffed by neurologists, neurosurgeons, neuroradiologists (including those offering interventional treatments) and neurophysiologists, as well as neuropathologists, neuropsychologists and paediatric neurologists, plus representatives of other relevant specialties such as genetics. They will remain an important part of the service, whatever solution is devised for acute neurology.

These centres provide a local service to their base hospital and the neurologists at such a centre usually cover between them several surrounding District General Hospitals. Sometimes these are many miles away. Such centres provide a full neurological on-call service and all should have sufficient neurological Specialist Registrars to provide a 24-hour registrar on-call service.

## **Links between the components of the Neurology Network**

There must be close links between all three components of the neurology network. The Association of British Neurologists has argued that all District General Hospital based neurologists should have at least two sessions a week at the local Neurology Centre or Neurology and Neurosurgery Centre (1993,1998)<sup>16</sup>. The importance of professional interaction with colleagues cannot be underestimated, for such contacts are a constant source of advice and education. Clinical governance, revalidation and continuing professional development are more easily facilitated at centres and the quality of these activities increases when centres reach a sufficient size. The training of specialist registrars is another important function of the Neurology Network.

## Conclusion

*It is very clear that in the United Kingdom we have far fewer Consultant Neurologists than in all other European countries for which there are available data. This has created a pattern for the delivery of neurological services which is very different from that found elsewhere. There are so few neurologists in this country that most hospitals do not have a neurologist who is on site, although there is a system whereby most (but not all) hospitals have visits from neurologists from elsewhere.*

*Patients with acute neurological disease do not conveniently fall ill just when the neurologist is about to visit, so the management of such patients is heavily dependent on the type of hospital into which the patient is admitted. If they live in a town with a Neurology Centre or a Neurology and Neurosurgery Centre, then it is far more likely that their care will be given by neurologists, whereas if they live in an area which is served by a hospital that does not have an on-site neurology service, then their care will be given by non-neurologists, with or without the benefit of subsequent advice from a neurologist. Some patients with such illnesses are transferred to specialist neurology units, but this does not happen in every case.*

*Thus, the present system has built into it a tendency for the type of specialist care that is available to neurology patients being determined by where the patients live. This is not a new phenomenon and it is not a problem that is exclusive to patients with neurological disease. However, that does not make it acceptable.*

# 4

## Is advice from a neurologist helpful?

So far we have seen that a considerable proportion of patients with acute neurological problems are cared for by physicians who are not neurologists. This leads to our questioning whether there is evidence that care given by a Consultant Neurologist is better than care given by other specialists.

### **The value of specialist advice**

Very few formal studies have been done to address this issue. Before citing those studies that exist, however, it should be said that it is self-evident that a specialist in a particular group of conditions is likely to be much more skilled at diagnosing, treating and managing those disorders than a non-specialist. To make this case more forcibly, it is evident to all Clinical Neurologists that those of our neurological colleagues who specialise, within neurology, in such conditions as movement disorders, epilepsy or myasthenia gravis (to give just a few examples) are better at managing those disorders than the neurologist without such a special interest. By analogy, a fully trained neurologist is likely to be better at managing general neurological disorders than a physician who has been trained, and who has a special interest in another branch of medicine altogether, such as diabetes, cardiology, gastro-enterology or some other specialism.

### **Do ward opinions help?**

Because most patients with acute neurological conditions are admitted to hospital under the care of non-neurologists, it is legitimate to ask if the advice that might be obtained subsequently from a neurologist is helpful or not, for this is an indirect way of evaluating the care that the patient might receive if a neurologist were not involved at all. There are few data on this subject.

A study by Steiger et al<sup>2</sup> of 169 patients seen as ward referrals at the Royal Free Hospital confirmed the diagnosis in 54%, but 18% of patients had their diagnosis changed. Important examples include reversing the diagnosis of epilepsy in seven patients, changing the diagnosis of stroke to Wernicke's encephalopathy in one patient and from dementia to phenytoin toxicity in another. A new diagnosis was made in 15% of patients who were previously undiagnosed. Thus, neurological in-patient appears to be important and valuable.

In a separate study on in-patient consultations Hillen & Sage<sup>17</sup> concluded that the neurologist contributed useful advice on diagnosis or management in 43% of patients seen. This is confirmed in a study from Bath<sup>18</sup>, which demonstrated that the neurologist's diagnosis was significantly more accurate than that of other clinicians in a group of neurological in-patients and out-patients having CT scans over a three month period.

### **Conclusion**

*These data establish that neurologists make a valuable contribution to the diagnosis and management of acute neurology through the medium of neurological ward referrals.*

# 5

## Should neurologists be doing more?

The quick answer to this question is a definite “Yes”. It should be recognised that this is very much a British question, for in the European countries mentioned in Figure 1, neurologists do all the neurology, which means that they look after all patients with the whole range of neurological disorders. One of the major reasons why British neurologists cannot do everything is that there are not enough of them. If there were more neurologists, then they would become much more involved in dealing with many more aspects of patient care, including acute neurology, than is currently possible.

