NATIONAL NEUROSURGERY NEEDS ASSESSMENT FOR SCOTLAND

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SUMMARY

Summary

This project has been undertaken on behalf of the Scottish Public Health Network between June and September 2007. The ScotPHN is a national network created to facilitate joint working between all organisations involved in health improvement and health services by providing a means of communication and through specific projects in areas of national importance The objective has been to conduct a rapid yet comprehensive, needs assessment to inform the work of the Neurosciences Implementation Group (NIG), which is to complete its work by late 2007.

This is a health care needs assessment. The objective is to assess the capacity of the population to benefit from a service or intervention and to make suggestions as to how such benefits can be delivered. Health care need is not, however, the only important factor in planning and delivering health care. As such, the conclusions of this report must be considered against other important considerations. These may include for example:- political direction, health care costs, legislation, competing NHS priorities, professional opinion, scarcity of resources or expertise and the existing pattern of services.

The main approaches taken have been:

- **Epidemiological Needs Assessment**
  - The assessment of incidence and prevalence
  - The effectiveness and cost effectiveness of services
  - The description of baseline services.

- **Corporate Needs Assessment**
  - Reporting the demands, wishes and alternative perspectives of interested parties including professional, political and public views.

- **Comparative Needs Assessment**
  - Comparing and contrasting the services in the population under study with those provided elsewhere.

SUMMARY

Summary (continued)

Conclusions

The population of Scotland is widely geographically separated.

The population is projected to increase slightly in size, to age significantly and to migrate towards the East over the next ten years. This, per se, will have little impact on the need for neurosurgical services. However, increasing patient expectations, particularly with regard to interventions in elderly people will have an impact, as will changes in the management of different conditions.

The need for neurosurgery services is evenly distributed between NHS Board populations.

Current neurosurgical activity of around 6600 procedures per annum is likely to increase slightly year on year but only by 4-6% per annum.

Scotland should ideally aim to have 34 neurosurgeons in post by 2017.

The existing model of service is not ideal as there are clear differences between centres and a lack of research, clinical audit and quality information.

The pattern of evidence and political context has rapidly evolved throughout the last 10 years.

Volume Outcomes data suggests Scottish neurosurgeons can practice at safe activity levels in either a regional or a national service model.

Sub-specialisation at national level is desirable for certain conditions.

There are critical clinical linkages which rely on the presence of neurosurgeons in local units.

New recommendations on head injury care make it desirable to retain neurosurgical services in regional A&E centres.

There are substantial obstacles to moving to a single national centre for neurosurgery which the NHS has no power to address, most notably public transport infrastructure.

There would be benefits from managing neurosurgery services as a single national service using either a commissioning or a managed clinical network model.

INTRODUCTION AND BACKGROUND

Introduction and Background

There has been a lengthy history of neurosurgical review in Scotland reaching back at least ten years. During that time there have been various proposed service models for neurosurgical services. In addition there has been a rapidly changing background, especially in relation to Medical Training and Medical Workforce. These changes have included the introduction of the European Working Time Directive (EWTD), the New Deal for junior doctor's hours of work, Modernising Medical Careers (MMC), the 2003 NHS Consultant Contract and Hospital at Night.[4]

The planning and delivery of neurosurgical care in Scotland is devolved to local NHS Boards rather than being managed nationally and as a result throughout the last decade all four Scottish neurosurgical centres have continued to develop. Planning assumptions, used to inform Reports published during that time therefore may no longer be valid due to local service changes and developments.

More recently there has been a change of the Scottish Government with the launch of *Better Health, Better Care* and a stated "clear policy presumption against centralisation".[5]

Better Health, Better Care sets out that this "does not, of course, mean that there will never be an occasion when it makes sense to concentrate services. It does however mean that any such moves must result in benefits to patients and be subject to meaningful consultation and independent scrutiny to ensure they are based on the best available evidence and give due weight to the views of local people."

In June 1998 the Chief Medical Officer, Sir David Carter published the Acute Services Review which included the work of a neurology/neurosurgery multidisciplinary sub-group.[6] This report first highlighted the potential of managed clinical networks as a mechanism for delivering highly specialized care across a geographically diverse population such as that in Scotland.

The neurosurgical element of this work was subsequently taken forward in a further group chaired by Sir David Carter, which reported in 2000[7]. This made recommendations concerning the configuration of the service, information requirements, support for teaching, training and research and the commissioning of neurosurgical services.

This report recognised the need for catchment populations to be sufficiently large to provide critical mass for 'core services' and recommended rationalising the range and location of neurosurgery in Scotland by differentiating between 'core services' which might be delivered from 4 sites and sub-specialist services which might be delivered from 1 or 2 sites.

It was suggested that Aberdeen and Dundee should develop operational links and enhance their links with Edinburgh to create a functional entity in the East of Scotland equal in population catchment size to the Glasgow unit.

INTRODUCTION AND BACKGROUND

The Carter report also took place against the background of the enquiry into paediatric surgery services at Bristol Royal Infirmary. This report recommended that paediatric neurosurgery should only be undertaken in units with sub-speciality trained paediatric neurosurgeons, able to provide 24 hour care and maintain their skills.[8] At the time, although this advice was recognised, there was no consensus on how rationalisation might be achieved or the pattern of service reconfigured. Additionally it was noted that Sir David Carter's group did not include paediatric neurosurgical representation.

A group under the aegis of the Scottish Colleges Committee on Children's Surgical Services also reviewed the issues concerning paediatric neurosurgery, reporting to the Chief Medical Officer in October 2001[9]. This group made a range of recommendations concerning the configuration of services, principally long term arrangements for paediatric neurosurgery. The report outlined a managed clinical network approach with a single lead site for Scotland, co-located with an adult neurosurgery service and with access to paediatric intensive care.

Since this work was undertaken significant factors affecting the provision of neurosurgery have come into being, particularly workforce legislation, changes in working practices, treatment advances, (eg endovascular coiling for the treatment of subarachnoid haemorrhage)**,** further sub-specialisation and increasing evidence, for some procedures, of a relationship between higher volume and improved outcome.

Sir John Temple in his 2002 report "Future Practice: A review of the Scottish Medical Workforce" described the core service issue as the delivery of 24 hour acute care, effective delivery of which would require both an increase in the number of doctors and a radical rethink of the way in which care is delivered.[10]

In 2002 the Chief Medical Officer requested Professor Graham Teasdale to ascertain the views of the Scottish neurosurgery community on the arrangements for the future provision of neurosurgical services.

Professor Teasdale conducted two surveys of Scottish neurosurgeons which set out and considered a number of options for service provision and used factors of ranked importance to come to a preferred future model of services.

It is important to note that at the time of these surveys there was a background of considerable uncertainty about the impacts of various critical workforce issues. These included the introduction of a new (time linked) consultant contract, substantial changes to junior doctors working arrangements and uncertainty around the likely impact of both the European Working Time Directive (EWTD) and changes to Specialist Medical Training (MMC).

Professor Teasdale Reported to the CMO in October 2003.[11] This report recognised the developing pressures on the service due to changes in the medical workforce, medical

training, and the European Working Time Directive. This work concluded that at that time there was a majority view amongst Scottish neurosurgeons that the extant provision for adult neurosurgical services in Scotland was not an appropriate basis for future planning and that future plans should consider substantial changes in service configuration.

The preference expressed was for a single, purpose built, integrated centre for adult and paediatric neurosurgery and other neurosciences on a new site in Central Scotland serving a population of 5 Million.

Additionally the Society of British Neurological Surgeons has published a range of reports setting out their best practice guidance on the provision of neurosurgical services including work on modelling the medical workforce in the light of changes in legislation and training programmes.[12;13;13-16]

Work has also been undertaken by the NHS Modernisation Agency in England in the area of Neurosciences Critical Care[17].

In 2004 the Minister for Health and Community Care appointed a National Advisory Group (The National Advisory Group on the National Framework for Service Change in the NHS in Scotland) under the Chairmanship of Professor David Kerr to set out a framework for health services in Scotland for the next 20 years. This Group was to report by Spring 2005.

Highly Specialised Care was one of the work streams identified by the Advisory Group recognising that similar issues apply to a range of specialities which are low in volume of activity and rely on scarce expertise and skills. The Advisory Group highlighted two specific areas of highly specialised care for its focus, those of neurosciences and specialised paediatric services. The resulting Neurosciences Action Team's remit included paediatric neurosurgery, which required liaison with the work of the Specialised Paediatric Services Action Team.

The Neurosciences Action Team provided a detailed report to the National Framework for Service Change Advisory Group. This report included 23 separate recommendations and was used to inform the production of "Building a Health Service Fit for the future, The National Framework for Service Change".

The recommendations which are included in full within this report as Appendix 2 included:-

INTRODUCTION AND BACKGROUND

Neurosciences Action Team[2] – Recommendations

- Implementation to be taken forward in the context of clinical neurosciences and with patient involvement.
- Patients to be at the centre of future development and decision making.
- Explicit standards for the neurosurgery service
- Neurosurgery centres to collaborate on service improvement, sharing good practice and developing action plans.
- A common minimum data set of activity information to inform planning and performance management.
- A planned audit programme for the service with funding, for clinical audit and data collection, analysis and reporting.
- Further evaluation of evidence of associations between volume and outcome.
- The evidence base to be developed based on agreed and mainstreamed audit, research and data collection.
- Substantial review of NHS transport infrastructure including:
- The role of the Scottish Ambulance Service and in particular the air ambulance service in rapid transfer of expert teams from specialist centres to stabilise patients in remote and rural areas and transfer ill children and adults over long distances to appropriate specialist centres.
- Protocols for transfer of head injured patients.
- Neurosurgical retrieval teams, following the paediatric and neonatal intensive care model.
- A transport service for the transfer of patients back to local care.
- Developing Scotland's public transport infrastructure with Local Authority partners and transport providers.
- A telemedicine strategy to support the maintenance of specialised services locally.
- A neurosurgery consultant workforce tool to support planning of the service model and to identify the needs for other staff groups, particularly nursing staff and clinical neuroscience specialists.
- Future investment decisions on staff appointments to neurosurgical services to be made on a single service approach not by individual NHS Boards.
- Adult and paediatric neurosurgery to be regarded as a single service for Scotland, delivered on a number of sites and through managed clinical networks.
- Future decisions concerning investment in staff, facilities and equipment to be taken through a national planning and commissioning model.
- National sub-specialisation on a planned and managed basis.
- Neurosurgical services to be planned and commissioned on a national basis.
- Strategic leadership for neurosurgery to be on an all-Scotland basis, working with Regional Planning Groups and NHS Boards.
- Moving towards one prime neurosurgery site for Scotland.

Unfortunately the Final Report of the Neurosciences Action Team was not widely published and some of the excellent work of this group would appear to have been overlooked.

The option appraisal for future neurosurgery sites for example was only one of a wide range of elements of the work. The Action Team, in considering the entirety of its work, particularly the service model, considered that the current configuration of neurosurgery was not the optimum to continue to provide comprehensive, high quality care to patients in the future however, of the 23 recommendations in the report only one referred to moving towards providing paediatric and adult neurosurgery on one prime site and only then within the service model described in the wider report.

INTRODUCTION AND BACKGROUND

The final Report of David Kerr's work was published in 2005 and recommended a high quality national Neurosurgery Service based around a National Network with some highly specialized services taking place only in a central specialist centre ("hub") whilst all others are delivered as locally as possible.[18]

"Specialised services, by their nature, tend to be characterised by:

- highly specific workforce challenges as a result of small staff numbers, specialised training needs and, in some cases, the significant time demands of providing shared care or outreach services
- a relatively small volume of patients needing this service
- complex interdependencies, often with other specialised services, as a direct result of the severity and complexity of the conditions displayed by many patients
- strong links to research and innovative leading edge practice particularly in terms of technology dependent interventions and drug therapy
- significant financial implications in terms both of revenue and capital investment.

In both instances, the conclusion reached was that the most specialised aspects of care should be delivered on a national basis on fewer sites in order to maximise clinical standards (including co-location of inter-dependent services) and to recognise the workforce sustainability issues. For neurosurgery the recommendation is to move, over time to a networked approach from a single hub."

Source: A National Framework for Service Change in the NHS in Scotland

The Scottish Executive Policy Document "Delivering for Health" was published in 2005 setting out the way forward for neurosurgery and neuroscience.[19] This policy document includes a three tier service model of care with one prime site where all adult and paediatric neurosurgical operative intervention would take place.

Although the overall theme is *"quicker, more personal and closer to home"*, this document does not fully reflect much of the important work of the Neurosciences Action Team. The policy seems to focus excessively on the option appraisal which was only one small part of the work and fails to recognise for example the importance of the recommendations on audit, information and standards of care. The following is lifted directly from the text of Delivering for Health…

INTRODUCTION AND BACKGROUND

"The National Framework team chose neurosurgery to help focus its consideration of the way in which highly specialised services should be designed in future.

An options appraisal carried out as part of the review indicated that Scotland should move from its current configuration of four neurosurgical centres towards a single centre for neurosurgical intervention for adults and children, as part of a service model that would provide local outpatient and rehabilitation services as well as pre- and post-operative care and diagnosis.

The review, which took full account of the views of patients, described a future service in which adult and paediatric neurosurgery will be co-located at a teaching hospital with other neuroscience specialties. The service will be integrated across specialist, secondary and primary care using the Managed Clinical Network model, and will be provided as locally as possible, with explicit standards of care across the integrated care pathway.

Sub-specialisation should continue, but on a planned and managed basis. Paediatric neurosurgery should be concentrated in one prime site co-located with paediatric intensive care. Unplanned neurosurgical activity would be managed locally within the model, which supports local unplanned care and subsequent transfer to specialist services through agreed pathways.

Taking a national approach to planning highly specialised services will improve integration, quality and productivity by:

- *ensuring that services are developed sustainably*
- *ensuring that we utilise effectively the distinctive skills of clinical teams providing services*
- *enabling links between highly specialized services to be managed*
- *ensuring that the quality of patient outcomes is the prime consideration.*

The model therefore is for a single, nationally organised service on three levels (Figure 3.2). Within the model is a new concept – Level N1 – that is designed to promote local access to neurological teams when needed, supported by nurse-led clinics and rehabilitation teams. The service at this level will be focused through CHPs, Community Casualty services and GP practices. SEHD will establish a national implementation team to take forward this work. Specific components of the work now needed include:

- *the development of the national model based on the three levels of service set out in Figure 3.2 and using a Managed Clinical Network approach*
- *a needs assessment for neurosciences*
- *the development of explicit standards for the neurosurgery service, including mechanisms for assessment of performance against the standards and action plans to*
- *address areas of improvement*
- *the creation of a common minimum dataset and a planned audit programme for the service*
- *a wide-ranging public consultation on the options for change.*

This programme will be completed by December 2007."

INTRODUCTION AND BACKGROUND

A particular difficulty with the recommendation to move towards a single centre model as set out in Delivering for Health is that it fails to recognize that this was an aspiration based on a twenty year time frame and that the Action Team also highlighted that

"The current NHS and public transport infrastructure would not support any reconfiguration in neurosurgical services and would require review in advance of any revised service disposition being implemented."

It is clearly not within the control of the Neurosciences Implementation team to revise Scotland's public transport infrastructure, nor is it within the capacity of this needs assessment to offer advice on what future changes to that infrastructure will do to the potential for creating or locating a national neurosciences "hub". The Action Team also recognized that travel issues are crucial for the full range of clinical situations and hospital attendees.

"Transfer of ill patients in emergency and planned situations would require exploration of increased use of air transport and dedicated transport teams with appropriately trained staff. Additionally support for families, carers and visitors through improved public transport links, provision of accommodation and other support whilst attending the specialist centre would need to be strengthened."

A further very significant recommendation of the Neurosciences Action Team was the need to establish national level strategic leadership of Neurosurgical services and the need for planning and commissioning neurosurgery to be on an all-Scotland basis, working with Regional Planning Groups and NHS Boards.

The Neurosciences Implementation Group

In 2006 a Neurosciences Implementation Group was established to consider and address the recommendations of the Neurosciences Action Team. These included the conduct of this first National Needs Assessment for Neurosurgery Services.

This work has been conducted by the Scottish Public Health Network (ScotPHN) between June and October 2007. The objective has been to conduct a rapid yet comprehensive, needs assessment to inform the work of the Neurosciences Implementation Group (NIG), which is to complete its work by late 2007.

WHAT IS NEEDS ASSESSMENT?

What is Needs Assessment?

In order to interpret and apply the information presented here it is first necessary to understand the basis on which these data are provided and the characteristics of health care need.

Traditionally Health Needs are probably best explored by basing assessment on a specific disease or disease group. However this is not an absolute rule. Needs Assessment techniques can usefully be employed to inform planning or redesign of specific NHS Services. This process is properly described as *Health Care Needs Assessment* in recognition that need for *health care* is different from need for *health*. Health Care Need is often defined as the populations capacity to benefit from a particular treatment or intervention.[20]

If needs assessment is to usefully inform commissioning decisions it needs to provide a useable level of detail for those who will subsequently specify services. It is thus important both to specify needs at a sufficient level of detail but to avoid pursuing the detail to such a level that the activity of health care need itself becomes overwhelming and unhelpful. Needs Assessment itself incurs costs and can create obstacles to progress. In conducting useful health care needs assessment a reasonable compromise must always be sought.

Need is a different concept to supply or demand. Demand is essentially what people would like or want and is often defined in research by an assessment of what an individual would be willing to pay for a particular service or treatment. *Supply* is a measure of what is actually provided.

The objective of Health Care Needs Assessment is to specify services and other activities which impinge on health care.[20] The principal activities involved in health care needs assessment are therefore:

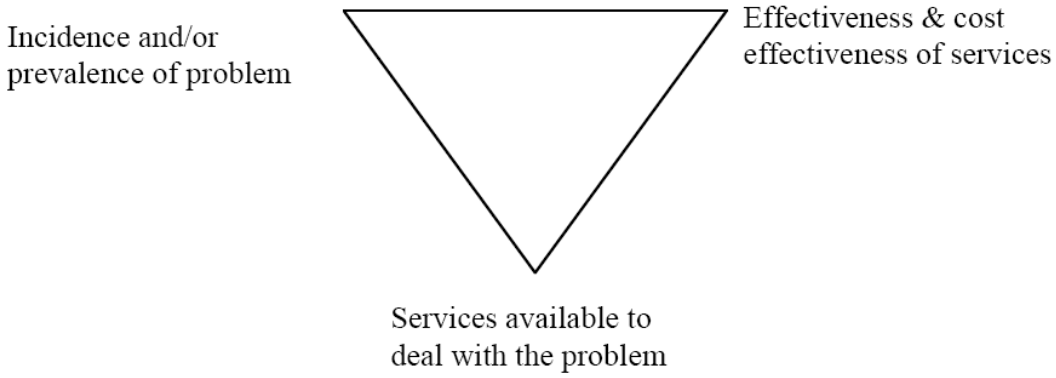
- Assessment of incidence and prevalence
- The effectiveness and cost-effectiveness of services
- The existing services (changing provision for the better requires and understanding of the baseline position)

From these three component parts health care planners can determine the policy direction they wish to pursue. There can also be other objectives in health care needs assessment. These might include

- Improving the spatial allocation of resources – if broadly equal populations need services it seems reasonable to give them broadly equal provision. This approach can work well at large area levels for national reviews but is less suitable in smaller populations.
- To target efficiently – that is to target resources at area of highest need.
- To gather general intelligence to get an overall perspective – often the first stage of more detailed needs assessment.
- To stimulate the involvement of the key players. The more key players are involved, the more likely it is that attention will be paid to the findings.

WHAT IS NEEDS ASSESSMENT?

Figure 1. The Triangulation of Health Care Needs Assessment.



Source: Stevens A., Raftery J. *Health care needs assessments: the epidemiologically based needs assessment reviews*, 1994, Oxford: Radcliffe Medical press Ltd.

Approach and Methods

This is a health care needs assessment. The principal objective of health care needs assessment is to specify services and inform health care service planning.[20] There are three main approaches which are used in compiling this assessment of the level of needs in the Scottish Population for Neurosurgical Services

- **Epidemiological Needs Assessment**
  - The assessment of incidence and prevalence
  - The effectiveness and cost effectiveness of services
  - The description of baseline services.

- **Corporate Needs Assessment**
  - Reporting the demands, wishes and alternative perspectives of interested parties including professional, political and public views.

- **Comparative Needs Assessment**
  - Comparing and contrasting the services in the population under study with those provided elsewhere.

The objective is to assess the capacity of the population to benefit from a service or intervention and to make suggestions as to how such benefits can be delivered. Health care need is not, however, the only important factor in planning and delivering health care. As such, the conclusions of this report must be considered against other important considerations. These may include for example:- political direction, health care costs, legislation, competing NHS priorities, professional opinion, scarcity of resources or expertise and the existing pattern of services.

Health care provision in the UK is through a National Health Service and is therefore subject to intensive public and political scrutiny and direction. This is not the situation in

WHAT IS NEEDS ASSESSMENT?

most comparable populations with alternative often private or insurance based health care systems. It is important to recognize the importance of population perceptions and political process. Recent election campaigns have seen candidates elected and deposed based almost entirely on proposals to close or re-locate local health care provision.

Given the considerable work regarding the future provision of neurosurgical services in Scotland that precedes this needs assessment, it was initially intended that this needs assessment should adopt as objective an approach as possible with its starting point being, in effect, a 'blank piece' of paper. This rapidly proved impossible and we have instead tried to give a review of the current situation, of how neurosurgery services in Scotland arrived at this point and of what the available evidence suggests is the optimum way to meet patient needs over the next decade or more.

As already discussed in the introduction and highlighted by the previous work of the Neurosciences Action team the available information on Neurosurgery and neurosciences in Scotland is less than ideal. This view has also been recently confirmed by the Report of Neurosurgery Implementation Group, Data sub group. The methods adopted to undertake this needs assessment, therefore included not just an analysis of ISD Scotland data on current neurosurgical activity in Scotland but also a synthesis of guidelines and recommendations from key documents, a brief review of current service provision, a comprehensive literature review, a corporate perspective from the neurosurgical community in Scotland and an attempt to obtain data on neurosurgical service provision in comparable populations.