### **Should neurologists be involved with stroke care?**

It will have been noted from the data given earlier in this document (pages 5-7), that a significant proportion of patients admitted to hospital with acute neurological conditions have suffered strokes. Thus, it is appropriate here to address the question as to whether neurologists should be more involved with the care of such patients.

Ideally the answer is yes; however, it is important to appreciate what this entails. Stroke has an annual incidence of two per 1,000, so a District General Hospital, serving 250,000, might have 500 admissions for stroke per annum. Present evidence shows that these patients are best managed in stroke units. Furthermore, stroke care is moving towards a seamless package of patient care with transient ischaemic attack clinics, stroke units and in-patient and out-patient rehabilitation, so it is probably best that such a service is coordinated by a “stroke physician”.

The work load involved in providing this pattern of care demands a full time specialist in every District General Hospital, whose duties are more or less confined to caring for stroke patients. With so few neurologists and a shortage of trainees (particularly with a vascular interest), the current neurology service cannot possibly take on the whole of stroke care at the moment. However, stroke units are being set up rapidly throughout the country and, whilst neurologists will be able to take some part in stroke care (for example, involvement in transient ischaemic attack clinics and the diagnosis and management of the particularly complex strokes), they cannot provide the full package of stroke care nationwide at the moment.

This does not mean that in some centres neurologists do not lead the stroke team, but if the stroke care package is to be comprehensive, then the neurologist has to spend the majority of his or her time doing little else. There is no doubt that neurological input is important in the diagnosis and management of stroke and transient ischaemic attack and it is unfortunate that the shortage of consultant neurologists limits their practical role. The most reasonable solution to stroke care at the moment is that a stroke physician or geriatrician leads the team, with in-patient from a neurologist as described above.

### **Should neurologists participate in acute care?**

All neurologists in the United Kingdom spend a period of their training doing general internal medicine and they all have the MRCP qualification before they enter the five-year specialist neurological training programme. The latter culminates in the award of the certificate of

completion of specialist training (CCST). Many spend more than five years in neurological training before achieving consultant status and there are no general medical on-call duties or teaching attachments in general internal medicine for specialist neurology trainees. Given the current climate of accountability and clinical governance, it would not be acceptable, or indeed legally advisable, for the present cohort of consultant neurologists or those currently in training, to participate in the acute general medical take.

Some consultant neurology posts in the United Kingdom are already being filled by graduates from other European Union countries who have only obtained a neurology CCST. In Europe the acquisition of a CCST in neurology does not require any general professional training, such as the MRCP in the United Kingdom, so most neurologists training in Europe have minimal postgraduate general internal medical training.

Because the number of consultant neurologists in the United Kingdom is so much smaller than in most other developed countries (see Figure 1), neurology out-patient waiting lists are long and neurologists already have great difficulty in coping with the current neurological work load. This workload will be increased when neurologists became more involved, as we feel they should, in the management of acute neurological admissions, so it has to be accepted that there simply isn't time to add in general medical on-call duties as well.

The Federation of Medical Royal Colleges (2000)<sup>9</sup> does not advocate neurologists taking part in acute on-call rotas, although the Royal College of Physicians of London, in its report cited earlier on neurological services in District General Hospitals (1996)<sup>6</sup>, does acknowledge that some neurologists could obtain dual accreditation in both neurology and general internal medicine. To our knowledge there are very few, if any neurologists in training in the United Kingdom who are pursuing this pathway of training.

So, for all of these reasons we conclude that it would be inappropriate for neurologists to participate in acute general internal medical take.

## Conclusion

*At the present time there are too few neurologists for them to take over all aspects of the stroke services, although in the long run this would be appropriate in some centres. We recognise that, for the time being, in the majority of hospitals, the care of patients with stroke will be shared with stroke physicians, who will not all be neurologists.*

*There are many reasons why it would be inappropriate for neurologists to join the general internal medicine on-call rota but, when there are sufficient neurologists, they should become involved in the care of acute neurological emergencies.*

# 6

## Essentials for acute care?

All parts of the country offer a neurological emergency care system, which is usually centre based, and which may be some miles from the District General Hospital to which acutely ill patients with neurological disease may be admitted. Currently some neurological units take an active role in dealing with acute neurological emergencies, but most have a selective admission policy and admit relatively few such cases on a 24-hour basis.

In order that the care of such patients can be optimised in the future, we consider that the following constitutes the basic essentials that are required for the care of patients with acute neurological disease:

1. Patients require a prompt and correct diagnosis.
2. They should be cared for by a team of medical, nursing and other staff that have the appropriate expertise to deal with their problems.
3. Ideally this team should be available on site on a 24 hour basis throughout the year; although we recognise that a lesser service is likely to exist in most hospitals.
4. The neurological service into which they are admitted should have an adequate number of beds and be staffed by neurologically trained nurses.
5. There must be 24 hour availability of appropriate investigations, such as neuroradiology and neurophysiology.
6. There must be appropriate equipment to facilitate management and this includes 24-hour availability of Intensive Therapy Unit (ITU) services with skilled staffing and monitoring facilities.
7. There should be a formal relationship with a Neurosurgical Centre.
8. The team dealing with the patients should be able to give adequate information and advice about prognosis.
9. All members of the team dealing with such patients should be members of a Regional Neurological Audit and Quality Programme.

## Conclusion

*An acute neurology service should be available on a 24 hour basis. It requires an appropriate number of designated beds (including ITU), neurologically trained nurses, paramedical services and adequate investigative facilities, including neuroradiology and neurophysiology.*

*There is unlikely to be a single method of addressing the problem of providing high quality care for all acutely ill neurological patients, so a flexible approach needs to be taken, with different models being employed in different parts of the country. Solutions must be feasible and take account of geography, the distribution of current services and local opinions on how services should be organised, as well as other pressures, which include revalidation and clinical governance. The frequency of acute neurological admissions is such that adequate clinical time needs to be identified to allow these patients to be seen promptly.*

*Development of the ideal service will vary in different parts of the country and there will also be variations between centres and districts. Any solution must assess local factors and provide at least the minimum level of acute neurological care deemed necessary.*

# 7

## Proposed organisation for acute neurological care

The following paragraphs contain our vision of how the service should be organised. We believe that all patients with acute neurological disease should be cared for by neurologists. We would regard this as the definitive plan for such patients. This will demand a substantial increase in investment in neurological services.

The Association of British Neurologists believes that acutely ill patients with neurological illnesses, who do not require immediate intervention, should be seen within 24-48 hours. In outlining how we believe the service should be organised we acknowledge that in the United Kingdom there are far too few consultant neurologists at the moment and that the numbers are not going to rise to anything like European levels for some years to come. We accept that it will take a long time before we achieve an ideal service and that in the interim we must accept a compromise. Thus, as the number of neurologists in the country increases, we must ensure that they are deployed in the most efficient way possible and that we create a service to patients with acute neurological illnesses that, whilst it may not be ideal in the interim, is at least as effective and efficient as possible within the constraints caused by inadequate numbers of consultants.

The definitive plan that we propose must be regarded as the long term aim, and it must be recognised that the implementation of this plan will require a substantial increase in neurological manpower in the country and a parallel increase in the facilities that will be required by these neurologists.

### **Immediate care**

Some patients are so ill that they require immediate assessment by a neurologist as soon as they present at the admitting hospital. Patients in this category include those with status epilepticus, sudden coma, possible meningitis, possible sub-arachnoid haemorrhage, myasthenic crises and other similarly dramatic conditions.

If they are admitted to a hospital that contains a Neurology Centre or a Neurology and Neurosurgery Centre, then immediate assessment by a neurologist is a realistic proposition, for in such centres it is expected that there will be a 24 hour on-call service provided by Specialist Neurology Registrars, supported by on-call Consultant Neurologists. A minority of hospitals in the United Kingdom are able to provide such a service. The exact number is not known, but the total is probably no greater than 35, this being made up of the 27 Neurology and Neurosurgery Centres and the very small number of Neurology Centres that have a 24 hour on-call service. There are approximately 250 District General Hospitals in the United Kingdom, so in excess of 200 of these do not have a 24 hour on-call on-site neurology service. In some of these hospitals there are one or more on-site neurologists for most of the week, but in the majority that will not be the case, for the neurology service to such hospitals is delivered by visiting neurologists from elsewhere.

If there is an on-site neurology service, with sufficient consultant numbers, in a District General Hospital, then it is feasible for immediate advice to be delivered by a consultant or trainee neurologist between 9am and 5pm. Outside those hours, telephone advice should be available from the local neurologist or from the on-call team at the nearest centre. If there is no on-site neurology service, then in the first instance, advice by telephone should be obtained from the nearest centre and a decision should be made as to whether the patient should be transferred to that centre.

### **Conclusion**

*The long term plan should be that all patients presenting to hospital with acute neurological disease should be assessed immediately by a neurologist.*

*Before this ideal system is achieved, all such patients should be assessed by a neurologist if they present to the hospital between 9am and 5pm on normal working days and a system should be devised wherein all hospitals have on-call neurologists, who can give telephone advice outside these hours.*

### **The next 24 hours**

Patients with acute neurological disease, who are admitted to a hospital which has a Neurology Centre or a Neurology and Neurosurgery Centre are most likely to be cared for subsequently by the neurology team that assessed them initially.

The comments that are to follow refer to patients at hospitals without this specialised service, but who were not so sick that they required an immediate neurological assessment as soon as they were admitted. Such patients also require an opinion from a neurologist. Conditions such as epilepsy, Guillain-Barré syndrome, headache (thought not to be due to meningitis or sub-arachnoid haemorrhage) and other similar disorders come into this category.