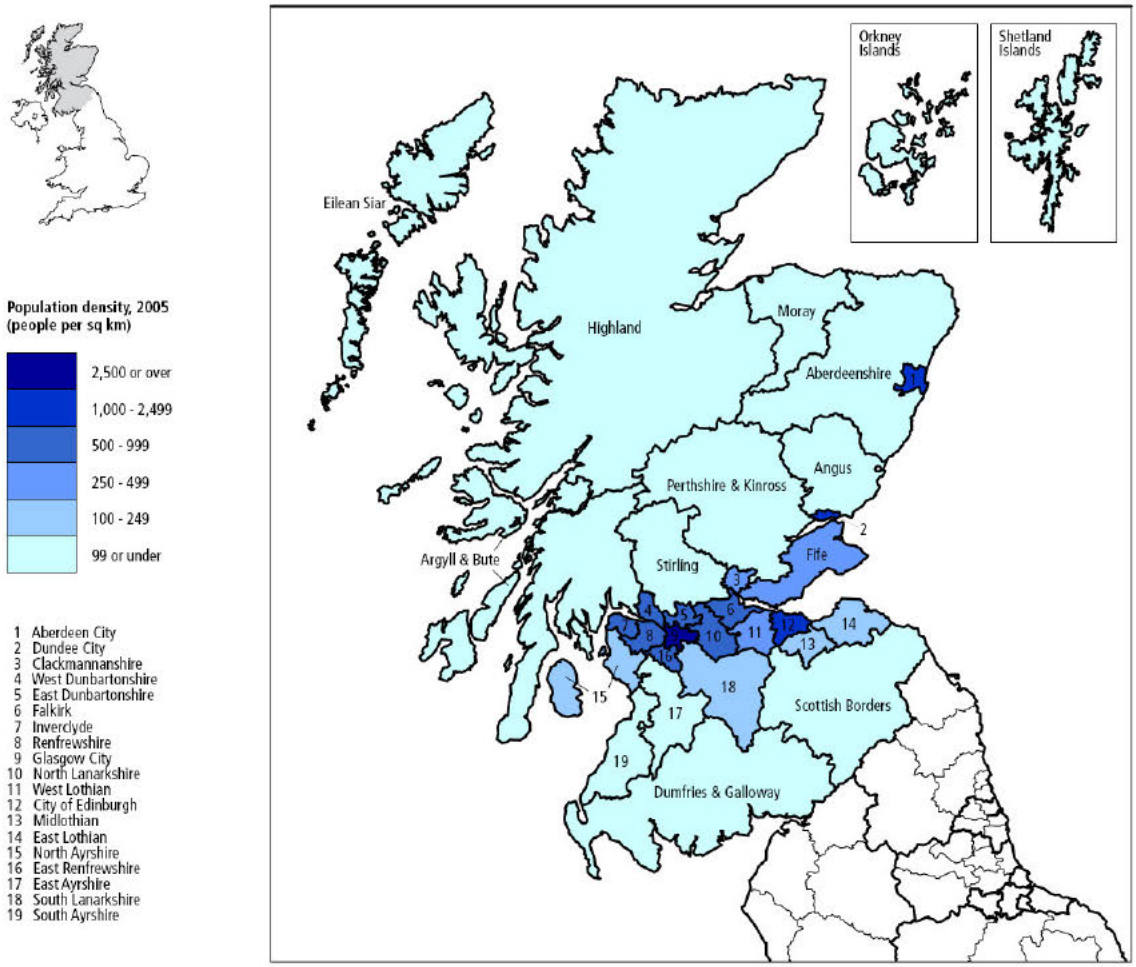
EPIDEMIOLOGICAL NEEDS ASSESSMENT

Demographic Data - Scotland

Geography

Scotland is a nation in northwest Europe and one of the four constituent countries of the United Kingdom. It occupies the northern third of the island of Great Britain and shares a land border to the south with England. It is bounded by the North Sea to the east, the Atlantic Ocean to the north and west, and the North Channel and Irish Sea to the southwest. Apart from the mainland, Scotland consists of over 790 islands. In general only the more accessible and larger islands retain human populations and fewer than 90 are currently inhabited. The total land mass is 78,772 km^2 (30,414 miles^2) [21] with 1.9% of the land mass covered by water.

Fig. 2 Population density of Local Authority areas in Scotland, 2005.

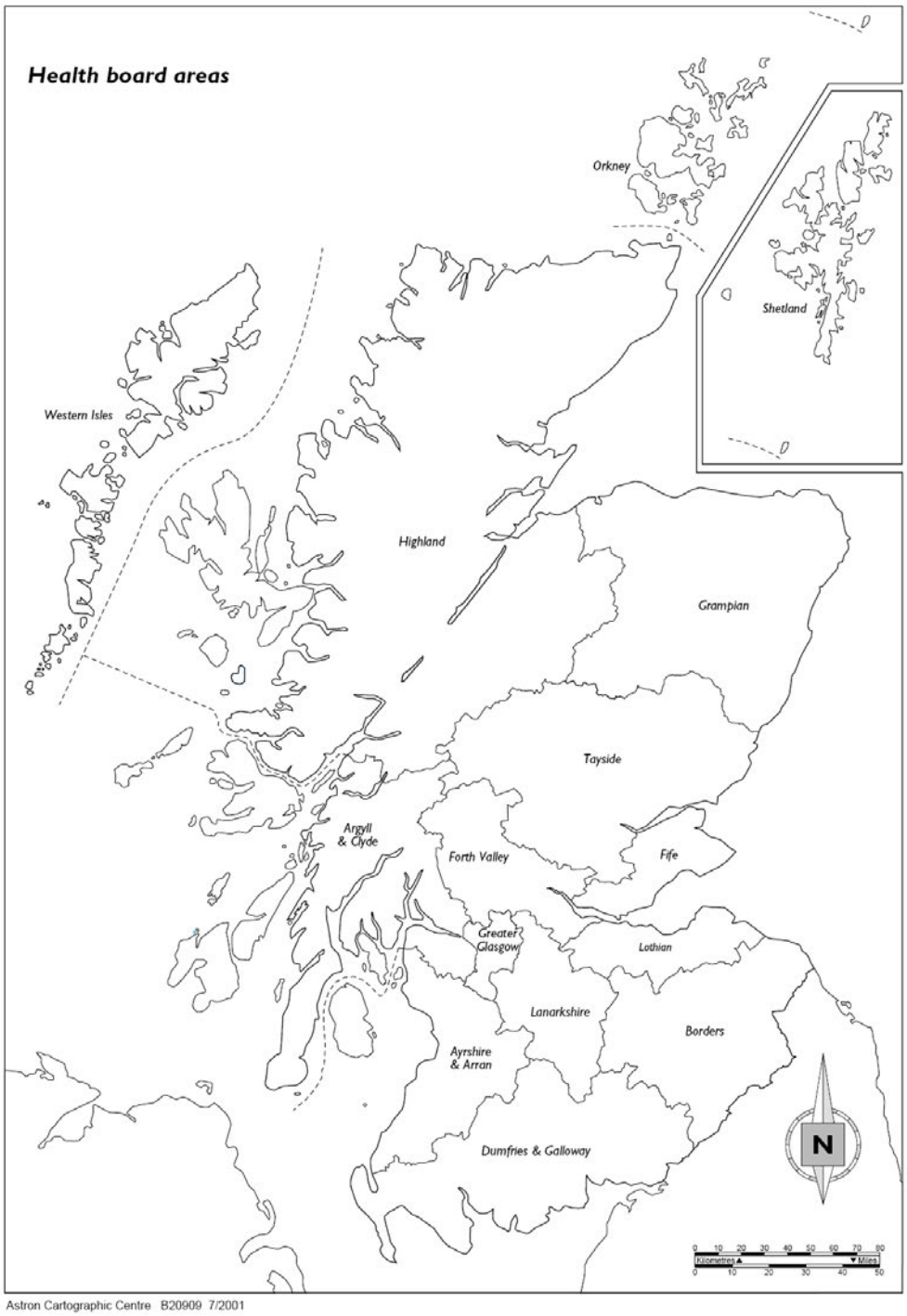


Source: www.statistics.gov.uk

EPIDEMIOLOGICAL NEEDS ASSESSMENT

NHS Boards
The population of Scotland is served by territorial NHS Boards. Before 2006 there were 15 geographical Boards.(Figure 3)

Fig. 3 NHS Board Areas in Scotland.



There are now 14 Territorial Boards as NHS Argyl and Clyde has been dissolved and responsibility for health care to that population shared between NHS Greater Glasgow and Clyde and NHS Highland.

EPIDEMIOLOGICAL NEEDS ASSESSMENT

Scotland Population Data

The population of Scotland in the 2001 census was 5,062,011. This has risen to 5,116,900 according to June 2006 estimates. [22]

Table 1. 2004 Estimated Population

	0-15	16-64	65-79	80+	All Ages
SCOTLAND	935,456	3,316,390	620,765	205,789	5,078,400
Argyll & Clyde	76,994	269,072	52,997	16,595	415,658
Ayrshire & Arran	68,313	234,486	48,769	16,022	367,590
Borders	20,271	68,014	15,610	5,375	109,270
Dumfries & Galloway	26,294	91,797	22,579	7,260	147,930
Fife	66,524	229,354	43,481	15,160	354,519
Forth Valley	54,253	183,133	33,649	10,729	281,764
Grampian	96,017	345,850	61,344	20,809	524,020
Greater Glasgow	156,133	575,794	101,444	33,712	867,083
Highland	39,683	135,046	27,653	8,958	211,340
Lanarkshire	108,751	364,413	64,547	18,403	556,114
Lothian	139,625	530,624	86,612	30,643	787,504
Orkney	3,675	12,407	2,518	900	19,500
Shetland	4,588	14,115	2,339	898	21,940
Tayside	69,522	246,117	53,411	18,858	387,908
Western Isles	4,813	16,168	3,812	1,467	26,260

Population Projections

The population is projected to rise slightly over the next decade with the projected populations by NHS Board Area appearing as in the table below.

Table 2. 2017 Projected Population

	0-15	16-64	65-79	80+	All Ages
SCOTLAND	836,329	3,269,940	747,110	273,790	5,127,169
Argyll & Clyde	64379	251693	62811	21437	400320
Ayrshire & Arran[1]	58279	220110	60744	21915	361048
Borders	20189	71001	20989	7527	119706
Dumfries & Galloway	21421	85395	29230	11059	147105
Fife	63831	235071	56449	20458	375809
Forth Valley	50377	184419	42806	14758	292360
Grampian	79134	322938	79820	29756	511648
Greater Glasgow	137161	570640	99805	38022	845628
Highland	34975	132361	37645	13416	218397
Lanarkshire	100125	361761	78077	27048	567011
Lothian	135098	566770	103232	39164	844264
Orkney	2794	11896	3652	1253	19595
Shetland	3455	12603	3565	1175	20798
Tayside	61062	229464	63633	25095	379254
Western Isles	4049	13818	4652	1707	24226

[1] Argyll and Clyde NHS Board is now merged into GG NHSB and Highland NHSB but has not yet been removed from GRO (S) projections.

EPIDEMIOLOGICAL NEEDS ASSESSMENT

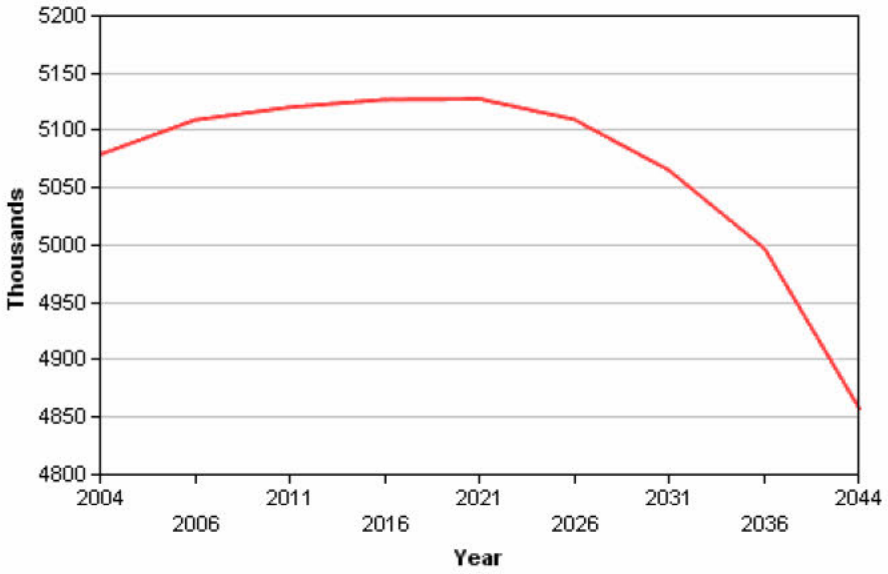
Although the figures above indicate an increasing population size this is explained by short-term inward migration with the overall trend for Scotland's population anticipated to decrease over time due to natural decline, as shown in the table below.

Table 3: Population Size Projections – and changes over time[23]

Year	Males	Females	Total Population
2021	2,471,000	2,656,000	5,127,000
2044	2,318,000	2,539,000	4,857,000

It should be stressed that precise population predictions are difficult and can be very sensitive to relatively small changes in the underlying assumptions. For example, in and out migration could change very substantially in comparatively short periods of time.

Figure 4. Scotland's Population – Long-term projection (Source: GRO Scotland)



Whilst it can be seen that the overall Scottish population is projected to rise very slightly over the next 15 years before decreasing, the size of these changes is small and these changes are unlikely to have any clinically significant effect on the overall need for neurosurgical services in Scotland.

Although Scotland's population size will increase slightly over the next 15 years, due to inward migration, the long-term projection is currently for an eventual decrease to below the current population size.

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Population Age Structure

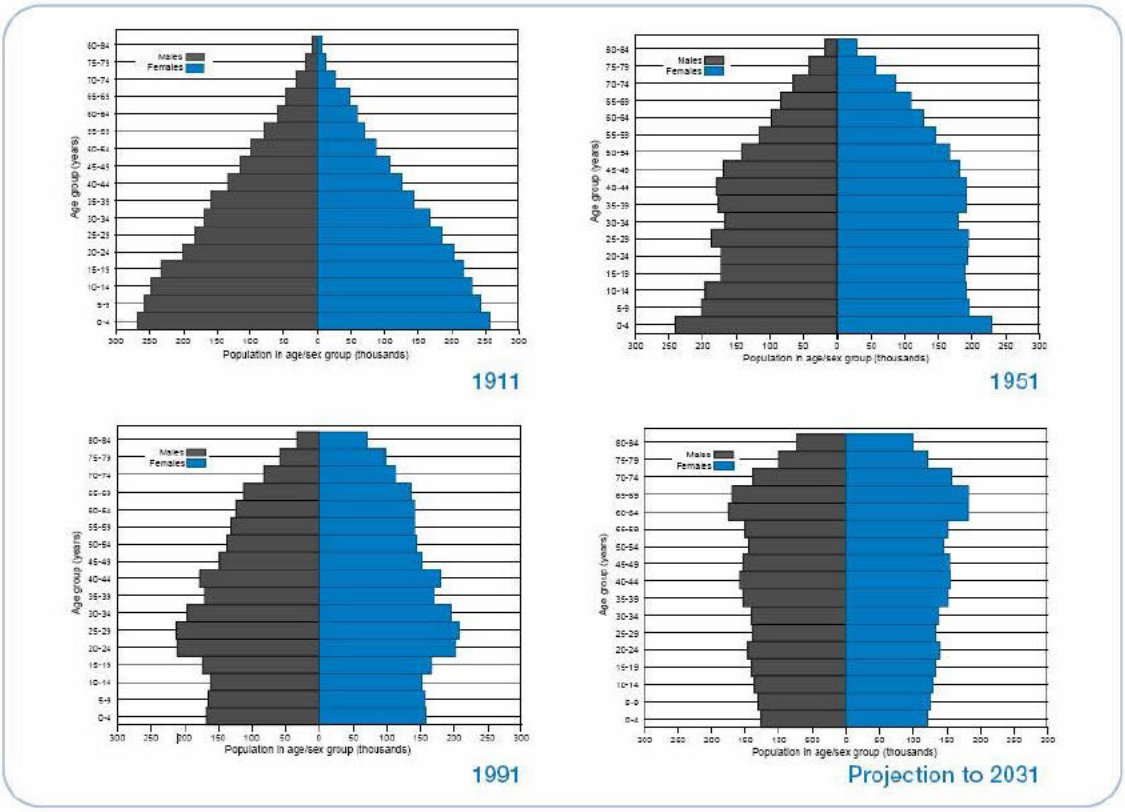
The effect of demographic changes is not, however, limited to overall population size and it is therefore important to consider the exact composition of the population by age. A key demographic feature of Scotland's population is that despite a relatively small rise in the overall size of the population, the population is projected to age markedly. This change in the population age structure means that the population of adults over 65 years is projected to increase in real numbers and as a proportion of the total Scottish population over 40 year period, as shown in the table below.

Table 4. Age Distribution – and changes over time[23]

Year	Males	Females	Total over 65	% of Total Population
2004	341,000	486,000	827,000	16%
2021	489,000	604,000	1,093,000	21%
2044	593,000	770,000	1,363,000	28%

Scotland's ageing population is dramatically illustrated in the four sections of Figure 5, each a snapshot of the size, age and gender structure of the population, at forty-year intervals and covering the 120 years from 1911. [24]

Figure 5: Scotland's Changing Population – 1911-2031



Overall, the number of children age 0-15 is projected to decrease by 12% over the next two decades, whilst the number of people of working age is projected to decrease by 1%

and the number of people projected of pensionable age is predicted to increase by 19%[23]. The table below provides further detail regarding the changing age structure of Scotland's population.

Table 5. Changes in Age Structure of Scotland's Population 2004-2024

	2004	2024
0 – 15	0.94m	0.82m
Working age	3.18m	3.14m
65+	0.97m	1.15m

Over the next two decades the proportion of the population of working age will decrease with this decrease reflected in the increased proportion of the population of pensionable age.

Clearly the growth in the number of people over 65 will have profound effects on a level of the chronic diseases and conditions associated with ageing[25].

In the Report, "*Dementia and Older People 2003,"* the changing population age structure was recognised as a significant challenge stating that "the demographic structure of Scotland will continue to change over the next 50 years." The "baby boomers" of the 1950s and 60s will be moving into their 70s and 80s from 2020 to 2040 and the ageing of this generation will be the major factor in the growth in the number of people over 65 in Scotland from 787,000 in the year 2000 to 1,238,000 in 2040, an increase of 57%. Over the same period, the number of people over 80 will rise by 103% from 183,000 to 373,000. Improvements in living conditions and better medical care will also continue to extend life expectancy, contributing to the growth in the number of older people. Whilst age is a risk factor, rather than a specific cause for conditions such as stroke, Parkinson's disease and dementia, this changing age structure will lead to significant increases in the prevalence of these conditions and the levels of need arising from them.

It can be seen that Scotland's population is ageing and this may lead to an increase in the number of patients requiring neurosurgical services due to age-related conditions.

The effects of population re-distribution

Although at the Scotland level the population is projected to rise over the next 15 years before declining slowly, there are differences in this pattern across Scotland with some areas projected to increase in size and others to decrease[23].

Whilst current predictions are that the population of 15 of the 32 Council areas in Scotland will increase, this is largely balanced by a corresponding decrease in the population in the remaining 17 Council areas.

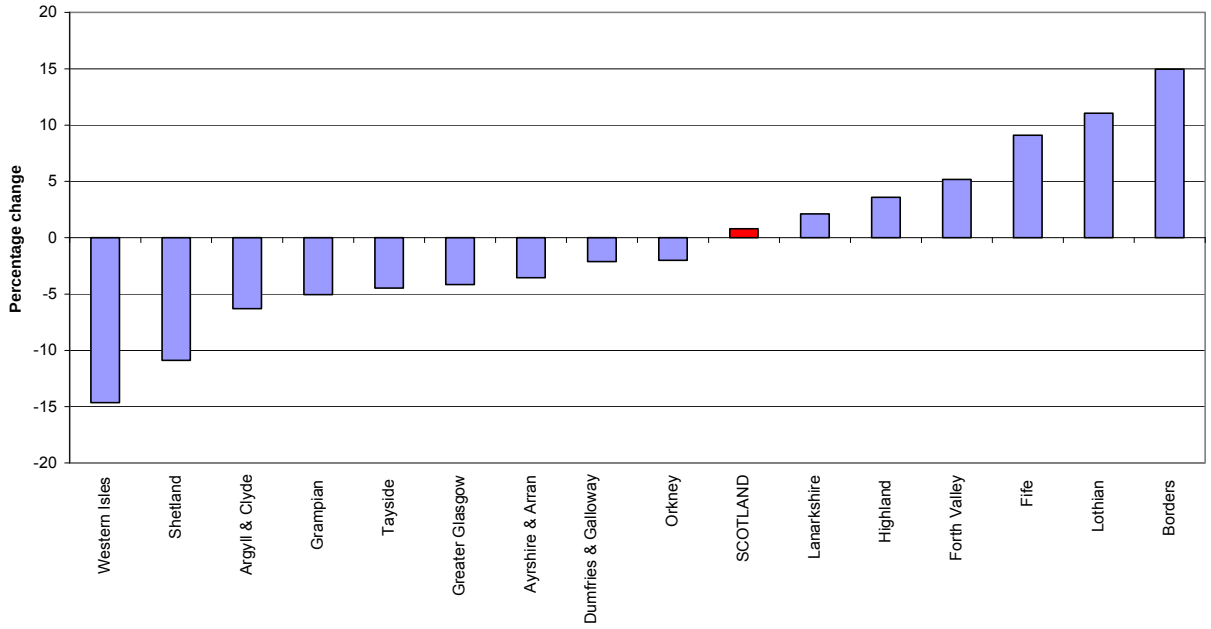
In general, most Councils adjacent to or close to Edinburgh City are projected to increase in size, whereas other large urban conurbations are projected to decline, for example, Glasgow City and Dundee City. Populations in other areas in the West, such as

Inverclyde, East and West Dunbartonshire, Renfrewshire and all the Island Council areas, are also projected to decline.

The Council areas projected to show the largest relative increases between 2004 and 2024 are West Lothian (21%), Scottish Borders (15%), East Lothian (13%) and Edinburgh City (10%). The largest relative population decreases are projected in Aberdeen City (24% decrease), Dundee City (15% decrease), Western Isles (15% decrease) and Inverclyde (14% decrease).

These figures, based upon local council areas are informative but do not reflect the impacts upon NHS Board Areas or Neurosurgical centres. For example, Tayside and Grampian NHS Boards contain large urban councils with populations predicted to decline but this decline may be partly offset by a corresponding increase in the population living in semi-rural locations. The only mainly urban NHS Board is NHS Greater Glasgow and Clyde. In 2005 the population of Argyll and Clyde NHS Board Area was reallocated to Highland (22%) and Greater Glasgow (78%). Whilst this makes detailed analysis of trend data more challenging the small area analysis published by GRO suggests that the population areas formerly in Argyll and Clyde and now attached to Greater Glasgow will show a similar but slower decline in population to Glasgow city whereas the rural areas now attached to Highland NHS Board will show a small expansion and aging of the population similar to but slightly less marked than in Highland.

Fig 6. Projected percentage change in population by NHS Board Area 2004-2024



Thus the geographic distribution of Scotland's population will change over time with the population density becoming greater in Edinburgh City and Council areas adjacent to Edinburgh.