The assessment of such patients is probably best done locally at the District General Hospital. They require a ward opinion. At present ward referrals are seen irregularly and we have already indicated that some patients may not be able to see a neurologist for several days (or they may not be seen at all). The Association of British Neurologists believes that all acutely ill patients with neurological illnesses, who do not require immediate intervention, should be seen within 24 hours if at all feasible. The care of such patients may be taken over by the neurologist, which implies that the neurologist should have an adequate number of properly staffed beds in a designated neurological area at the same hospital. There may be some advantages in having the neurology beds in close proximity to the stroke unit and the rehabilitation beds. If no neurology beds are available, then the patient should be admitted to the nearest Neurology Centre or

Neurology and Neurosurgery Centre. Other patients may not require this and it may be enough for a plan of investigation and/or management to be suggested by the neurologist and the day-to-day care of the patient left to the referring physician.

The consultant time required for such ward referrals should not be underestimated. This investment of time serves to improve the care of patients with neurological illness and it also helps to improve the expertise of the non-neurologist.

### **Conclusion**

*All patients with acute neurological disease, who do not come into the category of those demanding immediate assessment, should be seen by a neurologist within 24 hours.*

*The long term plan is that every District General Hospital should have sufficient neurologists to allow this to happen, but in the interim all hospitals should move towards identifying groups of neurologists who will provide them with that service.*

### **Subsequent care**

At the end of the first 24 hours all acutely ill patients with neurological disease should have been seen by a neurologist. Some will have been taken over by the neurologist and others will be continuing under the care of the general physician or other referring hospital doctor. The continued care of the latter group of patients could be enhanced by an intermittent involvement of the neurologist, who may review and re-assess the patient at intervals throughout the hospital admission. This too is an activity that involves an investment of time by the neurologist.

### **Conclusion**

*The definitive plan for the care of most patients with acute neurological disease is that, if it is clinically indicated, their care should be taken over by a neurologist. The neurologist must have access to an adequate number of designated and properly staffed beds, I.T.U. facilities, neurologically trained nurses, paramedical services and adequate investigative services, including neuroradiology and neurophysiology. If these are not available, then the neurologist should continue to review the patient until such time as that is no longer necessary.*

# 8

## Implications of this system of care

There are two main implications of the system of care that we have outlined in the previous section. The first relates to manpower, and the deployment of that manpower, and the second, which is intimately linked to the first, relates to the provision of facilities required by neurological patients to allow this system of care to be effective.

### **Manpower**

The definitive plan for services to acutely ill patients with neurological disease is that all such patients should be assessed by a neurologist immediately, if that is required, or if it is not, then within 24 hours. Furthermore, we advise that the majority of such patients should be transferred to the care of a neurologist, so they can receive optimal care from neurologically trained and experienced medical, nursing and other staff.

Thus, neurologists should be available 9am to 5pm during weekdays at all hospitals in the country and available for telephone consultations outside these hours. There should be a 24 hour on-call service for all hospitals, so that if it is necessary the neurologist can attend the hospital to evaluate the patient personally.

#### District General Hospital

It has already been noted that not all District General Hospitals have their own on-site neurology service, but some do. The comments in the next few paragraphs refer to this system of provision of neurological care.

The Association of British Neurologists recommends<sup>16</sup> that no neurologist should work alone, which means that if the hospital in question has neurologists based there, then there will be at least two Consultant Neurologists on the staff. It must be appreciated that in an average year the annual study and other leave allocations to these neurologists will result in there being only one Consultant in the hospital for up to four or five months. It follows that two neurologists would not be able to provide the 24 hour cover that we believe is necessary.

Three neurologists based at such a hospital could provide the 9am to 5pm cover that is required, but because of the European Working Time Directives, it is unlikely that they will be able to provide a full 24 hour on-call service, unless other aspects of their work are severely curtailed in order that time off during the day can be allocated to make up for the on-call duties. In order to provide the 24 hour service that we have outlined for acutely ill patients and to perform all their other out-patient and additional duties, each hospital will require at least five neurologists.

Having been seen by the District General Hospital based neurologist, it would seem appropriate that the patient should then come under direct neurological care – the so-called triage system of management – assuming that a skilled team and appropriate facilities to deal with acute neurological illnesses are available. This requires having an adequate number of appropriately

staffed neurological beds, with the necessary in-put from the professions allied to medicine (physiotherapists, occupational therapists, speech therapists etc.). The current national numbers of junior neurological staff and appropriately trained nursing and other staff will place limitations on this, but changes in policies in the future could allow sufficient staff to be available for such a service. The difficulties of providing a high quality District General Hospital based service, which can cover all the subspecialties without on-site associated services, such as neurophysiology and neuroradiology, must not be underestimated.

It must be recognised, however, that for the foreseeable future, many of the doctors providing immediate District General Hospital care for neurological patients will not be fully trained neurologists and this has implications for the training of general physicians of the future. Such training should include an obligatory period of attachment to a neurological service for those aiming for accreditation in general internal medicine. In this context, the need for the neurological beds in the District General Hospitals to be covered by junior medical staff is relevant. The Association of British Neurologists believes that training in neurology should apply to all specialist registrars in general internal medicine and it should last for at least three months. This training issue needs to be addressed by the Royal Colleges of Physicians.