Neurosciences Activity

Previous reports into neurosurgery in Scotland have already identified that current information systems, data recording and data analysis are inadequate to allow a clear picture of neurosurgery activity in Scotland to be established. In addition, there is insufficient high quality data to allow accurate clinical audit and monitoring of health care quality.[2;7]

The important data requirements were identified as

1. To establish a baseline of Neurosurgical Activity Data in the four neurosurgery units
2. To identify any clear trends arising from this data
3. To try to establish the incidence and prevalence of neurosurgical conditions requiring a neurosurgical intervention in Scotland
4. To analyse national level data on neurology and neurosurgery admissions to all Scottish Hospitals to identify if any other hospitals outside the four units are providing neurosurgery services in Scotland
5. To analyse national level data on neurology and neurosurgery admissions to all Scottish Hospitals to identify if any other specialists are providing neurosurgery services in Scotland
6. To use demographic data to predict any impact of demographic change on current activity levels

Baseline Activity Data

ISD Scotland produced selected Neurosciences activity data for the Neurosciences Action Team Report. As time and ISD resources were limited it was agreed where possible to use the previous data and the data already provided for the Data sub Group of the Neurosciences Implementation Group.

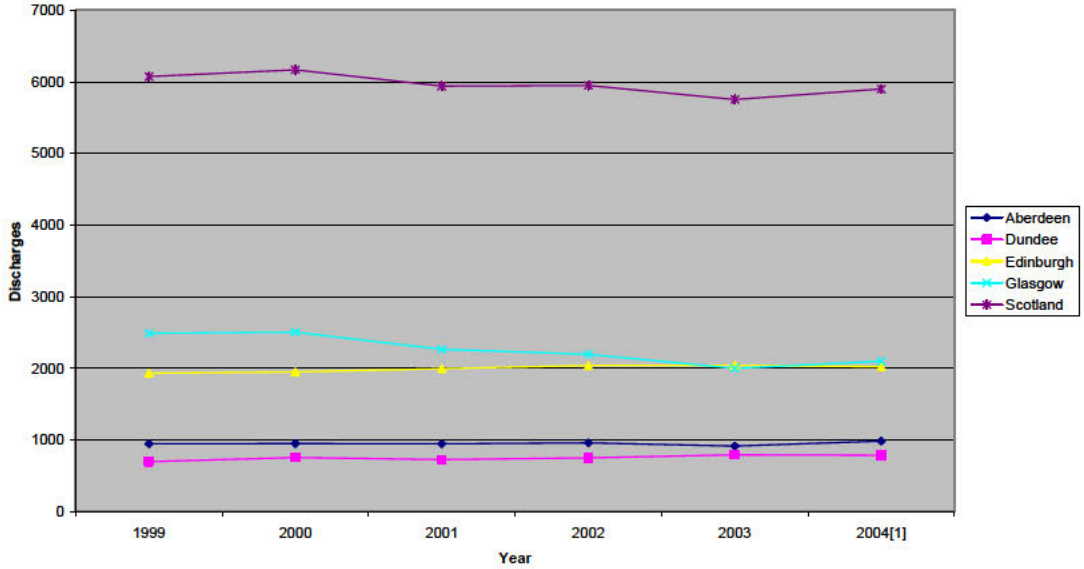
Table 6. Discharges from Neurosurgery with an operation code by year.

Year	Aberdeen	Dundee	Edinburgh	Glasgow	Scotland
1999	949	700	1933	2490	**6072**
2000	952	756	1952	2505	**6165**
2001	949	726	1996	2266	**5937**
2002	960	751	2040	2197	**5948**
2003	916	792	2044	2001	**5753**
2004[2]	987	788	2023	2100	**5898**

The average number of Neurosurgery Discharges following an operation was 5962. The actual number of procedures will be slightly higher than this as some patients may have had more than one procedure prior to discharge.

[2] Figures quoted in NAT Report were incomplete, part year figures. In this table an estimate is used for Glasgow activity based on previous years.

Fig. 7 Discharges from Neurosurgery with an operation by Neurosurgery centre



These data demonstrate that there is no clear historical trend in operation rates, either up or down. There may be a slight tendency to decreasing operation rates in Glasgow but the reason for that is not clear and would need further investigation before any conclusions could be drawn. Total numbers are too small to look at yearly trends for individual operations. Using three-year averages was more valid but no clear patterns were seen.

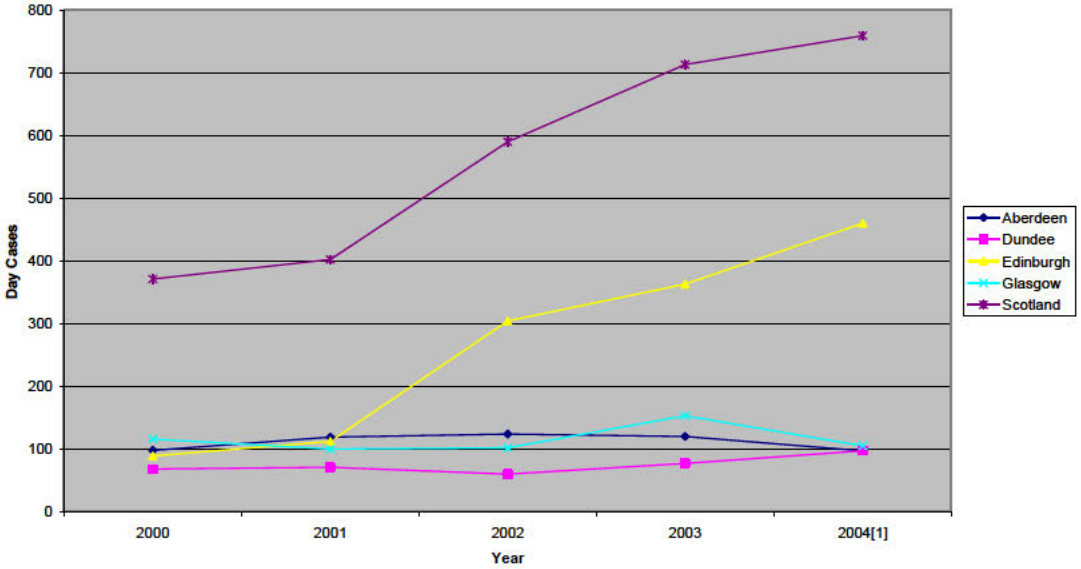
Day Case Procedures

The average number of day cases is 567 per year and there is a clear trend for this activity to increase. There has been a marked increase in day case activity in Edinburgh but this has not been associated with any reduction in in-patient activity. It is not possible from these data to ascertain if this increase reflects a high quality, efficient service or is due to pressure on in-patient beds.

Table 7. Day cases by Neurosurgery with an operation code

Year	**Aberdeen**	**Dundee**	**Edinburgh**	**Glasgow**	**Scotland**
2000	98	68	89	116	**371**
2001	119	71	112	100	**402**
2002	124	60	304	102	**590**
2003	120	77	363	153	**713**
2004[1]	97	97	460	105	**759**

Fig. 8 Day Case numbers by Neurosurgery centre.



These day case procedures must be added to the in-patient activity to give a true picture of overall surgical activity.

The total Neurosurgical activity in the four Scottish Centres is around 5962 in-patient cases plus 567 (and rising) day case procedures or 6500 procedures per annum.

Length of Stay

The other factor which might reflect changing practice, unmet need or pressure on beds is average length of stay per episode. The Neurosciences Action team found the following picture

Table 8. Mean Length of Stay (days)

Year	**Aberdeen**	**Dundee**	**Edinburgh**	**Glasgow**	**Scotland**
2000	9.1	8.4	6.5	7.2	**7.4**
2001	8.5	8.6	7.5	7.2	**7.6**
2002	8.5	8.1	7	7.1	**7.3**
2003	9.2	7.9	6.3	7.3	**7.3**
2004[1]	5.8	7.2	4.8	7.6	**6.2**

Interestingly there is a trend to reducing length of stay across Scotland which is likely to be an accurate reflection of the true trend. For smaller units these data will be less stable and subject to wider variations. The most marked trend has also been in Edinburgh. Again it is not possible to say if this is driven by quality improvement or by pressure on beds. It would be useful to compare these data with quality and outcomes measures but as stated above these are not currently routinely collected or available at national level.

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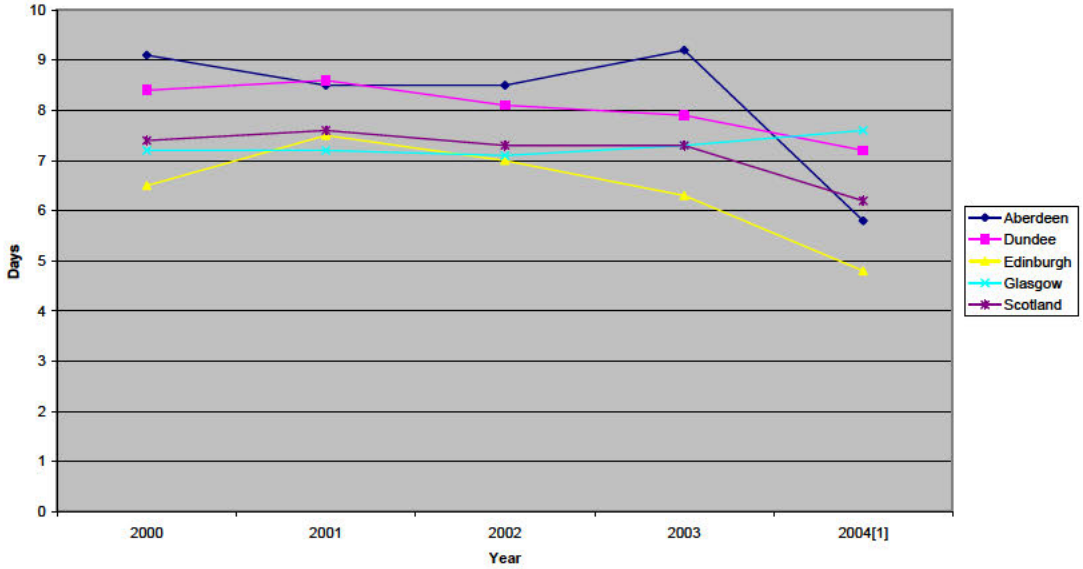
Fig. 9 Mean Stay (days) per episode.



Incidence and Prevalence of Neurosurgical and Neurological Conditions

In conducting a Needs Assessment of a specific disease or condition it is highly desirable to try to identify measures of need and use these to estimate levels of unmet need. This is particularly challenging when a needs assessment is requested for a service or intervention. Typically that service has developed to meet a particular indication or condition but this will usually reflect demand rather than need. As a scientific definition of need is "capacity to benefit" a true epidemiological needs assessment would need to assess the overall health of every member of the population and compare this with all the interventions which a service might be able to offer. In practice this is usually an impossibly large task and unlikely to reveal large areas of true need. It also tends to be unhelpful to an existing service to highlight health care needs which it has probably already chosen not to address. Often these are within the care provided by another service or agency.

As neurosurgical intervention is typically highly specialized and life saving surgery it seems unlikely that there are large numbers of patients requiring a significant neurosurgical intervention who are not presenting to the universally available National Health Service. In this analysis we have therefore looked mainly at Neurosurgery and neurosciences activity using this as a reasonable proxy for the level of neurosurgical healthcare need. Ideally this data should be viewed alongside an analysis of waiting times data but unless waiting times are rapidly changing it is likely that supply and demand are in a fairly steady state in all the NHS Board Areas.

Through discussion with ISD Scotland, the following analysis was undertaken using ISD Scotland's linked databases.

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To ensure consistency, the diagnoses (requiring neurosurgical services) used for the purpose of the ISD Scotland analysis were obtained from the Data Sub Group of the Neurosciences Implementation Group.

Analysis Plan
1) Incidence (new cases) in 2005 (i.e. count if first time person ever discharged for condition) – by age band (bands to be confirmed), sex and (new) NHS board – numbers and rates
2) "Active" prevalence in 2005 (i.e. number of people discharged with that condition mentioned) – by age band (bands to be confirmed), sex and (new) NHS board – numbers and rates
3) Count of procedures performed (2001-05 combined) by hospital (i) by individual procedure code and (ii) for each procedure group – by age band (bands to be confirmed) and sex
4) Count of procedures performed (2001-05 combined) by hospital and by specialty (i) by individual procedure code and (ii) for each procedure group – by age band (bands to be confirmed) and sex
5) For those patients receiving procedures at one of the four specialist neurosurgical hospitals (2001-2005 combined) a. how many were transferred from a non-neurosurgical specialist hospital and how many came directly to the neurosurgical hospital? b. How many who were transferred in had listed procedures at the non-neurosurgical specialist hospital before being transferred to the specialist hospital By (i) individual procedure code and (ii) for each procedure group.

ISD conducted a search of all data collected on discharges from acute hospitals (non-obstetric, non-psychiatric) (SMR01) in Scotland back to 1996. Probability matching methods have been used to link together individual SMR01 hospital episodes for each patient, thereby creating "linked" patient histories. "Incident cases" are patients who are admitted for the first time for a specific condition.

For this analysis the calendar year 2005 was selected as the base year this being the most recent calendar year for which full records were available. Thus any patient with a repeat admission for the same diagnosis or procedure is excluded and only new cases admitted during 2005 were counted. Up to six diagnoses (1 main and up to five secondary) can be recorded on SMR01 forms. All six positions were used to search for relevant diagnoses. Diagnostic group was assigned on the first relevant diagnosis encountered.

The data sub group of the Neurosciences Implementation Group assisted with developing the definitions and identifying the appropriate SMR 01 for analysis. The data sub group, led by Mr Douglas Gentleman submitted a final report on data quality to NIG in September 2007.[26] The data sub group found considerable use of non-specific codes and that the use of these codes is variable between centres. The data sub group met with representative groups of neurosurgeons from each of the four centres and agreed that whilst there may be a degree of under recording due to these coding issues that the numbers and patterns in the aggregate ISD data do give a broadly accurate picture of neurosurgical activity in each centre. Particular issues were identified at Ninewells where

there did seem to be a significant degree of under recording of neurosurgery activity and that it is likely that this is due to Ninewells using procedure codes which were outwith the procedure and diagnosis groups identified as neurosurgical.

In order to try and ensure all available data was captured the data definitions were deliberately broad. The data sub group looked at a broad basket of neurological and neurosurgical conditions, diagnoses and procedures and included all those which might be relevant to the provision of neurosciences care. Data was requested from ISD for all available data within 10 broad diagnostic groupings as follows.

Patients were grouped as follows:-

- Brain tumour - benign
- Brain tumour - malignant
- Cerebrovascular - head
- Cerebrovascular - neck
- Head trauma
- Functional neurosurgery
- Spinal - Trauma
- Spinal - Degenerative disease
- Peripheral Nerves
- Paediatric
- CSF
- Infections
- Complications

Incidence of New Neurosurgical and Neurological Conditions

Incident cases are defined as 'patients who are admitted for the first time for a specific condition'. This was achieved by using a matched analysis to exclude all patients who had a previous admission with a similar admission. Cases which were identified as have previously been treated for a similar diagnosis are therefore only included in the prevalence model.

Incidence levels were calculated at National and at NHS Board of residence levels. Due to the large quantity of data available it was agreed to reduce the complexity of data collection and analysis by grouping the analysis on the age groups 0-15, 16-64, 65-79 and 80+.

Data was analysed for 28,666 hospital discharges. A summary of data at Scotland level is provided at Table 9.

In order to try and identify differences in levels of neurosurgical need across Scotland the patients were grouped by broad diagnostic groups already defined by the NIG Data Sub group and by NHS Board of Residence. As the percentage of new "incident cases" presenting in each NHS Board Area closely matched the percentage of the overall Scotland population living in that NHS Board Area this suggests that at Board level incident cases are evenly geographically distributed throughout the Scottish population.

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Table 9. Incident discharges with a Neurological/Neurosurgical diagnosis, Scotland 2005.

SCOTLAND 2005	Age group				
	15 and under	16 to 64	65 to 79	80 and over	Discharges
Brain tumour – benign	11	137	69	28	403
Brain tumour – malignant	20	482	415	154	1,944
Cerebrovascular – head	17	1647	2246	1789	5,699
Cerebrovascular – neck	-	6	10	-	16
Head trauma	304	1143	381	270	2,098
Functional neurosurgery	793	2178	1333	1071	5,375
Spinal – Trauma	28	481	152	152	813
Spinal - Degenerative disease	16	1717	703	234	2,670
Peripheral Nerves	8	2697	869	320	3,894
Paediatric	67	-	-	-	67
CSF	-	101	36	6	143
Infections	10	43	26	3	82
Complications	341	3063	1549	509	5,462
Total					28,666

The above data are provided in full in appendix 4.

Given the evenly distributed incidence of neurological/neurosurgical condition diagnoses in Scotland, we can use the aggregate Scotland level data to build up a picture of which diagnoses groups most commonly occur across different age groups and this will apply in all four existing centres.

In the age group 15 and under, the highest reported number of neurological/ neurosurgical condition diagnoses incident cases are in the diagnosis group 'functional neurosurgery', followed by the diagnosis group 'complications' and the diagnosis group 'head trauma'. There is no marked gender difference.

In the age group 16 to 64, the highest reported number of neurological/ neurosurgical condition diagnoses incident cases are in the diagnosis group 'complications', followed by the diagnosis groups 'peripheral nerves', 'functional neurosurgery', 'spinal – degenerative disease' and 'cerebrovascular – head'. There appears to be a gender difference for two diagnoses with more men being diagnosed with a diagnosis of 'functional neurosurgery' and more women being diagnosed with a 'peripheral nerves' diagnosis.

In the age group 65 to 79, the highest reported number of neurological/ neurosurgical condition diagnoses incident cases are in the diagnosis group 'cerebrovascular – head',

followed by the diagnosis groups 'complications' and 'functional neurosurgery'. There is no marked gender difference. The diagnosis group 'cerebrovascular – head' includes the specific diagnosis for subarachnoid haemorrhage.

In the age group 80 and over, the highest reported number of neurological/ neurosurgical condition diagnoses incident cases are in the diagnosis group 'cerebrovascular – head', followed by the diagnosis group 'functional neurosurgery'.

Prevalence of Neurosurgical and Neurological Conditions

Having defined the incidence rates for new admissions with the neurosurgical or neurological conditions defined by the data sub group a second analysis was then conducted using a similar approach to record 'all cases admitted during 2005 regardless of previous admissions for the same condition' where the diagnosis or condition fitted the definition of neurosurgery/neurology as defined by the data sub group.

Again these statistics are derived from data collected on discharges from acute hospitals (non-obstetric, non-psychiatric) (SMR01) in Scotland and probability matching methods have been used to link together individual SMR01 hospital episodes for each patient, thereby creating "linked" patient histories. This analysis identified 34296 patient discharges.

Table 10. Prevalence – discharges, with a neurological/surgical diagnosis, Scotland 2005

SCOTLAND 2005	Age group				
	15 and under	16 to 64	65 to 79	80 and over	All ages
Brain tumour – benign	17	340	158	41	556
Brain tumour – malignant	30	1043	918	279	2270
Cerebrovascular – head	21	1904	2534	1969	6428
Cerebrovascular – neck	0	6	10	0	16
Head trauma	312	1236	411	285	2244
Functional neurosurgery	1012	3001	2189	1639	7841
Spinal – Trauma	28	493	154	155	830
Spinal - Degenerative disease	38	2067	796	254	3155
Peripheral Nerves	8	3305	999	355	4667
Paediatric	194	0	0	0	194
CSF	0	133	45	6	184
Infections	10	53	33	5	101
Complications	344	3272	1662	532	5810
Total					**34296**

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Again age specific prevalence rates for hospital admissions with these diagnoses were calculated for Scotland and by NHS Board area. (Appendix 4).

Analyzing these data by NHS Board of residence showed very similar patterns of admissions in all NHS Board areas. The percentage of overall admissions attributable to residents from each NHS Board Area almost exactly follows the proportion of the Scottish population in each NHS Board.

Table 11. Discharge Rates by NHS Board

Area	Total Prevalence of Neurological/ Neurosurgical Diagnoses [1]	Total Prevalence of Neurological/ Neurosurgical Diagnoses as %	Population as a % [2]
Scotland	34,296	100%	100%
Ayrshire & Arran	3,089	9.01%	7.16%
Borders	892	2.60%	2.15%
Dumfries & Galloway	135	0.39%	2.89%
Fife	2,669	7.78%	7.01%
Forth Valley	1,473	4.29%	5.59%
Grampian	3,673	10.71%	10.36%
Greater Glasgow	7,870	22.95%	23.29%
Highland	2,382	6.95%	5.99%
Lanarkshire	3,357	9.79%	10.91%
Lothian	4,905	14.30%	15.66%
Orkney	139	0.41%	0.39%
Shetland	No data	No data	0.43%
Tayside	2,455	7.16%	7.65%
Western Isles	205	0.60%	0.51%

1. ISD data
2. General Register Office for Scotland – Mid 2006 Population Estimates Scotland

As there are no significant variations between discharge rates by NHS Board and the expected level by NHS Board population size in these aggregate data this suggests that there are not significant variations in levels of activity or levels of neurological/neurosurgical need between NHS Board areas.

The prevalence in Dumfries and Galloway is artificially low as patients may have been treated in England and therefore not recorded in the ISD activity data for Scottish Neurosurgical Units.

Given the evenly distributed prevalence of neurological/neurosurgical condition diagnoses in Scotland, we can consider the Scotland level data to build up a picture of which diagnoses groups most commonly occur across age groups.

In the age group 15 and under, the highest reported prevalence of neurological/ neurosurgical condition diagnoses are in the diagnosis group 'functional neurosurgery', followed by the diagnosis group 'complications' and the diagnosis group 'head trauma'. This seems correct as the functional neurosurgery diagnosis group includes admissions for epilepsy and movement disorders. There is no marked gender difference. This is as anticipated given the incidence data for this age group.

In the age group 16 to 64, the highest reported prevalence of neurological/ neurosurgical condition diagnoses are in the diagnosis group 'peripheral nerves', followed by the diagnosis groups 'complications, 'functional neurosurgery', 'spinal – degenerative disease' and 'cerebrovascular – head'. There appears to be a gender difference for three diagnosis groups with more men being admitted with a condition in the 'functional neurosurgery' diagnosis group and in the 'cerebrovascular – head' diagnosis group and more women being admitted with a condition in the 'peripheral nerves' diagnosis. Again this information mirrors the pattern seen when looking at incidence in the age group.

In the age group 65 to 79, the highest reported prevalence of neurological/ neurosurgical condition diagnoses are in the diagnosis group 'cerebrovascular – head', followed by the diagnosis groups 'functional neurosurgery' and 'complications'. An apparent slight gender difference is seen with more being admitted in the 'functional neurosurgery' diagnosis group than women.

In the age group 80 and over, the highest reported prevalence of neurological/ neurosurgical condition diagnoses are in the diagnosis group 'cerebrovascular – head', followed by the diagnosis group 'functional neurosurgery'.

Neurosurgery and Neurology Activity Data

As well as quantifying the incidence and prevalence of neurosurgical and neurological conditions requiring hospitalization, it is important to attempt to quantify the levels and types of neurosurgical interventions being performed in Scottish Hospitals.

Whilst it appeared likely that the majority of interventional neurosurgery was being performed within the four main neurosurgical centres it was important to confirm that this was indeed the case. Also it was important to test whether the procedures being performed within the neurosurgery centres were also being performed in other hospitals or by other specialists.

For this reason ISD was asked to provide a complete record of all discharges from and procedures performed in Scottish Hospitals for patients with any neurological / neurosurgical condition or diagnosis for the five years 2001 to 2005. This data was then analysed by location, clinical specialty, sex and age. Diagnosis and procedures are based

on Neurosciences Implementation Group (Data Sub Group) categories. See Appendices for detailed breakdown.

Procedures are categorised into 3 groups:

- Procedures - episodes where an operation/procedure was performed belonging to the defined procedure group for that diagnosis.
- Other Procedures - episodes where an operation/procedure was performed but not classified as belonging to the defined neurosurgical procedure group for that diagnosis.
- No procedure done - episodes where an operation/procedure was not required or performed. These statistics are derived from data collected on discharges from acute hospitals (non-obstetric, non-psychiatric) (SMR01) in Scotland and record Scottish residents only.[3]

The appendices give a detailed breakdown of the surgical activity within the Neurosurgery Centres and of the activity taking place across all Scottish Hospitals.

Hospitals and Specialties involved in Delivering Neurological and Neurosurgical Procedures

Out of the 173 hospitals listed by ISD, 53 hospitals undertook procedures defined as possibly neurosurgical procedures by the Data Sub Group. The 53 hospitals include the 7 hospitals where neurosurgical procedures may be expected to be undertaken, namely Southern General Hospital, Royal Hospital for Sick Children (Glasgow), Aberdeen Royal Infirmary, Royal Aberdeen Children's Hospital, Western General Hospital, Royal Hospital for Sick Children (Edinburgh) and Ninewells Hospital.

Of 246,742 discharges with a neurosurgical or neurological diagnosis which were analysed 21,721 discharges (8.8%) recorded that a neurosurgical procedure was undertaken, 103,952 discharges (42.1%) recorded that another type of procedure was undertaken and 121,069 discharges (49.1%) recorded that no procedure was undertaken. It was important to include all these data to try and ensure all neurosurgical activity was captured and to check what if any activity was taking place outside the four main centres.

Workload related to Peripheral Nerve Diagnosis Group

Out of the 13 diagnosis groups identified by the Data Sub Group, 78.4% (17,040) of all the procedures fell within the diagnosis group 'peripheral nerves'. Most (77% /13,126 cases) of these were peripheral nerve procedures undertaken orthopaedic surgeons.

[3] Up to six diagnoses (1 main and up to five secondary) can be recorded on SMR01 forms. All six positions were used to search for relevant diagnoses. Diagnostic group is assigned on the first relevant diagnosis encountered. Up to four procedures (1 main and up to 3 secondary) can be recorded on SMR01 forms. All 4 positions were used to search for relevant procedures. Procedure group is assigned on the first relevant procedure encountered.

The vast majority (99.4%) of activity taking place outside the main neurosurgery centres was found to be undertaken to address conditions of the peripheral nerves. The only neurosurgery recorded as having taken place outside the neurosurgery centres was 'head trauma' (4 procedures), 'cerebrovascular – neck' (17 procedures) and 'spinal – degenerative disease' (1 procedure).
The vast majority of peripheral nerve surgery (99.4% / 3,989 procedures) was undertaken by orthopaedics.

Neurosurgical procedures performed within the Neurosurgery Specialty

The following section considers activity in those hospitals with dedicated Neurosurgery departments. The data relates to their overall neurosurgical workload (i.e. all neurosurgery diagnoses and condition whether undertaken by Neurosurgery or by other specialties).

The Southern General Hospital (G405H) has the largest workload (3,055 procedures) with 67% (2042 procedures) undertaken by Neurosurgery. A very small proportion (1.9%) of this workload deals with conditions within the peripheral nerve diagnosis group. Orthopaedics is responsible for 95% of the rest of the workload mostly to address conditions within the peripheral nerve diagnosis group.

The Western General Hospital (S116H) had the next largest workload undertaking 1,939 neurosurgical procedures across five specialties. Neurosurgery undertook 98% (1896 procedures) of this workload with 23% (431 procedures) of Neurosurgery's workload addressing conditions within the peripheral nerve diagnosis group.

Aberdeen Royal Infirmary undertook 1,163 neurosurgical procedures across 11 specialties - with 82% (956 procedures) of this workload undertaken by Neurosurgery.

Ninewells Hospital (T101H) undertook a comparative overall number of neurosurgical procedures (1,163 procedures) as Aberdeen Royal Infirmary.

Ninewells Hospital has built up considerable expertise in functional neurosurgery for psychiatric disorders (see Appendix re Advanced Interventions/Neurosurgery for Mental Disorder National Service) with the 26% of Ninewells Neurosurgery Dept.'s workload being "Functional" neurosurgery. Functional Neurosurgery represents 6% of the Southern's Neurosurgery workload and 4% of the Western's Neurosurgery workload. The total number of neurosurgical procedures to address functional neurosurgery undertaken by the Southern (112) is comparable to the number of neurosurgical procedures to address functional neurosurgery undertaken by Ninewells (136) but the case mix will be different. Despite the apparently smaller activity in these data, Edinburgh has a good track record for functional neurosurgery including a published clinical trial and recent provision of functional surgery for dystonia in adolescents.

Workload for "Other Procedures"

Out of the 173 hospitals listed by ISD, 85 hospitals undertook procedures defined as 'other procedures' by the Data Sub Group.

EPIDEMIOLOGICAL NEEDS ASSESSMENT

103,952 discharges out of the total 246,742 discharges analysed were recorded as having undergone an 'other procedure.

The 103,952 'other procedures' that were undertaken were to address a range of conditions.

Across all the clinical specialties 23.5% (24,441) of the "other procedures" were undertaken to address conditions listed as 'cerebrovascular – head' by the Data Sub Group, .

Neurosurgery, undertook 9.6% (9,984) of all the "other procedures", 38.8% (3,874) of these were for conditions in the spinal – degenerative disease diagnosis group with a further 15% (1,500) to address conditions in the cerebrovascular – head diagnosis group and 15% (1,495) for the head trauma diagnosis group.

Orthopaedics, was responsible for 8.8% of all the "other procedures", 16% (1,474) were undertaken to address conditions in the spinal – degenerative disease diagnosis group.

Analysis of all Discharges over five years confirmed that no significant neurosurgical activity is taking place outside the neurosurgery centres.

Almost 32,000 neurosurgical procedures were identified over the 5 years.

Over the five years, two thirds of all operations for spinal degenerative disease were by neurosurgery with the remainder by orthopaedics.

Almost all peripheral nerve surgery is undertaken by orthopaedics with a fairly small contribution from neurosurgery and plastic surgery.

EPIDEMIOLOGICAL NEEDS ASSESSMENT

What is the impact of population ageing on Neurosurgery Need?

By applying the previously calculated age specific incidence figures from 2005 to the predicted population for 2017 it is possible to calculated the expected number of incident cases for admissions and compare these data with that presented above.

Table 12. Expected discharges by diagnosis, Scotland 2017

2017 Cases					
SCOTLAND	Under 16	16 - 64	65-79	Over 80	All ages
Brain tumour – benign	10	237	140	48	434
Brain tumour – malignant	18	841	969	354	2182
Cerebrovascular – head	15	1624	2703	2380	6722
Cerebrovascular – neck	0	6	12	0	18
Head trauma	272	1127	459	359	2217
Functional neurosurgery	709	2147	1604	1425	5886
Spinal – Trauma	25	474	183	202	884
Spinal - Degenerative disease	14	1693	846	311	2865
Peripheral Nerves	7	2659	1046	426	4138
Paediatric	60	0	0	0	60
CSF	0	100	43	8	151
Infections	9	42	31	4	87
Complications	305	3020	1864	677	5866
Total					31509

Despite the rapidly ageing population the impact on incident cases of admission due to a neurosurgical or neurological condition as defined by the data sub group will be relatively small with a rise from **28,666** new cases per annum in 2004 to a predicted **31,509** by 2017.

Looking at Procedures versus no procedures predictions reveals that the majority of the increase in activity due to the ageing population will occur amongst those neurosurgical and neurological admissions which currently receive no Procedure. (Appendices) By 2017 the predicted total number of admissions with a neurosurgical or neurological diagnosis will increase from 22,040 in 2004 to 24,910 in 2017 but due to lower number of procedures in the very old groups the predicted number of procedures increases from **15501** to **15754**.

EPIDEMIOLOGICAL NEEDS ASSESSMENT

By combining the detailed population projections for each NHS Board area calculated by RGO with the age specific admission rates calculated above it is possible to begin to identify the effect of demographic change on the admissions numbers for patient with the neurosurgical and neurological conditions identified by the data sub group. A simple analysis of these effects is included in Table 13 below. Most NHS Board Areas will see an increase in admissions with the exception of Highland, Greater Glasgow and Ayr and Arran which will see reductions in new cases presenting by 2017.

Table 13. Projected admissions "incident cases" by NHS Board Area

	2004	2017
SCOTLAND	28,666	31,509
Ayr and Arran	2652	2342
Borders	765	787
Dumfries and Galloway	109*	1039
Fife	2243	2325
Forth Valley	1230	1776
Grampian	3136	3247
Greater Glasgow	6563	4858
Highland	1912	1428
Lanarkshire	2809	3365
Lothian	4163	4909
Orkney	114	132
Tayside	2090	2497
Shetland	No data	No data
Western Isles	168	166

Cost and cost-effectiveness of Neurosurgical Interventions

It is not possible to identify precise costs for neurosurgery services which are provided within the overall package of services provided by NHS Scotland. In particular it is difficult to estimate what proportion of the costs of parallel and support services should be attributed to neurosurgical care and such costings have little practical application as relocating neurosurgery services would not necessarily free any financial resources due to the need to maintain services such as laboratories, emergency theatres, blood transfusion and imaging.

Approximate expenditure attributable to Neurosurgery are published by ISD. These data suggest a total budget for neurosurgical services in NHS in Scotland of at least £35 Million per annum. These figures should be viewed with caution although the general impression is that the two larger units do not seem to offer any greater level of financial efficiency or "economies of scale".

Cost in health care can be a complex concept. It is not merely the financial cost attributable to a service which is important. Opportunity cost refers to the benefits lost (or gained) by changes in related services. The concept of opportunity cost is therefore fundamental to health economics and to needs assessment. It is based upon the idea that

scarcity of resources means that expending resources on one health care activity inevitably means sacrificing activity somewhere else. The opportunity cost of undertaking an activity is defined as the benefits that must be foregone by not allocating resources to the next best activity.[27] In the context of neurosurgery services the opportunity cost of maintaining a more expensive service model than necessary will be that resources are not available for expenditure elsewhere in health care. These effects might be felt within neurosurgery or might be passed on elsewhere, but in a health system where resources are limited there are always opportunity costs related to any decision.

It is also important to consider costs in the context of sustainability of services and affordability. A service model might appear initially attractive but will rapidly fail if it requires a level of investment which becomes unsustainable over time. It is therefore important to build a degree of flexibility into health care planning. Affordability must also be considered in terms of both capital and revenue costs. Additional staff have a substantial long term revenue cost whereas investments in structures do not. However, whilst capital costs can be offset into revenue by long term finance arrangements it must be remembered that these costs are fixed long term commitments and expensive purpose built health care facilities are of little use if the capital costs are such that there are no resources left to staff them.

Table 14. Acute Specialty Summary – Neurosurgery, by Patient Type 2006[28]

NHS Board	Inpatients			Day Cases			Outpatients			Total
	Net expend £000s	Dis-charges	Cost/ case £	Net expend £000s	Cases	Cost/ case £	Net expend £000s	Total Atten-dance	Cost per atten-dance	Expend £000s
Greater Glasgow	13,156	3,088	4,260	286	133	2,153	1,007	4,577	220	14,450
Grampian	3,516	1,095	3,211	149	110	1,350	180	2,432	74	3,845
Lothian	8,212	2,145	3,828	912	528	1,726	1,336	3,827	349	10,459
Tayside	4,964	854*	5,812	105	105	1,005	298	3,471	86	5,367
Totals or Averages	**29,848**	**7,182**	**4,156**	**1,452**	**876**	**1,657**	**2,895**	**15,207**	**190**	**34,195**

*As noted in data analysis above the data sub group identified a significant under recording of neurosurgical activity at Ninewells.

Neurosurgery services have been assessed to be cost effective with costs per QALY comparing favourably to those of other surgical interventions routinely provided in NHS Scotland.[29;30] Through the retrospective analysis of one year's admissions for neurosurgery which compared actual outcome with expected outcome in the absence of neurosurgical intervention and with the cost of neurosurgery, Pickard et al. [30] showed that neurosurgery in Britain is not expensive in comparison with the costs and benefits of other areas of medicine, and the cost per QALY is unexpectedly low except for severe diffuse head injury, malignant brain tumours and cerebral metastases.

Neurosurgery in Scotland – Current Provision

Adult neurosurgery in Scotland is delivered from four centres; Aberdeen Royal Infirmary, Ninewells Hospital Dundee, the Western General Hospital Edinburgh and the Institute for Neurological Sciences in the Southern General Hospital Glasgow. Except in Edinburgh, children requiring neurosurgical services are cared for in facilities close to the adult neurosurgical service. In Edinburgh, paediatric neurosurgery is based in the Royal Hospital for Sick Children. Ideally Neurosurgery should only be performed on a specialist paediatric neurosurgery site co-located with adult neurosurgery and paediatric intensive care. No such site currently exists in Scotland and there are no full time specialty trained paediatric neurosurgeons in place at this time. There is an NSD funded National Spinal Injuries Unit in Glasgow and all patients in Scotland who have a spinal injury with a corresponding neurological deficit are transferred there at the earliest opportunity.

Each of Scotland's neurosurgical units is an integral part of a multidisciplinary neurosciences service.[31] The larger critical mass of the Glasgow and Edinburgh units means that there is a free-standing Neurosciences complex. Although the two smaller neurosurgical centres (Aberdeen and Dundee) are not housed in a distinct neurosciences complex, the lack of a discrete neurosciences complex is offset in terms of good service delivery, access for teaching and research. Neurology services in Aberdeen will shortly move to an adjacent ward to the neurosurgery service providing a combined neurosciences unit. Each of the four neurosurgical units in Scotland provides high quality core neurosurgical services for their local population and some provide highly specialized national level services for specific patients or conditions.

Although professional opinion has consistently reported the standards of care in Scottish Neurosurgical Units to be high it has not been possible within the time frame of this report to challenge those reports or arrange a review of independent evidence of clinical outcomes. We have been made aware of some quality issues around the fabric of buildings and plant and the location of specific services. Specialty Advisors have identified some clinical areas as no longer "fit for purpose" and in Edinburgh the Neurosurgery Unit is located in a different hospital to the Regional Trauma Centre.

The four existing neurosurgery centres have always been managed independently by their local NHS NHS Board and for a time by competing NHS Trusts. As a result neurosurgery services in Scotland are continuously developing and as a result it is difficult for the findings of any review or analysis to remain accurate over time.

EPIDEMIOLOGICAL NEEDS ASSESSMENT

Table 15 – Neurosurgical resources and activity in Scottish units in relation to the population served including children.

	Notional Population Millions [1]	Consultants WTE (per million)	Average Staffed Beds (per million)	ITU Beds (per million)	Discharges (per million)	Operations (per million)	Operations as % of all admissions
Aberdeen	0.7	3.0 (4.3)	28[4] (40)	2+[4] (1.3)	1099 (1570)	949 (1355)	86%
Dundee	0.5	2.6 (5.2)	23 (46)	2+ (8.0)	925 (1850)	700 (1000)	76%
Edinburgh	1.3	4.7 (3.6)	46 (35)	4 (3.1)	2247 (1728)	1920 (1477)	85%
Glasgow	2.6	6.9 (2.7)	89 (34)	8 (3.1)	3433 (1320)	2490 (958)	73%
Scotland	5.1	17.2 (3.4)	187 (37)	17 (3.3)	7704 (1510)	6059 (1188)	78.6%

Source: Neurosciences Action Team Report[2]

Aberdeen

The adult and children's services are located at the Royal Infirmary at Foresterhill, the unit serving a notional population of some 700,000. Aberdeen's geographical catchment area is extensive, basically covering all areas North of a line between Fort William in the West and Montrose in the East, this and includes parts of the country served by relatively slow road links as well as the Northern Isles (Orkney and Shetland). Aberdeen Royal Infirmary has helicopter landing facilities.

Examples of typical travel times are

Inverness – Three hours by road
Elgin – up to two hours by road (one hour by helicopter)
Wick – Five hours (usually flown via Dyce airport)
Fort William – Five hours (Two hours by helicopter)
Orkney/Shetland (Two hours emergency by helicopter)

Note: Air transport times are one way only. In calculating delay to intervention journey times must be at least doubled as resources will usually require be flown in from another area.

A newly built children's hospital is adjacent to the main hospital and accessed by a short link corridor. There is no sub-specialty trained paediatric neurosurgeon although one consultant neurosurgeon has training and experience in providing paediatric neurosurgery. There is a paediatric theatre specially equipped for paediatric neurosurgery. Children with head injuries are looked after by a neurosurgeon (severe injuries) or a paediatric surgeon (more minor injuries). Paediatricians are actively involved in rehabilitation.

The current accommodation is high-quality and directly above all related services including access to a general ITU with 18 beds (allowing ITU bed availability to increase as outlined in Table 2.1), imaging facilities and a full time (5 days) dedicated operating theatre for neurosurgery. There are strong professional links with the intensive care unit and joint teaching sessions are regularly run involving nursing and AHP to ensure knowledge and skills are maintained to a sound specialist level.[32]

[4] Aberdeen has redesigned services to include neurosurgical ITU beds within a General ITU of 18 beds, staffed 24/7 and located adjacent to the neurosurgery unit. The staffed beds are now 30 which includes a four bedded level 2, ITU.

Out of hours surgery is provided in a general emergency theatre shared with other surgical specialties and staffed by experienced generic theatre nurses. Separate arrangements exist for out of hours paediatric and cardiac surgery theatres.

Interventional neuroradiology does not currently extend to the coiling of aneurysms although a consultant radiologist with committed sessions accompanies patients to Edinburgh and participates in their management.

Consultants are on the 2003 Consultant Contract and job plans specify a 45 hour working week which is EWTD compliant and includes infrequent out of hours call outs. Consultant specialty interests include paediatric surgery and pituitary surgery. Quality of life is reported to be high and recruitment and retention prospects good.

There is a shared middle grade rota including neurology and neurosurgical registrars and FY2 doctors. Junior Medical staffing is by surgical FY1 doctors to 10pm then covered by a surgical specialties FY2 rota shared with plastic surgery, urology and ENT. This arrangement work well.

Average ward bed occupancy currently exceeds 90%. Plans are in place to relocate acute stroke care to an adjacent ward on the same floor as existing neurology and adult rehabilitation beds creating a combined neurosciences unit. This will allow integrated provision of neurosurgery, neurophysiology, neuroradiology and neuropsychology, neurology and stroke medicine services. The combined unit will be managed by the same nurse and service managers and will provide for greater cross covering of middle grade doctors to further assist compliance with MMC rotas and EWTD. A business case has been prepared to extend consultant staffing to four neurosurgeons.

Dundee

Ninewells Hospital has accommodation for adult and paediatric neurosurgery, the latter being housed in a separate paediatric area. The unit serves a notional population of 500 - 600,000.

Accommodation and facilities are modern and developed to a high standard, the unit having relocated from the Dundee Royal Infirmary to a purpose built wing in1998. The adult unit is immediately adjacent to the new A&E Department, the trauma centre for Tayside and North Fife, and close to high quality vascular imaging facilities (although currently there is no specialist interventional neuro-radiologist).

Consultants are on the 2003 Consultant Contract and have a job plan of 44 hours which is felt to be EWTD compliant.

There is a dedicated 2-bedded adult neurosurgical ITU (with access to a general ITU if necessary) and a dedicated operating theatre. Since the introduction of Hospital at Night cover all ventilated patients are managed in the general ITU.[33] There is currently a vacant neuropathology consultant post. There are good road links to the surrounding region and the hospital has helicopter landing facilities.

There are no paediatric ITU beds and there is no sub-specialty trained paediatric neurosurgeon. Children are admitted to beds in the nearby paediatric unit.

Edinburgh

Adult neurosurgery is based in the neurosciences building of the Western General Hospital, while children are managed at the Royal Hospital for Sick Children.

The unit serves a notional population of 1.3 million but this has been increasing as more patients are referred from Dumfries & Galloway and Forth Valley.

At the Western General Hospital, neurosurgery has 2 dedicated operating theatres and shared access to a general intensive therapy unit at some distance from the neurosurgery unit. While no ITU beds are dedicated to neurosurgery, on average 4-5 beds can be occupied by neurosurgical patients at any time. Neuroradiology facilities (including MR and CT facilities) and a full range of complementary neuroscience services are on hand.

Overall, the neurosurgical facilities are well laid out (except for the distance from the ITU), although the unit is in need of some refurbishment and some expansion. The Western General does not have an Accident and Emergency Department and the main trauma hospital is the Royal Infirmary Edinburgh at Little France.

Neurosurgical inpatients are managed in a ward shared with neurology; junior medical staffing is provided by FY2 doctors and overnight cover is by a Hospital at Night Team.

The Royal Hospital for Sick Children has high quality accommodation, excellent functional links to adjacent supporting services, excellent imaging facilities and a paediatric intensive care unit.

Paediatric Neurosurgery is provided by a mix of sub-specialist paediatric neurosurgeons and neurosurgeons with extensive training and experience in paediatric neurosurgery (but whose main commitment is normally to adult neurosurgery). [34]

Glasgow

The Glasgow-based service is the largest in Scotland and ranks with the largest neurosurgery units in the United Kingdom, serving a population of some 2.6 million.

Neurosurgery is accommodated within the Institute for Neurological Sciences at the Southern General Hospital and incorporates a dedicated 8-bedded ITU and a separate 12-bedded paediatric ward. The unit has access to three dedicated operating theatres and the Institute incorporates a neuro-radiology suite including CT and MR scanners. The Institute offers a comprehensive spectrum of clinical neurosciences and an extensive portfolio of neurosurgical sub-specialty services through deployment of 3 surgical teams.