### **Conclusion**

*Using the model of service which is based on every District General Hospital having an on-site 24 hour acute neurology service, the manpower implications are severe. A substantial increase in Consultant Neurologist numbers will be necessary and more trainees, trained nurses and staff for the professions allied to medicine would be required. At the present time this plan is unrealistic, although it should remain the final goal if adequate supporting staff and back up facilities could be made available.*

#### Amalgamation of District General Hospitals

If all District General Hospitals served not 250,000 people, but 500,000, then fewer neurologists would be required nationally to provide the service that we feel is desirable. However, this is not a realistic proposition, for it is not likely that half the hospitals in the country will be closed in the foreseeable future, although we do recognise that currently some hospitals are closing and in some areas adjacent hospitals are amalgamating their management structures. The latter will not help the cause of the acutely ill neurological patient, for he or she could still end up in one or other of the hospitals that might have amalgamated in this way and it is unlikely that in many parts of the country all acutely ill medical patients will only go to one of a series of hospitals with

amalgamated management structures. Since neurologists cannot be in two places at one, this option looks unrealistic.

### Conclusion

*If all District General Hospitals served a population of 500,000, rather than 250,000, then the increase in the number of neurologists would be significantly less than that in the first model. We recognise that this is not a realistic proposition and we remain anxious that the numbers of junior neurologists, trained nurses and other staff would still be insufficient to allow this model to work.*

#### Hospitals with Neurology Centres

When the Association of British Neurologists (1998)<sup>15</sup> recommended the creation of such centres as a part of the national Neurology Network (see Figure II), it was anticipated that they could serve a population of about 500,000. This means that, in addition to the existing 27 Neurology and Neurosurgery Centres, more than 100 Neurology Centres would have to be created nationally. We now recognise that this is not a realistic proposition, because it is exceedingly unlikely that there will be enough neuroradiologists or neurophysiologists to staff such centres adequately. The British Society of Neuroradiologists (1996)<sup>19</sup> have recommended that there be three Consultant Neuroradiologists per 1,500,000 population and that they all work in the same hospital. Likewise, the British Society of Neurophysiologists (1995)<sup>20</sup> have suggested that there be three Consultant Neurophysiologists per million of the population. If we take these constraints into account, then it is more realistic to consider the catchment population of a Neurology Centre as being between 1,000,000 and 1,500,000. This would require that an extra 30 to 50 such centres be created nationally. These figures suggest that one such unit would serve four to six District General Hospitals.

For Neurology Centres to provide a high quality service to the local hospitals and, therefore, the local population, it will be necessary for there to be enough Consultant Neurologists to service all the District General Hospitals in the manner described in the previous paragraphs. To meet the 24-hour target would require a consultant neurologist visiting each District General Hospital on a daily basis. This would be best served by three consultant neurologists sharing the cover of each District General Hospital, with the neurologists each spending two or three days a week at the District General Hospital. That would allow the 9am to 5pm service to those requiring immediate care and it would also allow the less severely ill patients to be seen within 24 hours on normal working days. This scheme would also give the neurologists enough time for out-patients, postgraduate training, education and audit. The patients requiring specialist centre-based care can then be transferred to the Neurology Centre, while the majority of neurological in-patients in the District General Hospital can remain under the care of the local

consultants, who will have access to neurological advice on a daily basis. This scheme would require three neurologists for each District General Hospital serving 250,000, so if the centre serves four District General Hospitals, then 12 would be needed simply to provide this level of cover. If the centre covers six District General hospitals, then 18 neurologists would be needed. In addition, at least five further neurologists would be required at the centre to deliver the other services provided at the centre.

Outside the 9am to 5pm time bracket, advice by telephone would be available to District General Hospital staff from the neurological staff on call, which would consist of consultant neurologists and possibly specialist neurology registrars. For such units to provide this on-call service and 24 hour in-patient care for neurology patients, would require enough staff to give continuous cover.

The pattern suggested above attempts to describe a feasible solution to providing better care for the acute neurological admission. It takes into account the pattern of neurological care that we believe is ideal and it takes note of the increasing sub-specialisation and the complexity of delivery of neurological care.

### **Conclusion**

*The system which involves the creation of Neurology Centres serving between 1,000,000 and 1,500,000 population satisfies most of the requirements for high quality care for acutely ill neurological patients. The creation of such a service would require more neurologists. Such centres would also require considerable investment in other medical and para-medical staff and in the facilities that this team of professionals would require to work effectively.*

### Hospitals with Neurology and Neurosurgery Centres

It is not necessary to discuss these centres in quite so much detail. If they are to be staffed in such a way that the Consultant Neurologists provide a service to the District General Hospitals in the area served by the centre, then the same constraints apply. There must be enough neurologists to provide the on the spot service that is needed by these District Hospitals and additional neurologists to provide the extra services that will cover the various sub-specialties of neurology. Thus, the details concerning staffing are in many ways similar to those discussed earlier when Neurology Centres were described. It must be appreciated that some areas will have a Neurology and Neurosurgery Centre rather than a Neurology Centre and will have to provide care for patients with complex needs, as well as providing investigative facilities for the full range of neurological illnesses.

# Manpower calculations

## Consultant staff

Current Association of British Neurologists guidelines (1996)<sup>21</sup> state that there should be one neurologist per 100,000 of the population. This implies approximately 600 neurologists in the UK and somewhat more if we accept the obvious need for a strong academic base.