A fundamental refurbishment programme is underway with the early prospect of the integration of Maxillofacial surgery and ENT. The Southern General Hospital is one of two

hospitals in Glasgow designated as having a role in the reception and management of trauma in the city's medium-term acute services reconfiguration plans. It has a recently refurbished A&E department, enjoys good road links via the nearby M8 and has a helicopter landing pad.

Children with spina bifida and some children with hydrocephalus are currently managed at the Royal Hospital for Sick Children at Yorkhill, as are a proportion of children with head injury. Operative treatment is carried out at the Institute for Neurological Sciences. There are plans to re-site the Royal Hospital for Sick Children as part of a South Side Acute Hospital where it would be close to the neurosciences complex. It is anticipated that this development will take place on the Southern General Hospital site or on a new site in south Glasgow. The complement of neurosurgical consultant staff includes one sub-specialty trained paediatric neurosurgeon who is dedicated to the subspecialty on a full-time basis (1.0 WTE). This individual is supported by 2 consultants with training and experience in paediatric neurosurgery but whose main commitment is normally to adult neurosurgery. The paediatric neurosurgical service provides a secondary head injury service to A&E departments at the Southern General Hospital and other regional district general hospitals with paediatric units, and a tertiary head injury service to the Royal Hospital for Sick Children. [31]

The Queen Elizabeth National Spinal Injuries Unit

Approaching 1000 spinal fractures are dealt with by the A & E and Orthopaedic community annually. Only a small proportion have any neurosurgical involvement. Since 1992, all patients with a neurological deficit are meant to be transferred to the NSD funded Queen Elizabeth National Spinal Injuries Unit at the earliest opportunity. Research and on-going clinical audit does not support acute intervention or surgical stabilisation by the infrequent operator.

While there is no question that there is an increasing amount of spinal surgery being carried out by Neurosurgeons, the causes for this are multifactorial and may not be based simply on need. There is a huge debate regarding the need for degenerative disc surgery and a huge variation in operating rates within Scotland, UK and world-wide suggests many factors are involved.

Whilst it is clear the few orthopaedic surgeons are currently providing or training in spinal surgery, It is perhaps premature to suggest that in future all spinal surgery will be carried out by Neurosurgeons. It is possible that there will be convergence of orthopaedic and Spinal surgical training and practice but this is in the distant future.

At the National Spinal Injuries Unit a pragmatic approach is used with Neurosurgeons operating on neck injuries and an orthopaedic surgeon operating on thoraco-lumbar injuries. The patients are admitted under Rehabilitation Consultants and it is clear that this activity has not been captured in the analysis. Surgical figures are included in the Annual Report for the management of acute injuries.

Within the UK there is an increasing tendency to move Spinal Cord Injury Units to the vicinity of Neuroscience groupings. The driving force being the adjacent Neuroradiology and Neurophysiology Departments with Neurosurgery playing an important but relatively minor role.

In response to the Teasdale Report, it was felt this link would have to be maintained. This would become increasingly important as, on the not too distant horizon, interventional strategies are developed for the acute management of spinal cord injury. This is likely to lead to an increasing demand for Neuroradiology, Neurosurgical or appropriately trained Orthopaedic Surgeons.[35]

Elective Spinal Surgery

Elective spinal surgery is currently provided in all four Scottish Neurosurgical units. This is a developing area in which new technologies such as spinal implants are becoming more commonly used. Othopaedic surgeons are becoming less frequently involved and many new orthopaedic surgeons have very little training in back surgery.[34]

Neurosurgery Waiting Times

Standards concerning the promptness of admission and treatment were defined in Safe Neurosurgery 2000[15]. Those standards are: that every patient suffering from a neurosurgical emergency or a life threatening condition should be admitted immediately to a properly equipped and staffed neurosurgical unit; patients with urgent, but not life threatening, neurosurgical conditions should be admitted within 48 hours of diagnosis; and patients with painful or disabling conditions, that are not life threatening, should be seen by a consultant neurosurgeon within two weeks and be admitted, if admission is required, within six weeks of their condition being diagnosed.

Access is a significant component of satisfactorily addressing patient need. Typical waiting times are currently over 9 months at the two large centres in Scotland and less than 2 months at the two smaller centres.

Table 16. Neurosurgery Waiting Times, year ending 31 March 2007.

NHSSCOTLAND: WAITING TIMES FOR NEUROSURGERY
Selected locations; year ending 31st March 2007

Location	Indicator	Outpatient appointments	Inpatient / day case discharges
Aberdeen Royal Infirmary	Median Wait (days)	53	61
	90th Percentile Wait (days)	88	151
	Number of waiting times cases	1040	751
Ninewells Hospital	Median Wait (days)	72	28
	90th Percentile Wait (days)	160	88
	Number of waiting times cases	576	573
Southern General Hospital	Median Wait (days)	118	42
	90th Percentile Wait (days)	168	169
	Number of waiting times cases	626	946
Western General Hospital	Median Wait (days)	120	37
	90th Percentile Wait (days)	169	114
	Number of waiting times cases	958	1092

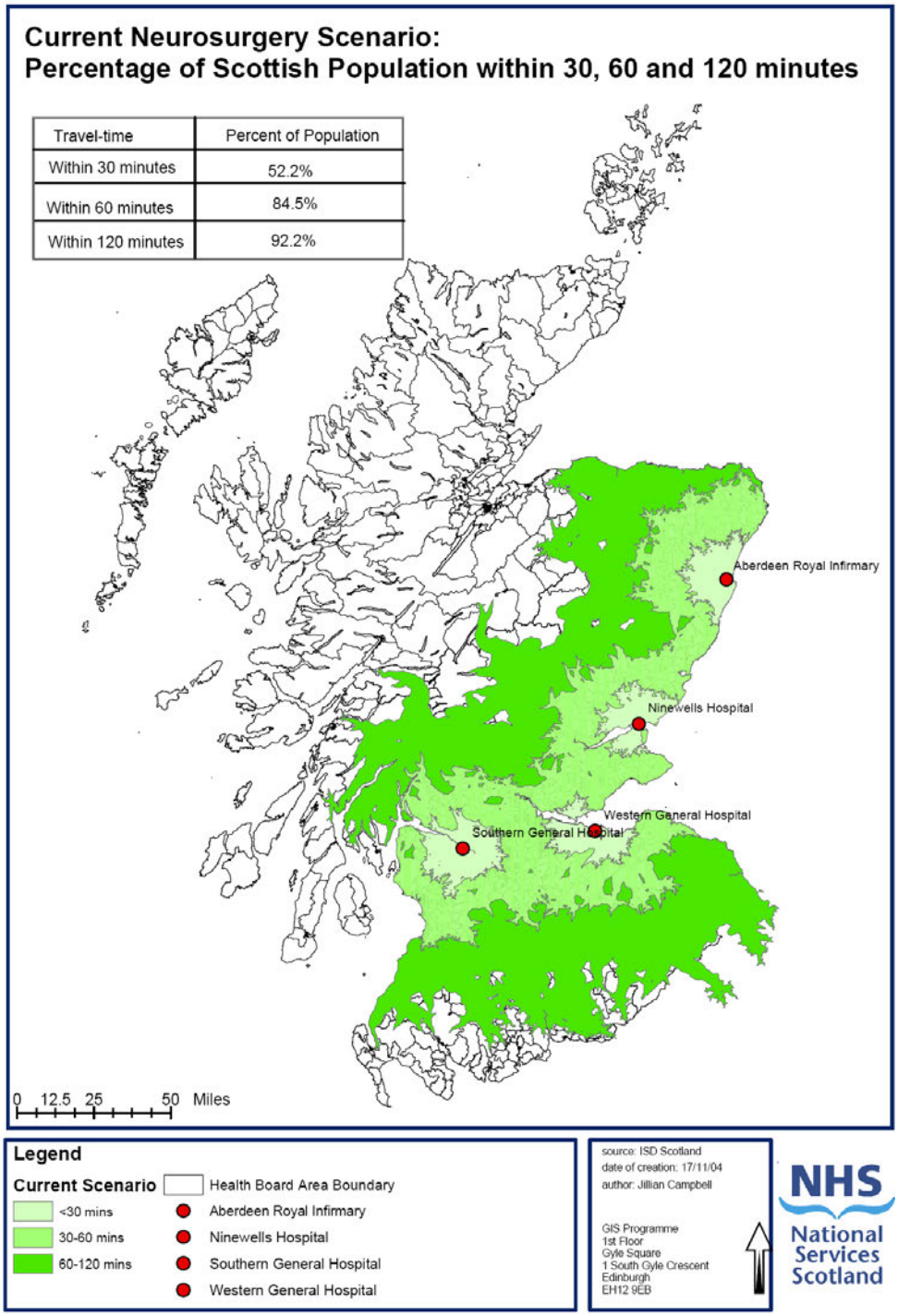
Source: SMR00, SMR01.
Date: 31st October 2007
Ref: IR2007-02635

Future neurosurgical provision in Scotland should be structured to enable specified acceptable waiting times to be met.

Travel Times and Access to Neurosurgical Centres

The Neurosurgery Action Team has previously considered the issue of travel time and access to Neurosurgical Centres. These data are most readily presented in the form of maps which demonstrate the percentage of the Scottish population within defined travel times of specified locations. The use of travel time rather than distance alone is an important component of these maps. These maps are included as appendices.

Fig. 10 Population within 30, 60 and 120 minutes of neurosurgery centres, Scotland 2004



EPIDEMIOLOGICAL NEEDS ASSESSMENT

It is important for emergency neurosurgical care to be accessible to as many of the population as possible.[36-38] For neurosurgical conditions there will occasionally be time critical emergencies but these are in fact relatively rare and frequently fatal. Whilst for much of England the travel time to the nearest neurosurgical centre is less than 30 minutes, the geography of Scotland is such that having reviewed the literature and taken advice from Neurosurgeons this Needs Assessment recommends using a travel time of 2 hours as the most realistic yardstick for a minimum level of neurosurgical access. The optimum model based on geography alone would be that which allowed the greatest percentage of the Scottish population to be within 2 hours of a 24/7 neurosurgery centre.

In summary the maps show that the current provision of neurosurgery across 4 centres, one in each of the major cities gives a coverage such that 92.2% of the Scottish population are within 2 hours of a neurosurgery centre. Currently, over 50% of the population live within less than 30 minutes. No other model proposed can achieve this level of coverage although if a centre had to be closed then closing the Dundee Unit would have the least detrimental impact on population coverage.

The recommendation in the Teasdale report that a single centre option was favoured by the majority of Scottish neurosurgeons as providing the best option to meet all the concerns at that time is based upon a single purpose built national neurosciences centre in the geographical centre of Scotland. The recommended site at that time was Larbert which would be within 2 hours for 80.7% of the Scottish Population.

No other identified location for a single site would approach this level of coverage. A single centre model based in Glasgow for example reduces the coverage to approximately 74% of the population.

In order to achieve a level of coverage from a single centre equivalent to that of the current four centre model it is necessary to include at least two satellite units, most probably in the South East (Edinburgh) and the North East (Aberdeen). Such a model could deliver coverage within 1% of the current arrangement.

EPIDEMIOLOGICAL NEEDS ASSESSMENT

Epidemiological Needs Assessment Summary

Scotland is a large country with a population of slightly over 5 million distributed widely over it's 30,414 squre mile land mass. There continues to be a significant concentration of population in the "central belt".

The Demographic data shows that over the next 20 years there will be only a small change in the overall size of the population but a marked ageing effect.

The aging of the population will result in increased demand for hospital admission and neurological care but the overall impact of these changes on need for neurosurgery procedures may be minimal.

If current care practices continue over the next ten years there will be an increased demand for hospital admissions due to the aging population but that there will be only a very small increase in the number of interventional procedures required.

The demographic data suggest that over the next decade to 2017 there will be a 20% in the level of neurosurgical and neurological need in the NHS Boards currently served by the Neurosurgery Unit in Glasgow balanced by an 18% increase in the level of need in the NHS Board Areas served by Edinburgh and to a lesser extent Aberdeen and Dundee. This equates to approximately 2000 neurosciences hospital admissions per year moving from West to East.

The incidence and prevalence data suggests the level of population need for neurosurgical services is fairly even across Scotland when expressed as an age specific rate per 100,000 patients.

Paediatric neurosurgery is currently provided two locations – Southern and Sick Kids Edinburgh although there is also paediatric activity in Aberdeen. None of these centres could be considered a comprehensively staffed paediatric unit as described by SNBS. Given guidelines that paediatric neurosurgery should be co-located with adult neurosurgery, planners may wish to transfer all activity to one unit.

Analysis of all Discharges over five years confirmed that no significant neurosurgical activity is taking place outside the neurosurgery centres.

Almost neurosurgical 32,000 procedures were identified over the 5 years.

Neurosurgeons in Scotland deliver approximately 6000 in-patient procedures per annum and there is no clear trend for this activity to decrease or increase. They also perform around 600 day cases per annum and this rate has increased significantly in one centre over the past five years with no effect on in-patient surgery rates.

Over the five years two thirds of all operations for spinal degenerative disease were by neurosurgery with the remainder by orthopaedics.

EPIDEMIOLOGICAL NEEDS ASSESSMENT

The only procedures commonly taking place outside the Neurosurgical Centres are Peripheral Nerve Procedures.

Almost all peripheral nerve surgery is undertaken by orthopaedics with a fairly small contribution from neurosurgery and plastic surgery.

Neurosurgery has been assessed as very cost effective intervention in terms of cost per QALY.

Available data on service costs does not evidence any economies of scale in larger units.

Access as indicated by waiting times data varies widely between the existing units.

The current configuration of units achieves good population coverage with 92.2% of the population within 2 hours of a consultant staffed neurosurgery unit.

CORPORATE NEEDS ASSESSMENT

Corporate Needs Assessment

Corporate Needs Assessment reports the demands, wishes and alternative perspectives of interested parties including professional, political and public views. "*Whilst such an approach blurs the difference between need and demand, and between science and vested interest, it also allows scope for managing supply and demand at the same time as assessing need as affected by local circumstances. It would be surprising if important information were not available from those who have been involved in local services over many years. In the National Health Service this approach has been widely used…*"[20]

Definitions

Neurosurgery involves the clinical management of patients with potentially surgical remedial conditions of the central (intracranial and spinal) and peripheral nervous systems. It provides elective, emergency and major trauma services. Integral and consequential functions include training, research and development and working closely with a wide variety of other specialists, increasingly in teams. [14]

The population of the British Isles generates two types of demand for neurosurgical services. The first is the emergency, urgent and trauma demand. This accounts for about 66% of the workload in neurosurgical units across the UK and Eire although the figure varies markedly between units. The second is the demand created by non life threatening (at that stage) or disabling conditions. The work generated by this demand is almost invariably subject to being placed on waiting lists with waiting times varying between six weeks to over twelve months. [14]

In access to services for patients, a key component is to assess the degree of urgency of various neurosurgical conditions. In surgical practice, it is normal to sub-divide activity into that which is elective and that is which is emergency. The term 'emergency,' however, is usually applied to all surgical activity which is not pre-planned and this unplanned activity is often not time critical. For this reason the terms Elective and Emergency as used by ISD, in particular in presenting data from SMR 01 are unhelpful in this context. In this report, the term 'urgent' will be used to describe cases where neurosurgical intervention is required and the time delay might prove critical to outcomes.

Common Neurosurgical Conditions

The diagnoses that commonly require neurosurgical intervention can usefully divided into ten patient groups which can then be further divided into 60 specific diagnoses. See appendices for table of Patient Groups and Diagnoses.

Common Neurosurgical Procedures

Forty-six separate neurosurgical procedures are commonly used to treat the range of identified diagnoses. See appendices for table of diagnoses and commonly-used treatment (procedures.)

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Sub-categories

As diagnoses that require neurosurgical intervention cover a broad range of conditions there are a number of ways in which these conditions may usefully be sub-divided. As described above the term Elective and Emergency are commonly used to differentiate planned from unplanned clinical work. For the purposes of this needs assessment, we have identified a separate category as "urgent" for cases where there is a definite time pressure requiring an intervention within a very few hours. One other common category is often used and may have some clinical relevance. This is "trauma" which relates to the mechanism of injury rather than the resulting clinical need. As a result there may be overlaps. A trauma case may be urgent, is probably defined as emergency but might have long term sequelae which could involve an elective admission for a planned revision surgery at a later date. In the following analysis we have chosen to present activity using all 4 subcategories; emergency, urgent, trauma and elective. This sub-division is included as it reflects the means by which many neurosurgical services have been analysed and planned.

Using the specified categories, we can sub-categorize the diagnoses to show the breakdown of neurosurgical workload by category categories. See Appendices for table showing diagnosis, procedure and sub-category.

- Out of the 34 diagnoses listed, 21 diagnoses (62%) are categorised as 'elective'.
- Out of the 34 listed diagnoses, 4 diagnoses (12%) are categorised as 'emergency'.
- Out of the 34 listed diagnoses, 5 diagnoses (15%) are categorised as 'urgent' [where urgent is considered to mean diagnoses which do not need to be addressed within the next 24 hours but which can not wait for long.]
- Out of the 34 listed diagnoses, 2 diagnoses (5.5%) are categorised as 'emergency/urgent'.
- Out of the 34 listed diagnoses, it is not evident which sub-category two diagnoses (5.5%) fall within.

Literature Review

The search terms 'neurosurgery services' were entered into the Health Scotland eLibrary Search function with preferences specified to search all eLibrary resources, including clinical practice resources, journal articles, eLibrary collections and remote/partner information services. The results of this search are summarised in the table below.

Table 17. Literature Review Summary Table

Clinical Practice Resource	
Cochrane CDSR	9 systematic reviews → not relevant
Cochrane DARE	2 systematic reviews → not relevant
Cochrane CCTR	2 systematic reviews → not relevant
Journal Articles	
PubMed	647 papers → 78 →35 → 22 relevant papers
Medline	198 papers → 11 → 5 relevant papers
Cinahl	31 papers → 1 relevant paper
Embase	126 papers → 12 → 3 relevant papers
Psycinfo	19 papers → 2 → 1 relevant paper
eLibrary Resources	
Book Titles	1 book → not relevant
Policy	3 policy documents → not relevant
More eLibrary	2 resources → not relevant

Relevant articles were defined as those that contained information relating to the planning or delivery of neurosurgical services. Whilst in an ideal world a needs assessment might aim to analyse the clinical and cost effectiveness of all available medical and surgical interventions this was felt to be outside the scope or resources of this project. Papers dealing with clinical cases or clinical trials of surgical methods or new medications were therefore excluded as being beyond the scope of this time limited needs assessment.

Thirty two pertinent journal articles were then reviewed for relevance and findings summarised.

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Qualitative Interviews and Correspondence

A number of meetings and email exchanges were undertaken in order to elicit the views of the neurosurgical community in Scotland.

The authors met with the data sub group and attended meetings at all four neurosurgical centres. In addition the authors wrote to key clinical contacts in Scotland as recommended by colleagues from the data sub group and Neurosurgery Implementation Team.

Adult Neurology	Prof Charles Warlow, Western General Hospital, Edinburgh
Paediatric Neurology	Dr Robert McWilliam, Royal Hospital for Sick Children, Glasgow
Neurosurgery	Mr Samuel Eljamel, Ninewells Hospital, Dundee
Neuropathology	Dr Colin Smith, Western General Hospital, Edinburgh
Neuro-anaesthesia and Intensive Care	Dr Peter Andrews, Western General Hospital, Edinburgh
Neurophysiology	Dr Alan Forster, Aberdeen Royal Infirmary
Neuro-rehabilitation	Dr Brian Pentland, Astley Ainslie Hospital, Edinburgh
Spinal Surgery	Tom Russell, Western General Hospital, Edinburgh
Spinal Surgery	Robin Johnson, Southern General Hospital Glasgow
Neuroradiology	Prof Donald Hadley Prof Robin Sellar
Scottish Ambulance Service	Mr Callum Kerr

Through the synthesis of the content of these meetings and email exchanges, a country-wide perspective of how neurosurgical services should be delivered in Scotland was obtained from the neurosurgical community in Scotland.

In addition, expert opinion was obtained from a range of allied specialties to ensure that that the any conclusions regarding the future of neurosurgery in Scotland took into account the impact of current developments in allied specialties on future delivery of neurosurgical services. Information regarding allied specialties was obtained through email exchanges with appropriate experts.

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Public and Patient Views

Unfortunately it is beyond the scope of this needs assessment to commission specific work with patients, carers and the public to ascertain their views on the need for and of configuration neurosurgical services.

Members of the National Framework for Service Change in the NHS in Scotland; Neurosciences Action Team included representatives of patient groups who are part of The Neurological Alliance Scotland, and through them the Alliance involved its members in considering these questions and in developing the criteria for a future service.

Standards of care set out in the Neurological Alliance document "Levelling Up"[16] (Levelling Up – Standards of Care for People Living with a Neurological Condition, Neurological Alliance, 2002) were also considered and can be summarised as:

- Independence and Quality of Life
- Speedy Access
- Comprehensive Assessment
- High Quality Information
- Well Trained Interdisciplinary Professionals
- Access to Voluntary Organisations
- On-going Access
- Equity of Service Provision
- Co-ordinated Care across Sectors
- Prevention
- User Involvement
- Holistic Rehabilitation
- Established Care Pathways
- Good Record Keeping
- Addressing the needs of Carers

In considering criteria for the future service the Alliance members advised the Neurosciences Action Team that they should focus on patients and services (not organisations, structures and sites) and that services need to be staffed by professionals who were knowledgeable about their condition. The key patient priority was an integrated Scotland-wide service and they assumed that any change would improve the service. The model should provide equity of access, including to diagnosis, assessment, and treatment provided as locally as possible.

They advised that irrespective of the final configuration proposed, the model should adopt a managed clinical network approach on an all-Scotland basis, which would develop a model of working which included clinicians as part of a virtual organisation that actively involved patients in service design. It would also promote interdisciplinary working at all levels and with other agencies, such as voluntary organisations.[16]

'Looking at services from a patient's point of view underpins everything we are seeking to do in the health service. Patients are concerned about:

- **quality of care;**
- **treatment at the right time and in the right place;**
- **being treated with dignity and respect;**
- **having their say in decision making;**
- **having their feedback taken into account; and**
- **getting clear explanations at every stage.**

All this amounts to a massive cultural change in the health service compared to the first fifty years of its history.'

Partnership for Care: Scotland's Heath White Paper, The Scottish Executive 2003

Policy Context

Synthesis of guidelines and recommendations from key documents

A number of key documents were identified and reviewed to provide evidence regarding guidelines and recommendations for neurosurgical care and services. These documents were drawn from a number of sources, notably the National Framework for Service Change in NHS Scotland and the Society of British Neurological Surgeons.