District General Hospital based service using current ABN guidelines

If we achieve 1:100,000 neurologists throughout the country then, on average, each District General Hospital will have 2.5 whole time equivalent consultants. These will be mainly National Health Service neurologists, but some will be academic neurologists. It is relatively simple to make the necessary calculations concerning NHS neurologists, but the situation with the academic neurologists is more complicated.

If we assume that academic neurologists spend 50% of their time in NHS work, then the 78 academic neurologists in the United Kingdom are the equivalent of 39 NHS whole time equivalent consultant neurologists. Thus, they could cover approximately 15 District General Hospitals between them. There are about 250 District General Hospitals in the country, so the remaining 235 will be covered by NHS staff. The number of NHS whole time equivalent consultant neurologists required is, therefore, 235 multiplied by 2.5, which is 588. Thus, to cover all District General Hospitals would require a total of 588 (whole time equivalent neurologists) plus 78 academic neurologists, which comes to 656 neurologists nationally. This figure refers to full or whole time equivalent neurologists, so in reality it equates to approximately 725 individuals, or one neurologist per 83,000 population.

District General Hospital based service using the 24 hour complete cover model discussed earlier.

We have already calculated (pages 20-21) that to provide a 24 hour service in every District General Hospital would require 5 Consultant Neurologists per hospital. It is reasonable to leave academic neurologists out of this equation, because it is to be expected that with this system all academics will be working in centres rather than primarily at District General Hospitals. Thus, 250 District General Hospitals will require 1,250 NHS consultant neurologists, to which we have to add those primarily based at the Neurology and Neurosurgery Centres and the academic neurologists. At least 5 neurologists will be required at each centre simply to deliver the 24 hour service that will be required of the centre. With approximately 35 such centres nationally (see page 17), an additional 175 neurologists will be needed. Thus, this model demands 1,250 NHS neurologists, 175 centre based neurologists and 78 academic neurologists, which gives a total of approximately 1,400 nationally, or a population ratio of 1:43,000.

District General Hospital based service using the amalgamated DGH model discussed earlier.

We considered earlier (pages 21-22) the theoretical model of all District General Hospitals serving 500,000 people rather than 250,000, which is more-or-less the situation at the moment. If matters really were organised thus, then 1:83,000 or 725 neurologists would be enough to provide a full on-site acute neurology service at all such hospitals. We recognise that this is not a model that is likely to become a reality.

#### Centre based service

Basing all or most neurologists at a Neurology Centre and providing an on-site 9am to 5pm service during the working week at District General Hospitals and an emergency system involving the centre outside those hours, would require three neurologists for each District General Hospital serving 250,000 people. With 235 such hospitals covered by NHS neurologists, the manpower requirement for this level of cover would be 705 NHS consultant neurologists, in addition to the 78 academic neurologists mentioned earlier. The centres would also require at least five neurologists to deliver the conventional and acute services at the centre and, because there are about 35 such centres nationally, a further 175 consultant neurologists would be required to do this work. Thus, the centre-based model demands 705 plus 175 NHS neurologists and 78 academic neurologists, which gives a national total of 958 neurologists or a population ratio of 1:62,600.

#### The current situation and projections for the future

At present there are approximately 350 neurologists in the United Kingdom, but a few are required by their contract to do very little clinical work. It is reasonable to argue that nationally there are the equivalent of about 300 active neurologists. It is appropriate to take this as the starting point for calculations of the length of time it will take to achieve the objectives defined already.

**Table III. Calculations of the length of time it will take to expand the numbers of neurologists.**

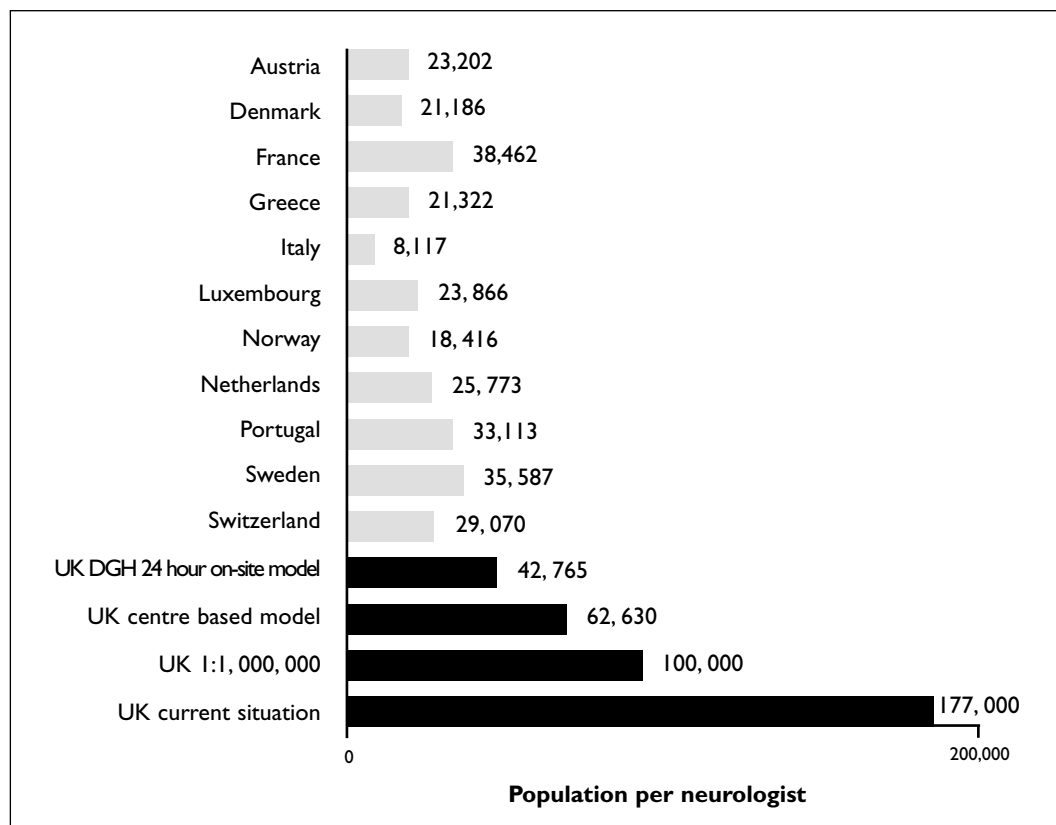
|                                | Current number of active neurologists | Number required | Ratio to population | Length of time to achieve target with expansion rates of: |              |               |               |
|--------------------------------|---------------------------------------|-----------------|---------------------|---|--------------|---------------|---------------|
|                                |                                       |                 |                     | 5% per annum  | 7% per annum | 10% per annum | 15% per annum |
| Current 1:100,000 Model        | 300                                   | 600             | 1:100,000           | 16 years  | 12 years     | 9 years       | 6 years       |
| DGH 24 hour onsite cover model | 300                                   | 1,403           | 1:42,765            | 32 years  | 28 years     | 17 years      | 12 years      |
| Centre based model             | 300                                   | 958             | 1:62,630            | 24 years  | 18 years     | 13 years      | 9 years       |

The numbers in Table III clearly indicate that it is going to take a very long time for us to achieve the desired numbers of neurologists for any of the models discussed in earlier paragraphs. The current rate of expansion is between 5 and 7% per year. Even with a 7% rate of expansion it will take 12 years (until 2014) to achieve what we regard as the very simplest of services for acutely ill patients with neurological disease. To achieve the final objective of a full on-site District General Hospital service in every part of the country would take until about 2030 at the present rate of expansion. To achieve this objective in 10 years would require a rate of expansion of 18% per annum.

### Comparisons with Europe

If we should ever achieve this level of penetration of neurological services into the country, we would still have between a half and a third the number of neurologists that are currently found in virtually every European country. The data previously presented in Figure I on page 8 must be recalled, wherein it is revealed that the population per neurologist in Europe is between 8,100 and 38,500, which contrasts to the current United Kingdom value of 177,000. What we are suggesting here may appear superficially to be extravagant, but it is not, for all our European neighbours have already invested in services that are more comprehensive than anything that we are proposing.

**Figure III: Distribution of neurologists in various European Countries showing the distribution in the UK with the various models discussed earlier.**



This point is emphasised by the details in Figure III, which show how the various models that we have discussed so far would compare to the situation that currently prevails in other European countries. It is absolutely clear from the figures that we have presented that neurological services in the United Kingdom must be expanded at a rate far in excess of the current 5-7% per annum.

### **Junior Staff**

To maintain a stable consultant body of 650-700 would require between 110 and 170 specialist neurology registrars in training; this assumes that the number of consultants is remaining constant. This is based on the consultant career lasting 25-30 years and each specialist neurology registrar spending 5-6 years in training. A full 24-hour specialist neurology registrar rota to cover the full week requires a minimum of 5 trainees. Thus 110-170 specialist neurology registrars would allow only 22-34 units to be adequately staffed to provide full 24-hour specialist neurology registrar cover. If the specialist neurology registrars were more widely distributed, then full 24-hour cover by neurological trainees becomes impossible and under these circumstances consultant neurologists will sometimes be on call without the assistance of neurologically trained specialist registrars. A stable consultant body of 1,400 would require 220-340 specialist registrars in training. It goes without saying that all neurology specialist registrars need exposure to significant numbers of ward referrals and the full range of acute neurological illnesses. This can only be achieved by both Centre and District General Hospital based experience.

## Conclusions

The Association of British Neurologists believes that a 24-hour neurological service should be available to all patients admitted with acute neurological illness and that all those who do not require immediate intervention should be seen within 24 hours. This document discusses the different ways in which this can be achieved, depending on whether neurological care is provided on a District General Hospital based model, Neurology Centre or Neurology and Neurosurgery Centre pattern of care. The strengths, weaknesses and practicalities of these different patterns of care are addressed. There is no single correct method.