In 2005, the Scottish Executive Health Department (SEHD) published the document, 'Delivering for Health' [19] which describes the actions required by the SEHD to turn their vision for the health service into reality. 'Delivering for Health' builds on the National Framework for Service Change to provide a template for the future NHS Scotland.

The emphasis of this document is to provide health services to tackle the causes of ill-health and provide care which is quicker, more personal and closer to home. The emphasis on local provision specifically refers to the provision of primary care services with the document stating that, 'We want services delivered as locally as possible, when that can be done safely and sustainably, but with prompt access to specialized services when necessary.' and 'If they need specialist treatment in hospital they will get access to a good, safe service provided by the right person, even if that means they have to travel.'

These statements can give confidence that any potential reconfiguration of neurosurgical services will be in line with the David Kerr Report and the 'Delivering for Health' approach and recognize the balance to be struck between local provision of health services and the need to maximize specialist skills. The latter point is further supported by statements in 'Delivering for Health' that centre on the relationship between volume and outcomes, as follows;

'We now know that, across a range of procedures, there is variation in the relationship between increasing volume and improved outcome (reduced mortality and/or improved recovery). We also know that for a condition that is not common and is relatively complex, the improvement tends to be greater: the more operations of a particular type a surgeon

performs, the better the outcome. There is a strong case for ensuring volume is maintained in complex cases. In a country the size of Scotland, that can only be done by offering those procedures in a few locations. Clinicians (and their teams) should undertake common procedures locally, provided there are sufficient cases to maintain clinical skills and it represents a good use of public resources.'

More recently there has been a change of the Scottish Government with the launch of *Better Health, Better Care* and a stated "clear policy presumption against centralisation".[5]

Better Health, Better Care sets out that this "does not, of course, mean that there will never be an occasion when it makes sense to concentrate services. It does however mean that any such moves must result in benefits to patients and be subject to meaningful consultation and independent scrutiny to ensure they are based on the best available evidence and give due weight to the views of local people."

This information supports the position that neurosurgical services should be structured to balance local provision with the need to maintain sufficient volume of complex cases to improve patient outcomes.

The nature of neurosurgery

Neurosurgery is a relatively low volume specialty by population. The population base to provide the volume and diversity in order to sustain full sub-specialisation has been proposed as a minimum of 2 -2½ million[39] and it has been proposed that for certain sub-speciality areas this might be larger, eg neurovascular services 7 million[39;40]. Neurosurgery is technologically dependent with a large acute element requiring 24 hour care. The specialised and skilled work force required to do this is a relatively scarce resource. There are however few UK centres that serve populations as large as Glasgow currently does.

There are several centres within the United Kingdom that have within the last 10 years satisfactorily merged, the most recent being the amalgamation of the Hope Hospital Salford, Manchester Royal Infirmary and North Manchester Hospital together with an amalgamation of the paediatric services from Booth Hall and Pendelbury. There was an amalgamation of three units in Leeds, which is celebrating its 10th anniversary on 18 October this year. This amalgamated the Pinderfield Hospital in Wakefield, Chapel Allerton and Leeds General Infirmary and was an extremely successful and well worked out process. Prior to that Tomlinson, which was much more difficult did not really resolve any of the major issues within London.[41] There is also ongoing discussion of the configuration of neurosurgery in Wales.[34] The situation in Wales is interesting though not directly comparable to Scotland. Currently the population of North Wales travel to Liverpool for Neurosurgery services but there are two units located close together in South Wales serving a total population similar to that served by the Galsow Unit. These are based in Cardiff and Swansea. Recently highly controversial plans to amalgamate these two units on one site have been overturned following elections to the Welsh Assembly and discussions are currently underway on how to make the two units sustainable, possibly through an MCN arrangement.

What is important is that any proposed mergers deliver health care benefit to patients. There does seem to be good evidence that managed clinical networks can enhance clinical linkages, support education and facilitate sub specialisation whilst maintaining smaller centres.[6;7;39]

What is an acceptable time delay before Neurosurgery?

The majority of neurosurgery is not undertaken on an "immediate" basis although much of the work is defined as "emergency" workload. In this context the term "emergency" is used to distinguish acute, unplanned work from elective, planned activity which can be scheduled well in advance. In practice urgent, time critical, "immediate" neurosurgical need is fairly uncommon but this still amounts to a regular workload which must be managed and requires care to be available 24/7. Immediate time critical neurosurgical need tends to be limited to specific indications such as a blocked paediatric CSF shunts, severe intracranial aneurismal haemorhage, spinal trauma, malignant spinal cord compression and management of head injuries.[42] In such circumstances "immediate" intervention is generally taken to mean within 2 hours. There is a well-evidenced requirement for paediatric head injury surgery to always be provided within 4 hours but in practice few centres within the UK achieve this standard. Delays preventing this standard from being achieved tend to relate more to in hospital processes and procedures than travel[38;43] times. This suggests most of the UK Paediatric population can expect to be within 2 hours travel time of a major neurosurgical centre.

In Neurosurgery, interventions are infrequently undertaken as urgent life saving heroic measures which have to be undertaken within minutes but it is important to recognize that these situations do occur. "In Scotland there are some 50 craniotomies a year for extradural haematoma and over 100 for acute subdural haematoma. These are time-critical, and a wealth of literature shows that even a moderate delay worsens mortality and quality of survival. There are also patients with malignant spinal cord compression and acutely blocked shunts where the successful management of the condition is time-critical. My estimate is that some 300 patients a year in Scotland (roughly one a day) will have a time-critical neurosurgical emergency, where a delay in diagnosis or treatment will cause death or disability that could have been avoided. As you know, death is cheap but catastrophic disability that could have been avoided exposes NHS Scotland to huge compensation claims. I have personally been an independent expert in several seven-figure claims against the NHS that involved delay in diagnosis and/or treatment of neurosurgical conditions."[33]

The complex and specialised nature of neurosurgical interventions is such that patients have to be stabilised and prepared before surgery. It seems that the ability of the operator and the expertise of the surgical centre are the most important factors. There has been longstanding evidence that neurosurgical intervention is not always best undertaken as an urgent procedure and that the timing of surgery has a significant impact upon outcome.[44] In published research neurosurgical timing tends to be categorised as early (0-3 days), intermediate (4-10 days) or late (11 to 14) days approximately.

In Scotland there are some 50 craniotomies a year for extradural haematoma and over 100 for acute subdural haematoma. These are time-critical, and a wealth of literature shows that even a moderate delay worsens mortality and quality of survival. There are

also patients with malignant spinal cord compression and acutely blocked shunts where the successful management of the condition is time-critical. My estimate is that some 300 patients a year in Scotland (roughly one a day) will have a time-critical neurosurgical emergency, where a delay in diagnosis or treatment will cause death or disability that could have been avoided. As you know, death is cheap but catastrophic disability that could have been avoided exposes NHS Scotland to huge compensation claims. I have personally been an independent expert in several seven-figure claims against the NHS that involved delay in diagnosis and/or treatment of neurosurgical conditions.

The International Study on the Timing of Aneurysm Surgery was an early attempt to define the relationship between timing of surgery and outcome. Surgeons wished to define whether the operative risks of operating early when the intra-operative conditions were difficult "soft swollen brains, and that early operation precipitated or exacerbated vasospasm" were more significant than the value of early intervention in preventing re-bleeding and facilitating the management of vasospasm. This observational study of 3521 patients across 68 centres needs to be interpreted with caution but it does give some evidence that there are differences of opinion between a policy of early or delayed surgery. One confounding factor might be that all of the patients receiving early surgery were treated in expert centres where operator experience may have given an unusual ability to overcome the unfavourable operative conditions. The authors conclude that the overall result of the study did not give strong evidence to support either early or delayed surgery and that practice would follow surgeon choice, balancing the known natural history of the condition (subarachnoid haemorrhage) and post operative morbidity. [44]

In Scotland It is generally agreed that the earlier one can manage an intracranial aneurysm by either surgery or interventional radiology the better. SBNS published a consensus view on management of subarachnoid haemorrhage in October 2004.[34 45]

A Cochrane Review of the timing of surgery for aneurysmal subarachnoid haemorrhage found that there was little randomised control evidence available, but that the timing of surgery was not a critical factor in determining outcome following subarachnoid haemorrhage. The authors concluded that for this patient group there was uncertainty about the balance of risks (surgical morbidity and mortality) and the potential benefits (safer introduction of aggressive treatments to augment cerebral profusion and elimination of the risk of further haemorrhage) of early surgery to secure a ruptured intracranial aneurysm and that present evidence did not clearly identify a safer time window. The Review detailed discussions with neurosurgeons of international repute which indicate that the majority of neurosurgeons operate on good graded patients within 3 or 4 days of the initial haemorrhage, a position that is supported by the fact that, currently, most neurovascular surgeons elect to operate within a similar time period in good grade patients to minimize the chances of a re-bleed. The authors reported that there appears to be a body of evidence and neurosurgical opinion indicating that early surgery is rarely indicated due to the potential for excess morbidity and mortality.

It seems that the ability of the neurosurgeon performing the operation and the expertise of the surgical centre in which the operation takes place are more important factors in outcome rather than any time delay before operation.

Head Injury Care

At the time of the Neurosciences Action team report and Option Appraisal exercise it was noted that admissions to neurosurgical units were decreasing and this trend was expected to continue. This assumption has important implications for the future provision of services. Since 1995 there have been several important developments in this area.

Despite improvement in outcome during the 1990s as shown in the data from the UK East Anglian Regional Audit of Head Injury, mortality and morbidity from head trauma remain high and controversy continues both about the fundamental concepts of treatment and about specific techniques. Outcome after head has not improved in the 1990s and differs from other organ system trauma. New evidence is mounting that all moderate & severe head injuries should be admitted to specialist centres that have the full range of expertise (including NICU). NICE now recommends this approach.[46-48]

Guidelines for the early management of head injuries have been published by the Scottish Intercollegiate Guidelines Network (SIGN 46). These set out the indication for seeking a neurosurgical opinion but it is likely that there will be a significant change in the management of all moderate and severe head injuries in the near future and this will have a significant impact on plans for local neurosurgical units. NICE recently published revised guidelines for head injury management in England and Wales recommending that head injuries should be managed in neurosurgical units (or at least in neuroscience centres) not at DGHs in A&E or orthopaedic wards and in Scotland a SIGN group is finalising a draft of revised guidelines on the early management of head injury, which will make similar recommendations.[33]

This will put pressure on neurosurgery beds (perhaps less so in Scotland than in England), but it is also a strong argument against the centralisation of “general neurosurgery services”.

Mode of transport

Whilst the introduction of both rotary and fixed wing aircraft for the transport and pre-hospital care of patients has increased the number of options available for the early management of medical emergencies including head trauma, there remain many situations where road transport may be preferable or indeed air transport may unsuitable or impossible. Significant factors include mechanism and type of injury, availability of pre-hospital life support, transport time, space for medical attendants, visibility, access including landing site and prevailing weather conditions.[49]

Whatever the mode of transport clear guidelines will need to be in place to ensure neurosurgical patients are taken directly to the nearest specialist neurosurgery centre avoiding unnecessary stops. A serious head injury patient for example should be taken directly to a neurosurgery unit and not delayed for assessment or stabilization at an intermediate stop such as a DGH casualty unit.

Management of Head Injuries

Head injury is a major cause of morbidity and mortality worldwide. Trauma is the leading cause of death in the first four decades of life with head injury being implicated in at least half the number of cases.[50]

An apparently minor blow to the head is a common event in every day life and many patients do not require hospital referral. The principal reasons for hospital referral are the existence or potential for brain damage or the presence of a wound that may require surgical repair.

There are approximately one million patients in the United Kingdom who present to hospitals each year with head injuries. Of these head injuries, 1500 per 100 000 of the population (total one million) attend Accident and Emergency Departments with a head injury, 300 per 100 000 per year are admitted to hospital, 15 per 100 000 per year are admitted to Neurosurgical Units and 9 per 100 000 per year die from head injury Almost half are under 16 years old. Many patients are left with significant behavioural, cognitive, emotional and physical damage, resulting in severe social and economic effects including marital breakdown, loss of employment and dependence on social services, at significant cost to the community at large.

About 100,000 people attend hospital every year in Scotland with a head injury, and around 20% are admitted, a rate of 330 per 100,000 population. Although case fatality is low (3.2% of admissions, 10 per 100,000 per annum), trauma is the leading cause of death under the age of 45 and up to a half are due to a head injury. Furthermore, sequelae are common in survivors: a recent study in Scotland estimated an annual incidence of between 100 and 150 per 100,000 adults disabled a year after a brain injury.[51]

About half of patients attending Accident and Emergency Departments in Scotland with a head injury are children under the age of 14 years. The very great majority are fully conscious, without even a history of loss of consciousness or amnesia or other signs of brain damage.[51]

Some 63% of adult patients who sustain moderate brain injuries and 85% of patients who sustain severe brain injuries remain disabled one year after their accident. Even patients with minor brain injuries have problems. Three months after sustaining minor head injuries, 79% have persistent headaches, 59% have memory problems and 34% are still unemployed. Only 45% of patients who have sustained a mild brain injury have made a good recovery one year after admission. The resources available, in terms of manpower, facilities and beds, for treating these patients and for the training of the medical staff who care for them are inadequate.

Guidelines for the Early management of Head Injuries have been published by the Scottish Intercollegiate Guidelines Network (SIGN 46).[51] These set out the indication for seeking a Neurosurgical Opinion.

Only two groups of doctors are currently being trained in the immediate/early management of such cases, those working in accident and emergency (A&E) medicine and the neurosciences. It would therefore seem reasonable that these specialties should be responsible for the care of the head-injured patient. It has been considered reasonable

and appropriate for A&E departments to admit and supervise head injured patients for up to the first 48 hours, provided satisfactory facilities and suitably trained staff are available on-site. In 1999 the Royal College of Surgeons recommended that "Patients with minor head injuries who require admission to hospital for up to 48 hours should be admitted under the care of the A&E department to an observation/ short-stay ward."[52]

Despite improvement in outcome during the 1990s as shown in the data from the UK East Anglian Regional Audit of Head Injury, mortality and morbidity remain high and controversy continues both about the fundamental concepts of treatment and about specific techniques.[38]

Recent advances in the management of head injury have occurred at several levels including prevention, pre-hospital care, immediate hospital care (trauma teams, advanced trauma life support courses), acute hospital care (neuro-intensive care units with protocol driven therapy) and post-acute hospital care (rehabilitation). Recently, recommendations have been produced by the Royal College of Surgeons, including the transfer of all patients with severe head injury to regional neurosurgical units.

The RESCUEicp study is currently underway to evaluate the impact of early decompression on the long term outcome of traumatic brain injury.(www.rescueicp.com)

The fundamental pathophysiological process following head injury is the development and propagation of an escalating cycle of brain swelling, increase in intra-cranial pressure (ICP), reduction in blood supply and oxygen delivery, energy failure and further swelling, enhancing brain injury and poor outcome The aim of the RESCUEicp trial is to determine the effectiveness of an operation (decompressive craniectomy) to intercept this cycle, treat brain swelling and improve outcome.

Head Injuries and Trauma Care

"Neurosurgeons should be part of a multidisciplinary neuroscience unit that houses an intensive care unit with trauma beds and neuroanaesthetists. All neurosurgical units should be sited in major acute hospitals and should have input from neurosurgeons, neuroradiologists, neuroanaesthetists, rehabilitationists and neuropsychologists. Neurosurgeons should be available at all times for advice regarding patients with head injuries.

Patients with multisystem severe injuries require treatment from a multidisciplinary team at major acute hospitals with the input of the full range of surgical, anaesthetic and imaging specialties. General surgeons and orthopaedic surgeons must retain a key role in the management of patients with multisystem injuries."[52]

Organisation of Care

"The overall care of patients with head injuries should be within the remit of regional or sub-regional neuroscience departments, but no single specialty is able to treat all aspects of a patient with a head injury. However, each department of neurosciences (which must include neurosurgeons, neuroanaesthetists, neuroradiologists, neurologists,

neuropsychologists and rehabilitationists) should take responsibility for and oversee the organisation and management of all patients with head injuries within their region or sub-region. This will require additional resources.

All patients with head injuries report initially to the A&E department. Consultants in A&E medicine have the responsibility for initial patient assessment and specialist registrars are being trained to assess these patients competently as part of their training programme."[52]

Patient Transfers

The Association of Anaesthetists of Great Britain and Northern Ireland has published Recommendations for the Safe Transfer of Patients with Brain Injury.[53]

Sub-specialisation

Changing case mix will continue to have a major impact on the numbers and skills of staff required. Safe Neurosurgery 2000 illustrated many of these case mix changes, most of which require increasingly specialised skills if neurosurgery is to be practised safely.[14]

As outlined by Hardy [39], one of the factors (with other factors picked up throughout this report) likely to affect the location and provision of future neurosurgical services in the UK, is the pressure for sub specialisation in neurosurgery. This pressure can be summarized as resulting from three factors,

1. Under the 'Calman' system of training, the final year of the training programme is usually spent developing a sub specialty interest.
2. Increasing incidence of complaints and litigation.
3. The increasing technical complexities of the specialty.

Given this situation, Hardy suggests that the 'rational policy' is for smaller units to transfer rare, complex or high risk cases to larger units who have sufficient volume and expertise to provide better patient care and thereby also medical litigation. However, for the larger units this situation presents other challenges, namely the need to provide sufficient sub specialty expertise to comply with the European Working Time Directive and also provide full emergency cover, presenting difficulties in both on-call and sub specialisation rota planning.

Despite Hardy's concerns and the introduction of the EWTD, MMC and the 2003 Consultant contract most neurosurgery in the UK continues to be provided in units serving populations of around 1.5 to 1.8 Million and larger units are rare. Even in large conurbations there is little evidence of smaller units choosing to merge although centres in London and Paris to operate shared or rotating on call arrangements.

Hardy, Carter and Edwards have all suggested a clinical networking approach as an alternative to major structural change and NHS MEL 1999(10) set out a model for this approach in Scotland.[6;7;39;54]

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There is a contradiction between the need to centralize services in order to allow surgeons to become sub specialists and the need to deliver services in such a way that general neurosurgery services continue to be available as required and as locally as possible for the benefit of a population dispersed over such a wide geographical area. It is important to ensure that as many as possible of the very small pool of neurosurgeons in the UK continue to have general neurosurgical skills and provide 24/7 clinical cover for neurosurgical emergencies.[55]

Regardless of the actual numbers required to staff both on-call and sub specialty rotas, sub specialism within the neurosurgical specialty will become more and more common and required. Therefore, any future restructuring in neurosurgical services provision in Scotland should ensure adequate numbers of appropriately trained staff are available to maintain general neurosurgical cover. This might lead to pressure to move to larger units but could presumably also be achieved in a nationally managed service using a Managed Clinical Network Model.

CORPORATE NEEDS ASSESSMENT

Neurosurgery & Mental Disorders

With regard to the sub specialty of functional neurosurgery for mental disorder, it appears that for a very small group of patients with severe mental health problems, neurosurgery has a place especially with new forms of less destructive surgery[56;57]. However the number of patients requiring such intervention are too small to have much effect on overall service provision. In Scotland, neurosurgeons in Dundee have built an interest and reputation in the neurosurgical treatment of mental disorder, such that patients requiring such interventions can be referred to them from throughout Scotland. Neurosurgeons at the Southern General Hospital in Glasgow also carry out a comparative number of procedures for "functional neurosurgery", this has been described to us as at the simpler end of the spectrum and includes no movement disorder surgery for example. Both consultants who undertake this work are expected to retire within the next five years and this may represent a good opportunity to redistribute this work using a network approach and sub specialisation.

It does seem clear that highly specialised neurosurgery should only take place within one appropriate specialist service in Scotland for each condition or specialist procedure although this does not need to be the same centre for all procedures. Sub-specialists could develop expertise in any of the neurosurgery centres provided the service is managed as a single service and all appropriate patients are referred to that centre and treated by the appropriate clinician. As an example, the AI/NMD service in Dundee now has designation as a National Service and is the only recognised centre for AI/NMD in NHS Scotland.(Appendices) This change in status took effect on 1 April 2006 and is not therefore reflected in the available ISD data. [56;56;57]

Critical Clinical Linkages

A further important issue to consider is that of critical clinical linkages. These can be critical linkages within neurosurgery – that is key linkages to supporting services like neuroradiology and critical care – or critical linkages for other specialties. Consider the need for neurosurgery support to Regional Trauma Teams, to Accident and Emergency Units for head injuries, and to orthopaedic surgeons in the management of spinal degenerative disease for example. In conducting this needs assessment it has been important to include an assessment of corporate views on a complex range of inter related clinical issues.

Neurosurgery Workforce

Current neurosurgical provision as measure of need for future

According to SNBS, workload, including that generated by demographic change, is rising by approximately 3% a year. [14] If this rate of increase continues for the next fifteen years there will be a rise from 43,466 operations to about 60,000. Given the population changes and other factors, not least of which is pressure to meet current unmet demand in the overwhelming majority of neurosurgical units, and the recommended changes proposed for head injury management, SNBS suggests 3% p.a. growth in demand is conservative but realistic for workforce planning. This rapidly rising need for neurosurgical care due to demographic changes is not evident from the Scottish data presented above but this does not address the issue of workload pressure due to changing patient expectations. It is clear from the data in this report for example that neurosurgical procedures are not currently carried out on the most elderly patients. As the population ages and enjoys a healthier retirement it is likely that expectation will change and this may drive considerable increases in the requirement for general operative neurosurgery across Scotland.

Head injuries currently represent about 9% of neurosurgical workload. [14] If the Royal College of Surgeons of England's recommendations on the management of head injuries were to be implemented and other specialties transfer the management of serious head injuries to neurosurgery, it is estimated that conditions related to head injury will form approximately 15% of neurosurgical workload.

In July 2002 The Scottish Executive accepted the recommendations set out in *Future Practice: A Review of the Scottish Medical Workforce*[1] and the Report's principal message of the need for change, essential if the National Health Service is to respond to increasing and considerable pressures, including those on the medical workforce.[10]

At the same time it set out its *Response to Future Practice*.[58] Within an integrated, multidisciplinary workforce doctors will have a pivotal role in delivering the service and, as partners, contribute to its reform.

A Working Group led by Professor Sir John Temple, President of the Royal College of Surgeons of Edinburgh was established to review career structures for all doctors in Scotland. "Securing Future Practice" the final report of that working group sets out a range of key issues relevant to the future neurosurgical workforce in Scotland.[3]

The working group agreed ten key messages and a single conclusion as follows:-

The medical workforce can only be secured by simplifying its structure, through service re-design and by effective national and regional planning. This will deliver the doctors and the service Scotland needs.