The crucial points considered have been: -

1. Patients require a correct prompt diagnosis.
2. 24 hour on site availability of medical and nursing staff with appropriate expertise throughout the year with the appropriate number of neurological beds.
3. Appropriate investigations and management within an acceptable time on a 24-hour basis including neuroradiology and neurophysiology.
4. 24-hour availability of ITU services, with appropriate neurological skills and monitoring facilities.
5. A formal relationship with a Neurosurgical Centre.
6. Adequate information and advice about prognosis.
7. Membership of a Regional Neurological Audit and Quality Programme.

### **District General Hospital model**

The District General Hospital model would require 2-3 neurology consultants (whole time equivalents) to provide a barely adequate service. It would provide the most immediate on-site opinion service, but would not provide a full out of hours service, for that requires a minimum of 5 consultants. The District General Hospital based neurologist would require an adequate number of neurology beds, ancillary staff and the prompt availability of other neuroscience consultant colleagues (especially neuroradiology and neurophysiology) if they were to look after complex seriously ill neurological patients in the District General Hospital. If this service were not available, then some patients with complex neurological illnesses would need to be transferred to the Neurology Centre. The District General Hospital based consultant should spend a minimum of two sessions at the regional centre for postgraduate education. This allocation of time, however, would be inadequate for managing in-patients at the centre, which could only follow if at least 4 sessions were spent at the centre. Even this is probably inadequate for looking after in-patients unless a system of shared care or an attending system was undertaken at the centre. Alternatively, such patients could be transferred to the care of a centre-based neurologist.

### **Centre based model**

With a centre-based service, the neurologist would not be on site at the District General Hospital, but could be present 2-3 days in a single District General Hospital. If each District General Hospital was covered by 2-3 centre based neurologists then, with appropriate coordination, it would be possible to provide a daily service to all District General Hospitals, as well as offering the facilities of the centre when required to all those patients with complex or severe illnesses, whilst the patient remains under one consultant. Sub-specialty services would then be more readily available.

# References

1. Craig J, Patterson, V, Roche L, Jamison, J. Accident and emergency neurology: time for a reappraisal? *Health Trends*, 1997, 29,89-91.
2. Steiger, MJ, Enevoldson, TP, Hammans, SR, Ginsberg, L. Influence of obtaining a neurological opinion on the diagnosis and management of hospital in-patients. *J. Neurol. Neurosurg. & Psychiatry*, 1996, 61, 653-4.
3. "Providing a Service for People with Neurological Conditions" Published by The Neurological Alliance, 1996.
4. Downing H - Responses to questionnaires to each organisation that is part of the Neurological Alliance. 1995 (see reference 13 for more details).
5. "In search of a service: The experiences of people with neurological conditions." Published by The Neurological Alliance, 2001.
6. Royal College of Physicians. The district general hospital as a resource for the provision of Neurological Services. Royal College of Physicians of London, 1996.
7. Royal College of Physicians. Future patterns of care by general and specialist physicians – meeting the needs of adult patients in the UK. Royal College of Physicians of London, 1996.
8. Royal College of Physicians of Edinburgh & Glasgow. Acute Medical Admissions and the Future of General Medicine. Royal College of Physicians of Edinburgh, 1998.
9. Federation of Royal College of Physicians of the UK. Acute Medicine: the physician's role. A report of the Working Party, London. Royal College of Physicians, 2000.
10. Morrow, JI, Patterson, VI. The Neurological Practice of a District General Hospital. *J. Neurol. Neurosurg. & Psychiatry*, 1987, 50, 1397-1401.
11. Playford, ED, Crawford, P, Munro, FS. A survey of neurological disability at a District General Hospital. *Brit. J. Clin. Pract.* 1994, 48, 304-6.
12. Hewer RL. supplied data included in reference 6 (q.v.)
13. Eurostat Annuaire 2000 *Vue statistiques sur l'Europe and Union Européenne des Médecins Spécialistes Compendium 2000*. Cited in reference 14 (q.v.)
14. Livre Blanc de la Neurologie Française, 2001 published by various organisations including the Fédération Française de Neurologie and the Société Française de Neurologie
15. "Neurology in the United Kingdom: Towards 2000 and beyond" Association of British Neurologists. 1998
16. "Neurology in the United Kingdom: Job Plans for Consultant Neurologists". Association of British Neurologists. 1993 and 1998
17. Hillen, ME, Sage, JL. Proving the worth of neurologists. *Neurology*, 1996, 46, 276-7.
18. Nixon, J, Bateman, DE, Malthouse, S. Computerised tomography scans of the head in a District General Hospital. *J. Royal College of Physicians, London*, 1996, 30, 547-550.
19. "Effective Neuroradiology - guidelines for safe and effective practice" The British Society for Neuroradiologists, 1996.
20. "Clinical Neurophysiology in Neuroscience Centres". Association of British Clinical Neurophysiologists. 1995
21. Stevens D L "Neurology in the United Kingdom: Numbers of clinical neurologists and trainees" Association of British Neurologists. 1996 (*J. Neurol. Neurosurg. and Psychiat.* 63 (suppl.) S67-S72. 1997)