Table 18. Key Messages from Securing Future Practice

TEN KEY MESSAGES	
1.	We are short of doctors – particularly trained doctors – making service reform both a challenge and a necessity.
2.	To comply with the Working Time Regulations by 2009, we will not have sufficient doctors across all grades to provide 24/7/52 care in every locality and unit functioning today.
3.	The critical and defining role of a doctor is diagnosing clinical problems and determining their management; but more work is needed to identify new professional roles, new ways of working and how these may be developed within the service.
4.	There will be a move towards a *trained-doctor based* service with much less service being delivered by doctors in training than is current practice.
5.	All trained doctors need to be *judgement-safe* in their fields of specialist and general practice. This must include mastery of the core competences necessary for that field of practice and the knowledge to know when to refer on. This defines what is a specialist.
6.	The *judgement safe* level must be synonymous with acquiring Specialist or General Practitioner Registration.[6] Doctors on these Registers remain competent to practice through revalidation.
7.	Implementing the changes set out here will require adequate resource with training given a high priority.
8.	The period for general practice training must be increased to ensure that GPs are adequately trained for the increasing demands of practice and to continue to develop their role; hospital training should be shorter, structured and focused.
9.	Effective workforce planning and development is essential to secure the medical workforce: leakage of doctors from Scotland is too great; and the potential of our supply of doctors is not realised.
10.	The public must be engaged in taking forward these reforms.

A Trained Doctor Based Service

The Temple Report attempted to model the workforce from 2002 to 2012 as follows:-

The proportion of training grades in the total workforce is reduced from 38% in 2002 to 30% in 2012. **This is the most significant change and reflects a move towards a *trained-doctor based* service**;

And

The proportion of consultants is whatever is needed to make up the remainder. This assumes an average annual growth of 6.1%. The current target growth in the consultant grade by 2006 is 4.1% per annum.

CORPORATE NEEDS ASSESSMENT

We believe that the following actions are of immediate importance to sustaining services in Scotland:

- **Arrangements for coherent, clear, integrated workforce planning must be established and be operational as soon as possible;**
- **Steps must be taken to provide larger managed health economies with the capacity to work across existing health board boundaries and with the critical mass to support national and local delivery of the workforce reforms set out and referred to in this Report;**
- **Services must be redesigned, based first and foremost on patient safety, aiming for local delivery where practicable;**
- **Service redesign must be underpinned by re-evaluating and resourcing patient transfer arrangements to ensure that they are responsive to changing local circumstances;**
- **The public must be treated by trained and competent doctors;**
- **A shift towards planning for and delivering a trained-doctor based service must be made;**
- **Implementation of medical workforce reforms must be taken in Scotland within the context of a UK-wide regulatory framework;**
- **Steps must be taken to lengthen the training time for general practitioners and to move towards more streamlined training for hospital-based specialties;**
- **We must concentrate firstly on strategies to retain in Scotland more of those doctors we train and then to recruit those others we need.**

The Temple Report 2004

Table 19. Current Staffing Levels, Neurosurgery centres, Scotland 2004.

Neurosurgical Unit	Catchment Population*	Programmed Activities**
Southern General Hospital, Glasgow	2.6 m	7 NHS Consultants – 73 1 Academic – 11 Total – 84
Ninewells Hospital, Dundee	0.6 m	3 NHS Consultants – 36
Royal Aberdeen Infirmary	0.75 m	3 NHS Consultants – 36
Western General Hospital, Edinburgh	1.3 m	54 in the adult service 6 in the paediatric service Total – 60
Scotland	5.65 m	216 PAs

Source – The four neurosurgical centres
* notional, note there will be some duplication due to sub-specialisation
** Consultant Contract basis 10 PAs ≡ 1 Whole Time Equivalent

Source: Neurosciences Action Team Report 2004

CORPORATE NEEDS ASSESSMENT

The Neuroscience Action Team carefully considered the workforce issues for the future provision of neurosurgery across Scotland but were unable to fully resolve these complex issues.

The Team recognized that workforce pressures are not unique to Scotland and are being felt on a global basis, thus NHS Scotland needs to create its own solutions. For neurosurgical services this was felt to require satisfying jobs and opportunities for career progression across the spectrum of the workforce to recruit and retain staff.

Some specific issues were:

- The scarcity of skilled staff – medical, nursing and Clinical neuroscience specialists
- The implementation of the new contract for consultant medical staff
- The implementation of the requirements of the Working Time Regulations (WTR), with particular implications for consultants and junior medical staff
- The demographic changes in Scotland which project a smaller workforce in the future.

There are also issues concerning opportunities to develop skills and experience in sub-speciality areas.

In a global market, working in Scotland must remain attractive and provide opportunities for career development and the service also needs to recognise the contribution and needs of its current staff and acknowledge the potential risk of service reconfiguration on retention of these staff.

A particular challenge is to balance the need to have sufficient consultant staff to provide 24/7 cover whilst providing those staff with sufficient operative experience to maintain skills and satisfactory workload and job plans.

The Society of British Neurological Surgeons have produced a British Neurological Workforce Plan and the Action Team commissioned an independent opinion from Mr David Palmer who had developed the Consultant workforce modeling tool for SBNS. The report from Mr Palmer extrapolated activity data from the Scottish centres and from the Plymouth Neurosurgery Unit but identified significant differences between these analyses.

The baseline in England and Wakes is significantly different to Scotland with fewer consultants and correspondingly larger operative workloads.

Using the SBNS tool, Mr Palmer predicted that to achieve EWTD compliance with the current configuration of units would require between 10 and 24 additional neurosurgeons and that if a single centre could be established it would require between 2 and 13 additional neurosurgeons.

CORPORATE NEEDS ASSESSMENT

The Neuroscience Action Team expressed concern that increasing the consultant numbers would reduce the frequency of operating below the "safe" level of 180-250 operations per consultant per year.

We have been unable to identify the evidence base for the 180-250 operations figure although it certainly dates to Safe Neurosurgery 1993. At that time few consultants worked less than 55 hours per week and most averaged 60 and it seems to have been considered as a desirable maximum number of procedures per patient rather than a safe minimum.

In 1993 there was no volume outcomes evidence to support such a figure. This figure carries forward to safe Neurosurgery 2000 which reviews this figure, quoting consultant workload as ranging from 171-454 cases and concluding that safe Neurosurgery 1993 significantly underestimated the impact of the Calman training regime and the pressure to reduce Consultant workload. Safe Neurosurgery 2000 states that "Overwhelming professional opinion indicates that the ideal number of cases a consultant should have is 180-250 per year".

The Action Team report also notes the SBNS concerns that increased consultant numbers would lead to a corresponding increase in trainee numbers, this assumption does reflect the SBNS workforce model but is not appropriate to Scottish Worforce Policy as set out in the Temple Report and the stated intention to move to a consultant delivered service.

Scotland does enjoy a higher number of consultants per head of population and as such is significantly less dependant upon training grade doctors for service delivery. Scottish workforce planning predicts a steady decrease in training numbers as training programmes become shorter and more focused and doctors in training are no longer required for service delivery with a corresponding increase in consultant numbers over time.

The Society of British Neurological Surgeons has recommended that non-consultant career grade (NCCG) staff should not be used in neurosurgical centres. [14] This is because, in a relatively small specialty performing a wide range of complex procedures, the Society believes safety and quality could be compromised and the training of junior staff would be diluted if NCCGs continue to be used. This is a view shared by most specialist surgical societies but evidence for this view is difficult to find.

The traditional view of training grade doctors as core staff, especially out of hours has changed substantially in recent years and under MMC. As the NHS moves of necessity to a consultant led and delivered service with training grades becoming supernumerary it seems likely that NCCD doctors may offer a valuable alternative means of staffing units when direct consultant supervision is not present 24/7.

The Temple Report sets out that the use of Non Consultant Career Grades is different in Scotland to the rest of the UK and does not see these grades as a threat to Consultant numbers or training programmes.

"We recognise that those who are already in or who may seek to enter these grades will have particular needs and will be concerned as the reforms that are envisaged in MMC progress. Their contribution to NHSScotland is invaluable, should be recognized and the security of tenure they enjoy should not be disturbed but opportunities for career enhancement, where appropriate, must be established. We also agree that a more suitable title for these doctors is merited."

The SBNS Neurosurgical Workforce Plan suggest that for safe house cover in a unit of up to sixty neurosurgical beds during the period 9.00am - 5.00pm, Monday to Friday, the appropriate number of Senior House Officers (SHO)/House Officers (HO) has increased to five.[14]

For similarly safe cover in neurosurgical units with more than sixty the appropriate number of SHOs/HOs is suggested as eight. These levels are unlikely to be deliverable within the NHS unless cover is shared with other specialities and NCCG may offer a valuable solution. The alternative is to redesign services to take training grade doctors out of the staffing structure replacing their traditional roles with clinical neuroscience specialists and specialist nurses.

Impact of European Working Time Directive (EWTD) on Staffing Levels

The European Working Time Directive was agreed by the Member States of the European Union to establish minimum safety and health requirements regarding the organization of working time. The Directive specified minimum health and safety standards in respect of periods of daily rest, breaks, weekly rest, maximum weekly working time, annual leave and aspects of night work, shift work and patterns of work.

The Working Time Regulations

This UK legislation expresses European Union Directives concerned with workers' heath and safety and the organisation of working time. Member States are required to ensure that workers enjoy an average working week of not more than 48 hours.

A transitional period of five years from 1st August 2004 has been laid down for training grade doctors. By 2009 the ceiling will be 48 hours weekly.

Compliance with these Regulations has profound implications for:

- the delivery of health services, especially in the hospital sector because doctors in training contribute so much to out-of-hours cover;

and for

- meeting the standards required by the new training arrangements.

In parallel with this the 'New Deal for Junior Doctors' is already limiting the hours worked by doctors in training. Together with the working time regulations they are powerful drivers for change, for service redesign and for reform of the medical career structure.

Modernising Medical Careers

In the spring of 2003 the four UK Health Ministers launched *Modernising Medical Careers* (MMC) an important statement by the Government in response to consultation on *Unfinished Business: Proposals for Reform of the Senior House Officer Grade*.[59;59;60]

At the time of the first introduction of the EWTD there was great concern amongst all hospital doctors but especially amongst staff in smaller units and specialist roles that it would not be possible to meet the proposed reductions in working hours with substantial restructuring of NHS services.

"Current interpretation of the European Working Time Directive indicates that:

> - time spent on-call in hospital is to be counted as working time even when the doctor concerned is resting or sleeping;
> and
> - it is implied that compensatory rest must be taken immediately after working time so reducing flexibility for both employers and employees.

In effect this is likely to mean that doctors in training will need to change from working on-call rotas to full-shifts rotas and that NHS services are likely to operate effectively with eight doctors for a full-shift rota although 10 could be more practical to minimise out of hours work. There are also implications for senior doctors who should already comply with the Working Time Regulations and who will require to take a period of compensatory rest at the end of working time."[3]

We believe that, to comply with the Working Time Regulations and with current service models, we will not have sufficient doctors across all grades to provide 24/7/52 care in every locality and unit functioning today. *As a result it will be increasingly difficult to deliver service especially for 24/7/52 emergency care. Since there is at present limited prospect of employing more doctors to staff the current service, there will inevitably be increasing difficulties in retaining and recruiting doctors. Even if we could secure the numbers required to meet our current service need, current practice suggests that these would not uncommonly be trainees. That would be wrong. Doctors in training already provide too much care.*

The low clinical demand in smaller units and in remote areas would be insufficient to develop and refresh clinical competence nor to justify the additional staff required to meet the Working Time Regulations. (Sir John Temple 2004).

This concern was further compounded by the negotiations around the introduction of the 2003 consultant contract which moved consultants for this first time into a time based contract with duties defined and in some cases time limited by job plans.

The Directive has had, and continues to have, a considerable impact in respect of both providing sufficient manpower to safely cover rotas and providing a good training to junior staff in preparation for consultant practice.

Referring to Hardy, [39] another factor likely to affect the location and provision of future neurosurgical services in the UK, is the impact of the European Working Time Directive on out of hours services. Rotas are increasingly being covered through shift working arrangements with fewer junior doctors on the rota at any given time. Initiatives such as Hospital at Night were initially very unpopular with specialist consultants and units who were very concerned at the effect of having wards covered at night by doctors not training in that specialism or based in that specialist unit.

Consultants also feared that junior doctors will shoulder less of the service workload, thereby missing out on valuable experience whilst increasing pressure on their Consultant colleagues in terms of workload demands. Whilst many of these concerns over quantity of training have not been fully resolved they have been countered by a determination from post graduate Deans that any reduction in hours on the job be countered by improvements in the quality of medical training. Many hospital at night schemes have now been successfully introduced and are proving to be an effective and safe way to ensure high quality medical staffing is available 24/7 within NHS hospitals.

In his paper on the European Working Time Directive [40], Shaw outlines in considerable detail the potential challenges that a neurosurgical unit may face in complying with the Directive. He spends considerable time projecting how the Directive may translate in terms of the number of staff of different grades who would be available and how such changes would impact on services.

It is worth noting that this paper was written in 2002. Rather than summarizing the potential challenges outlined therein, it is useful to observe that although the challenges outlined may have come to pass, the neurosurgical community in Scotland has found ways to negotiate such challenges as demonstrated by the fact that Scotland has a functioning neurosurgical service that is largely compliant with the EWTD.

A particular factor which has changed since 2002 is that the NHS has increasingly come to recognize that patients should be treated by trained doctors and the historical practice in the NHS of relying very heavily on training grade doctors to staff NHS Units, especially outside core hours is no longer acceptable.

We believe there will be a move towards a trained-doctor based service with much less service being delivered by doctors in training than is current practice. *It is the latter who presently provide much of the out-of-hours service cover.(Sir John Temple 2004)*[3]*……* **A 'trained doctor' being a doctor who is on the Specialist or General Practitioner Register remains competent to practice through revalidation.**

One significant advantage of moving to a single neurosurgery unit for Scotland would be the potential to staff such a unit 24/7 with a Consultant workforce and to provide a resident on call Consultant rota to provide the immediate on site expertise which would be expected from one unit serving the whole of Scotland.

In 2005 there was a concern that consultant contracts in smaller units would not comply with EWTD. This has not proved to be the case with consultants in Aberdeen and Dundee now holding job plans for no more than 45 hours per week. In any future restructuring, it would be valuable to ascertain the working patterns adopted in neurosurgical units in Scotland which have been able to continue to provide a 24/7 service and comply with the EWDT. Such working patterns could then, potentially be applied to any reconfiguration of the service in Scotland to ensure compliance.

Specialist Manpower

Whilst this report has largely relied for evidence on the data and conclusions from previous expert reports which have tended to focus on medical manpower and consultant neurosurgeons in particular, it must be remembered that similar issues must be addressed with regard to staffing of allied specialties. Examples of these would be neuropathology, neurophysiology and neuroradiology.

Whilst some highly specialist staff would be willing to relocate within Scotland it would have to be accepted that a substantial reconfiguration of services could not be completed without a real risk of losing highly specialized staff. Neurosurgical Specialist nurses for example might elect to move to other specialties such as ITU or Trauma care rather than move to a central location and neurosciences specialists if required to relocate to a national center might well choose not to remain in Scotland.

Workforce planning is extremely complex and whilst identifying that much further work required to be done to try and quantify the future medical and professional workforce needs of NHS Scotland, the Temple Report also identified a range of other important factors which will shape future workforce planning in the NHS:-

CORPORATE NEEDS ASSESSMENT

Other factors that will shape the development of the medical workforce These are well known, even if their impact is not always understood or quantifiable:

- increased public and patient expectations of high standards of health care wherever it is delivered;
- staff who expect to work sensible hours, and whose work patterns will sit more easily with family and life-style commitments;
- the inevitable advance of medicine and technology and its impact on clinical practice requiring a workforce with the capacity to adapt to change; and
- the *gender shift* which is resulting in increasingly larger numbers of women entering medicine (*see Table 2*). Some of the reasons for this are now clearer and reflect the age and stage of personal development at which we select for medicine – a time when young women can perform better than young men. The resultant effect on the medical workforce can be predicted. As the gender shift becomes increasingly established this will necessarily increase expectations for different patterns of work and career. The service must respond to this.

A 'trained doctor-based' service (consultants) We see the consultant grade continuing as the primary means of employment within the hospital and community services for doctors who have completed specialist training.

More trained doctors will mean more consultants working in the hospital and community services ar the opportunity to move progressively to a consultant- or 'trained doctor-based' service. To achieve this more consultants are needed. The new contract will help (*see also paragraph 18*).

There are, however, challenges in taking this policy forward that have still to be resolved:

- how are new roles and patterns of working for trained doctors to be introduced and accepted?
- new responsibilities are required of consultants but until their numbers increase they will feel under pressure - what can be done to reduce that pressure in the interim?
- should consultants be available in all cases and if, relative to their overall numbers, junior and middle grade staff diminish, will they be the first contact?
- as teamwork develops how far can the consultant remain ultimately responsible for patients?

- diversity in consultant practice must follow as some remain more broad-based in their clinical practice while others become more specialised. How will that balance be managed?
- how are resources managed to achieve this outcome?

The Temple Report concludes on consultant practice:-

CORPORATE NEEDS ASSESSMENT

These are important matters that must be resolved and, given the pressure for change on the workforce, we recommend there is an immediate priority to increase the consultant workforce and an urgent need to revisit the consultant numbers planned for 2006.

Future trends and new technologies

In order to assess likely changes in neurosurgical practice over the next ten years, we reviewed the literature on future trends in neurosurgery to identify evolving technologies and assess the potential of these technologies to change neurosurgical practice. Broadly, there were few innovations which appear to have significant implications for practice, with most of the impact coming from changes in management or patient expectations. The most important observation from this aspect of the needs assessment is the need to continue to support neurosurgical research and specialist training programmes in neurosurgery and the neurosciences. [61]

The introduction of advanced imaging technologies has made possible a substantial advance in the field of neurosurgical care. In assessing the future need for neurosurgery and neurosciences in Scotland, it would be important to make allowance for the continuing need to revise equipment and adopt new technologies, if we are to ensure the optimal level of care for all the population of Scotland. [62]

Whatever the future model of neurosurgery services in Scotland it will be important to expect changes and new developments to continue and to build sufficient flexibility into arrangements to allow the system to adopt to such new developments. For example if developments in the management of stroke led to an increase in the need for immediate access to neurosurgical care or assessment this might depend upon ensuring more rapid access for the population to the neurosurgical centre or centres. It is not possible to predict the precise nature of future developments, only to say with a degree of certainty that neurosurgical practice like all medical care is constantly changing and evolving.

Future trends in head injury management

Unlike complex multi-system trauma survival, outcome after head injury has not significantly improved since the early 1990's. Guidelines on head injury management are now being revised. New guidance will have significant implications for neurosurgical activity. NICE guidance has just been launched and SIGN guidance is currently being updated to recommend that all moderate and severe head injured patients are managed in specialist centres.[48;63] This has significant implications not just for volume of activity but also for configuaration of services. Many head injured patients also have multiple trauma and could not be transferred safely to a distant centre. It has been estimated for us that currently 2200 patients per annum are managed in Scottish neurosurgery centres and this will rise to approximately 4000 per annum. "The potential for improving the outcome of patients with severe head injury by expanding the number of UK neurosurgical centres is much greater than any other potential new intervention or treatment under investigation."[46;64]

The Cost implications of New Technologies

Neurosurgery like many areas of specialist medicine is a rapidly developing field and will require continual investment in new technologies. The current pattern of provision does not allow for planning and co-ordination of the introduction of expensive new technologies and equipment. In designing future plans it will be important to consider how the

introduction of expensive new technologies can be introduced without uneccessary duplication of expense.

The introduction of intra-operative MRI scanning for example is an important advance in tumour surgery with a high cost implication in accommodation and equipment.[34] A significant volume of surgical throughput would be required to make this a cost effective development. It would be inefficient to have two units competing to introduce this new technology. This is an example where a single unit would appear to offer a significant advantage in delivery of service although a single managed national neurosurgery service would appear to deliver all the same advantages without the need for the risks, cost and disadvantages of building a large central unit.

Future trends in the application of telemedicine

Telemedicine, the use of two-way audiovisual communication and imaging technologies to communicate between clinicians over long distances, offers a substantial advance in the management of patients with unusual conditions presenting in remote locations. Telemedicine has already been used very successfully in Scotland. For example a remote telemedicine link is currently used for the assessment of paediatric cases before transfer to the National Centre at Yorkhill.

Mendez et al [65] tested the feasibility of long distance telemonitoring in neurosurgery to provide sub-specialist mentoring of a general neurosurgeon performing a surgical procedure in a remote location. The authors concluded that their initial experience with long distance telemonitoring suggested that this was feasible, reliable and safe. This paper reports a small case series in which specialist neurosurgeons monitored six procedures in real time using a video camera mounted on a robotic arm controlled remotely from a specialist centre 400km away.

These reports suggest there is a clear potential for telemedicine linkages to be used to support the care and assessment of neurosurgical cases in centres without on-site neurosurgical sub-specialist support. This would enable a viable model of service, to balance the benefits of establishing a major neurosurgical centre of excellence, with a sufficiently high volume of cases to facilitate expert specialist care, with the need to provide of a population-wide neurosurgical service to a population which is sparsely distributed over a wide geographical area.

Whilst telemedicine for direct clinical interventions is still a fairly new and developing field, there are already examples of very successful examples of using remote linkages for clinical case conferences, for clinical audit, for CPD and for training. Using tele-video links to provide effective networking between remote sites is a practical measure which could facilitate clinical networking and help to deliver the single centre on two or more sites envisaged by various previous reports.[6]

The clinical use of telemedicine is a rapidly developing field. Whilst the proposed uses of new technologies and telemedicine are exciting and show much promise it is important that any investment in such technologies must be supported by evidence of effectiveness and be rigorously evaluated.

Future trends in stem cell research with regard to neurosurgical interventions

Whilst stem cell research is advancing rapidly, there is still a long way to go and it will be many years before the potential promise of this new technology can be fully realised. Currently, therapeutic uses of this new technology are limited to trials of individual cell transplantation and at the present time, it seems unlikely that significant changes in therapeutic practice, leading to changes in the need for neurosurgical interventions, will take place over the next ten years. [66]

In the Department of Health Report "*Stem Cell Research Medical Progress with Responsibility"* which reviewed the potential of developments in stem cell research and cell nuclear replacements to benefit of human health, the authors look forward to potential treatment possibilities. This exciting therapeutic potential must, however, be seen in perspective and there is much further work to be completed before such therapeutic advances are available in practice, including complex legal restrictions and ethical considerations to be overcome. As such, it is highly unlikely that advances in stem cell research will impact the need for neurosurgery within the next ten years. [67]

Future trends in Neuro-regeneration

Current research programmes are examining the fundamental cellular and molecular mechanisms that underlie neuronal regeneration in the peripheral nervous system with the long-term goal of developing cell and gene-based strategies that promote functional neuro-regeneration in the injured brain and spinal cord. Whilst these innovations may hold much promise for brain-injured patients in the long term, they are unlikely to impact on NHS practice within the next ten years.

Future trends in Stroke, Dementia, Parkinson's and SAH

Given Scotland's aging population, any planning of future neurosurgical services provision must take into account the neurosurgical needs of elderly people, in particular their needs with regard to the effective treatment of subarachnoid haemorrhage, dementia and Parkinson's Disease - conditions which are all more common in older people.

Future trends in the management of stroke

Recent guidelines suggest significant benefit could be gained by earlier and more intensive management of stroke patients. The concept of an approach based on the principle that a "brain attack" is as time critical as a heart attack. This has particular implications for imaging services as part of the intensive early management is a CT scan within a few hours of admission to differentiate ischaemic from Haemorrhagic stroke and identify patients for thrombolytic therapy.

Clinical, technological and organizational developments in acute stroke care mean that patients who a few years ago would have died or been seriously disabled after their stroke now have a much better chance of making a good recovery, provided they receive fast and effective access to appropriate care. For every patient who experiences a stroke, the cost to the NHS in the UK is around £15,000 over five years, and when informal care costs are included this increases to around £29,000.[68] Rapid access to a brain scan is critical for stroke patients. CT scans show whether brain damage is caused by a clot or a haemorrhage, but there can be further delays in getting the diagnosis if no one is available to read the scan once it has been done. Hospitals need to provide not only access to scanning equipment and to radiographers, but also access to staff who can read and interpret the scan itself (such as radiologists, neuroradiologists or stroke consultants who have been trained in this area). Such access is rarely available 24 hours a day and seven days a week. The development in the late 1990's of thrombolytic (clot-busting) drugs, which can reduce mortality and morbidity in eligible patients, was an important step forward in the acute treatment of stroke. Achieving rates of thrombolysis in England in line with those currently being achieved in leading Australian hospitals could generate net savings to the health service of over £16 million a year in care costs avoided, with more than 1,500 patients fully recovering from their strokes each year who would not otherwise have done so.[68]

Future trends in Subarachnoid Hemorrhage and endovascular therapy

In Bardach's analysis of 12,804 subarachnoid hemorrhage discharge abstracts from California, rates of mortality and adverse outcomes were lower at hospitals treating more cases, although in practice patients were rarely transferred to high-volume hospitals.[69] Average age was about 58 years plus or minus 17 years (one standard deviation).

The difference between in-hospital mortality rates in highest and lowest quartile hospitals was large (32% versus 49%, respectively). If these findings are correct, policies encouraging transfer to high-volume hospitals could significantly reduce overall mortality for subarachnoid hemorrhage.

To define High Volume Hospitals , the odds ratio for in-hospital mortality was calculated for each possible volume. This process identified the "cut-point" as hospitals treating more than 20 SAH cases per annum. The study identified the crude rate of SAH in the Californian population to be 8 per 100,000 population.

Transferring patients from low to high volume hospitals is not always feasible and because instability during transfer itself could worsen the outcome for some patients. In addition, Bardach found that hospital charges and length of stay were greater at high-volume

hospitals. These added costs, as well as those directly associated with transfer (not examined in our analysis), could be prohibitive. However, given the high costs of long-term care, an intervention that produces even a modest reduction in disability is often cost-effective when lifetime impacts are considered. Therefore, a policy encouraging the transfer of patients with subarachnoid hemorrhage to high-volume hospitals could reduce both mortality and costs.

Endovascular therapy was also more frequent at high volume hospitals and, similar to findings in a previous study, its presence was associated with improved outcome. However, only a small number of patients received endovascular treatment (n_143) as primary therapy, so it could not account for the large discrepancy in results between high- and low volume hospitals.

In Bardach's study only 29-40% of SAH cases admitted were "treated" suggesting that to achieve a treatment volume SAH should only be, managed in hospitals serving a population of at least 750,-850,000. Scottish experience is that around 90% of cases admitted with a SAH are now treated.[33] This suggests all four Scottish Neurosurgery Centres would be considered "high volume" hospitals by Californian standards.

Thomson, Ryan and Lyndon [70] carried out a study to assess the characteristics and audit the management of patients for whom diagnosis of subarachnoid haemorrhage (SAH) was made and who were admitted to a neurosurgical centre from an accident and emergency department (A&E). The objective was to use the results to make recommendations for improving care in this group of patients. The study's findings showed that a major constraint to accurate diagnosis and therefore timely and effective treatment was access to computed tomography. Given that computer tomography has been shown to be diagnostic in 97% of cases [70] any delay in accessing scans is deemed unacceptable. In addition, the authors found that treatment of SAH was suboptimal and the Society of British Neurosurgeons (SBNS) guidelines were rarely followed.

From their findings, the authors conclude that;

1. computed tomography should be easily accessible 24 hours a day
2. SBNS guidelines should be available in A&E and all A&E staff should be familiar with these guidelines and able to implement them
3. Patients who are admitted with headache and collapse or with a suspected SAH should be seen by a focused 'Brain Attack Team' to ensure rapid and effective treatment.

Those charged with planning for neurosurgical services in Scotland, a country with an increasingly elderly population, may wish to consider these conclusions. In addition, it is worth noting that the authors' conclusion regarding wider access to CT scans dovetail with Marsh's arguments [71] regarding access to CT scan at DGH level to ensure efficient diagnosis of neurosurgical condition thereby allowing time-efficient transfer of patients to neurosurgical units, as required.

Advances in stroke management are far more likely to require additional neuroradiological interventionists than surgeons as the interventions will involve intra-arterial thrombolysis and "clot pulling."[72]

Future trends in stereotactic radiosurgery

This treatment is causing a major change to the landscape of neurosurgical practice. There is now clear evidence for its benefits in AVMs and acoustic nerve tumours. Papers in the last few months have shown clear benefits of radiosurgery over surgery for smaller acoustic tumours. Emerging studies now show the treatment of choice of brain metastases is stereotactic radiosurgery, the numbers of such patients across Scotland will be significant. For commissioners treating these patients with radiosurgery is also more cost effective.

Scottish centres are developing expertise and capability to provide radiosurgery. Gamma Knife® is a registered trademark of one of the many devices available to deliver stereotactic radiosurgery. The Cyberknife® is also a trademark describing a similar device. The Gamma Knife is currently only available in Sheffield although the technology is likely to become available in more centres in the near future.

Discussion with neurosurgeons has suggested that with the availability of high quality LINAC based devices the exclusive role of the Gamma Knife® is limited to only a few patients in the population therefore appropriate for a single UK treatment centre. SBNS advise that for a population of five Million it would be appropriate to develop and implement a regional stereotactic radiosurgery service. This would require two neurosurgeons who perform stereotactic radiosurgery in a team with two neurooncologists.

Scotland should encourage one of the neurosurgical centres to develop a regional stereotactice radiotherapy service.

Future trends in the management of Parkinson's Disease

Parkinson's disease is commonly associated with elderly people and can be managed effectively among mid-stage patients with chronic deep brain stimulation. [73] The success of such a procedure requires a multidisciplinary approach involving both neurosurgeons and neurologists and is determined by three factors: proper patient selection, accurate lead placement into the intended brain target, and careful postoperative device programming in conjunction with management of antiparkinsonian medications. Starr concludes that 'Extraordinary advances in the surgical treatment of Parkinson's disease have occurred in the past 10 years and the many more may be expected in the next 10 years.' Given this and Scotland's ageing population, future provision of neurosurgical services in Scotland may wish to more closely examine the anticipated need for such surgery, including the cost-effectiveness of managing Parkinson's disease using neurosurgical intervention. Any such considerations may also wish to look more closely at the multidisciplinary approach that such management requires.

Safe Practice

Volume/Outcome Relationship in Neurosurgery

In determining the optimum distribution of neurosurgical services, it is important to consider the relationship between the volume of procedures performed and surgical outcomes.[74]

This volume outcomes relationship seems theoretically sound but is difficult to evidence in practice. Many studies have shown that for specialized procedures, specialist surgeons achieve better outcomes then general surgeons. In addition there are many published studies reporting that hospitals that treat more cases achieve better outcomes than very low volume hospitals.[29;69;75-81]

This relation has been shown with respect to a wide range of conditions and procedures including; diagnosis of subarachnoid haemorrhage or cerebral aneurysm, craniotomy for ruptured or unruptured cerebral aneurysm, subarachnoid haemorrhage, endovascular coil embolisation and angioplasty for cerebral vasospasm, unruptured intracranial aneurysms, surgical treatment of cerebral aneurysms, carotid endarterectomy, craniotomy for re-section of paediatric brain tumours, microvascular decompression, paediatric ventriculo peritoneal shunt procedures, and craniotomy for brain tumours.

However, the analysis of volume outcome studies is complex and beset by confounding factors.[82] Whilst there is evidence that specialist surgeons achieve better outcomes for complex interventions than general surgeons there is much less evidence to suggest that sub specialist surgeons performing very large numbers of a particular operation achieve significantly better outcomes than specialists who perform the same procedure regularly. For example studies use very different volume levels to define low, medium and high volume surgeons. The largest gains in outcome are clearly in moving from very few of a procedure (less than 10) towards regularly performing a procedure (20 or more times per annum). There are many examples in neurosurgery where centralization or sub specialisation has or could move the number of procedures peformed within a team from less than ten to more than twenty. This may well fit better with current neurosurgical training which it is felt may produce surgeons with less breadth of experience. It has also been suggested that newly qualified consultants would be better working within a larger team rather than being expected to perform as individuals in a smaller centre.[34]

In the Scottish context there are only a very small number of neurosurgeons to provide the full range of neurosurgical emergency care to a widely dispersed population. The few studies suggesting better outcome can be achieved by highly specialized sub specialists are reporting operative volumes far in excess of what could be achieved within the job plan of an NHS Consultant. Most, if not all Scottish neurosurgeons are already delivering surgical volumes for most procedures which take them well into the ranges of activity which defines them as specialist and are associated with generally favorable outcomes. SBNS recommends an ideal surgical volume of 180-250 cases per consultant per year.[14;15]

The other major issue of debate in volume-outcomes research is the role of hospital volumes. Again there seems to be fairly strong evidence that treatment in a specialist unit

with appropriate support facilities achieves better outcomes than management in a lower tech general surgical unit. However there seems to be little published evidence of better outcomes in very large specialist units over smaller but still specialist units such as those in Scotland. It is also difficult to interpret many of the studies, especially those from the US as there are multiple potential confounding factors including selection bias and the impact of early discharge policies where the sickest patients are both unlikely to be transferred to a large unit and very likely to have early discharge back to a smaller unit where they may well eventually die from late post op complications.

It will therefore be important to deliver neurosurgical services in such a way that each individual neurosurgeon is performing sufficient procedures to maintain their operative ability, but also to ensure that each neurosurgical centre is managing sufficient cases to ensure skill levels are maintained in all staff, including those involved in pre and post-operative management and to ensure that policies and procedures are in place to ensure optimum outcomes.

With reference to the studies cited above, it is worth highlighting a few additional points of particular interest;

Solomon et al [75] noted that it was not only experienced neurosurgeons that lead to improved outcomes but that the availability of experienced allied specialists and health professionals also lead to improved outcomes. They concluded that this finding, along with the volume/outcome relationship, strongly indicates that surgical outcomes are greatly improved for complex neurosurgical procedures where these procedures are performed in high volume specialist centres. It is important to note the details of Solomon's evidence in interpreting this advice. In this context high volume centres were defined as those performing more than 30 craniotomies per annum. Whilst in the US in 1987 – 1993, the period of study, there may have been surgeons performing occasional craniotomies in DGH type settings it is very clear that this is not the case in Scotland in 2007. All four Scottish centres would currently be rated by Solomon's criteria as high volume centres which would be expected to give the best surgical outcomes.

Bardach et al. [69] findings regarding outcome for subarachnoid haemorrhage suggest that policies encouraging transfer to high volume hospitals could significantly reduce overall mortality for subarachnoid haemorrhage. However, the authors noted that the substantial benefits of treatment in high volume centres may be partially offset by the worsening outcome for some patients due to instability during transfer and that treatment in high volume hospitals was also associated with a longer length of stay and greater hospital costs. This paper does not satisfactorily exclude the possibility of an admission bias in that regional units would only receive patients who were fit for transfer. It is possible that patients unfit for transfer remain in smaller regional units leading to an adverse effect on mortality profiles in those units.

Johnston and Claiborne [76] found that the beneficial effect of treating highly specialised conditions in high volume centres is not limited to operative neurosurgery but also applied to endovascular coil embolisation and angioplasty for cerebral vasospasm. The authors concluded that multi-disciplinary specialised neurovascular services offering endovascular therapies are associated with reduced in-hospital mortality and better outcomes overall.

Cowan et al[78] for example found that for carotid endarterectomy, a procedure performed across a range of hospitals and surgeon sub specialities, it was individual surgeon volume which was the important factor.

Barker et al [77] noted that, in addition to better outcome at time of discharge, patients with unruptured intracranial aneurysms who were treated by high volume surgeons also had fewer post-operative neurological complications.

Callan et al 2002 concluded that for carotid endarterectomy, surgeon volume was a more significant indicator than hospital procedure volume. Clearly, for surgeons to achieve high operative volumes, a degree of specialism and a limited number of centres is required.

Smith, Butler and Barker [79] concluded that for craniotomy for brain tumour, the best outcomes will be achieved by surgeons performing at least 1 procedure per month and in hospitals performing at least 2 procedures per month. On average, of the differences in outcomes between high and low volume hospitals, the largest were in the youngest patients.

Smith, Butler and Barker [81] concluded that paediatric shunt procedures performed at high volume hospitals by high volume surgeons or by high volume surgeons were associated with lower in hospital mortality rates, with no significant difference in length of stay or total cost. In this study the poorest outcomes were achieved in centres performing less than 28 procedures a year and by surgeons performing less than 9 procedures. The best outcomes related to centers treating more than 121 shunts and with surgeons performing more than 65 shunt procedures. These levels would be achieved in a single paediatric neurosurgery centre serving all Scotland.

Long et al. [29] concluded that it is clear that regionalisation could bring mortality benefit, but that such an approach is not without problems. Transferring tertiary neurosurgical care to specialised centres will increase costs at those centres and decrease costs at smaller hospitals and that such changes have potential implications for neurosurgical training with training doctors who are not sited in neurosurgical centres not gaining experience of neurosurgical care.

With reference to Long et al.'s finding that suggests that the cost of treating neurosurgical patients in specialized centres is inevitably greater than providing such care in more local hospitals, this is not necessarily the case. Using the ISD data presented above, it can be seen that the cost per case of inpatients treated in Greater Glasgow or Lothian, which have large neurosurgical centres, is not significantly different from the average and the highest cost per case is in the centre with the lowest number of inpatient discharges per annum. [28] Interestingly, this situation is reversed for day cases where the cost per case is greatest in the largest centre in Scotland and least in the smallest centre. Using the published data would appear to suggest that the cost of out-patient attendance at the centres in Greater Glasgow and in Lothian is significantly greater than at any of the smaller centres. These ISD costs are indicative only and should be viewed with a degree of caution.

Another compounding factor which may lead to bias in US studies is that of lifetime experience. It may well be that an experienced surgeon with a lifetime of practice who

performs a procedure regularly will be as good if not better than an inexperienced surgeon who is performing large numbers of similar procedures on a carefully selected patient population. In the US system surgeons are unlikely to be recruited to large specialist centres until they have already established a reputation and clinical practice. Thus the volume outcomes picture may reflect bias related to an experience/outcome relationship.

In Scotland the recent changes to medical training have led to concerns that future consultants will have less breadth and depth of experience and may be less able to undertake unsupervised practice in smaller units. This issue was addressed in the Temple report which concluded that although existing consultants were concerned about revised training arrangements that the quality of the training received should compensate for the long hours of on call "marking time" which characterized much of a traditional medical training. It would be wrong to design health systems on the assumption that the consultants of tomorrow will be less competent than their traditionally trained peers.

Thus the volume outcome evidence may not be transferrable to the NHS where this effect would be less marked as new consultants are appointed more evenly across the service and there is less occupational migration between centres. A neurosurgeon who does small numbers but who has been doing them for many years may be better at them than one who has been only doing them for a few years. It would be important to ensure within any national model that a situation was not created where regional centres were staffed by junior surgeons or generalists who then moved to a national centre of excellence as they gained experience and expertise. Such a situation would compound health inequalities and lead to a lesser standard of service for those patients served by the regional centres, especially the most deprived who would encounter greater obstacles to referral and travel to a national centre.

Within NHS Scotland the volumes and outcome picture may change more in future as older surgeons, with higher cumulative numbers over their careers (partly due to age, partly EWTD, on call rotas, etc) retire.

Health Inequalities

The relationship between socioeconomic status and health status has been well documented. It is therefore useful in planning neurosurgical service provision to consider the relationship between social deprivation and the need for neurosurgical services.

Dunn, Henry and Beard [83] looked at the association between measures of social deprivation, mechanisms of injury, patterns of care, and outcome (mortality) following head injury in Scotland. This study is particularly informative in the assessment of need for neurosurgical services in Scotland when adult head injury is used as a proxy for diagnoses necessitating neurosurgical intervention.

The researchers found that, after adjusting for known predictors of outcome using logistic regression analysis, there was no significant difference in mortality between patients from more deprived and less deprived areas. Although residing in a more deprived area was not associated with increased mortality for head injury among adults in Scotland, living in such areas was associated with different patterns of injury and a different process of care following presentation to hospital. Those living in more deprived areas tended to present

with head injury as a result of assault with those living in less deprived areas presenting with head injury sustained through a road traffic accident or fall from a height. The differences observed in process of care were consistent with the differences in mechanism of injury.

It should be noted that the researchers' chosen outcome measure, mortality, may lack the sensitivity of other potential outcome measures, such as the Glasgow Outcome Scale and Disability Rating Scale, and does not take into account the burden of disability resulting from head injury. The findings regarding a lack of association between social deprivation and head injury may not be upheld if another outcome measure was used.

Does specialisation generate health inequalities or service inequity?

Whilst some papers report that with sub specialisation good outcomes can be achieved even in small neurosurgical centres, there is evidence from the USA that small (often under resourced) local units do not produce good outcomes and can promote health inequalities as it is the deprived who are least likely to be referred on to a specialist centre.[84-86;86;87]

Great care should be taken to ensure that centralising services in national centres does not promote health inequalities. Referral to such a specialist centre would be the most unattractive for deprived populations who lack the transport or finances to travel for their care or to visit relatives. Faced with referral to a distant centre such patients might opt for less specialised local care. This could have an unintended but adverse effect on measures to try and address health inequality in Scotland's deprived populations., especially those living in remote and rural areas.

SBNS Standards for Patients Requiring Neurosurgical Care

The Society of British Neurological Surgeons, in their document 'Standards for Patients Requiring Neurosurgical Care'[12] set out detailed standards of care and service delivery.

In the report 'Safe Neurosurgery 2000' [15], the Society of British Neurological Surgeons (SBNS) outline their recommendations to ensure safety and quality for the provision of neurosurgical services, as follows;

- Neurosurgical units should be situated within a multi-disciplinary Neurosciences centre and on a General Hospital site.
- For maintenance of neurosurgical expertise and satisfactory training there must be an adequate volume and diversity of work and sufficient population to generate this. Whilst this must be reconciled with equity of access a 1million catchment population should be the minimum.
- Thirty neurosurgical beds and four dedicated neurosurgical intensive therapy beds per million population are needed to deliver safe practice.
- Every neurosurgical unit should have at least two fully resourced operating theatres; units serving a population of more than two million need three theatres.
- Each unit must provide a full core neurosurgical service before any sub-specialities are developed.
- The standards recommended in for operations per consultant per year is 180-250 and the number of consultants per million is 4 with a minimum of 6 in units covering less than 1.5 million [14].
- The recommendations for ward beds and neuro intensive therapy unit (NITU) beds are 30 per million population and 4 per million respectively [14].

Paediatric Surgery

Safe Paediatric Neurosurgery 2001

'Safe Paediatric Neurosurgery 2001' [13] set out a number of recommendations to ensure paediatric neurosurgery is provided safely.

The authors considered that, in common with adults, children with neurosurgical emergencies requiring urgent neurosurgical intervention should have access to appropriate neurosurgical help within two hours. In addition, they stated that children being transported for urgent neurosurgical intervention should have appropriate nursing support and airway protection during transfer. Such care could be provided by specialist paediatric retrieval teams or the local paediatric team, whichever is most expedient.

It is worth noting at this juncture that Tasker et al.[37] found that, contrary to expectation and the stated recommendations of the Scottish Intercollegiate Guidelines Network, the Royal College of Paediatrics and Child Health, and the National Institute for Clinical Excellence, that the involvement of paediatric transfer teams contributed to a prolonged interval between accident and arrival at the regional neurosurgical centre, such that the interval exceeded five hours in 7 out of 10 cases.

An ideal situation would see the immediate treatment of every patient by a highly skilled surgeon who specializes in exactly that condition in that age of patient. In practice this is not reasonably practical and compromises must be made to provide the best quality service within the limits of staff training and availability, cost, local geography, likely weather conditions and weather patterns. Tasker's review of actual practice suggests it is probably better to be treated quickly by a competent surgeon who can seek advice from an expert centre than to significantly delay treatment whilst arranging a safe transfer for a critically ill and clinically unstable patient.

The authors reported that all neurosurgical units providing care for neurosurgical emergencies should have clinicians with the necessary experience and training to undertake the immediate care of paediatric neurosurgical emergencies and that the neurosurgical training programme should, therefore, give every trainee neurosurgeon exposure to paediatric neurosurgery and specific training in the management of paediatric neurosurgical emergencies. They went on to say that if separate facilities for children are not available then children should not be housed in adult facilities for longer than is required for their safe neurosurgical management and the child should be transferred to appropriate paediatric facilities as soon as is practicable. The authors stressed the importance of access to CT and MR scanning for neurosurgical units undertaking the paediatric emergency care.

The authors outlined the need for neurosurgical units providing specialist paediatric services to have sufficient facilities and resources to allow immediate transfer, urgent same day admission or admission within 48 hours, as necessary, and appropriate support facilities including access to Paediatric Intensive and High Dependency Care. They reported that specialist paediatric neurosurgical facilities should be supported by specialist Neuroradiologists, Neuropathologists and Anaesthetists with expertise in paediatrics. In addition, in units offering specialist paediatric neurosurgical services, a member of the

paediatric neurosurgical team should be available to provide telephone advice to referring hospitals and neurosurgical units who may be undertaking the emergency care of paediatric neurosurgical conditions.

Safe Paediatric Neurosurgery 2001 states that a minimum of two specialist paediatric neurosurgeons are required per specialist paediatric neurosurgical unit. However, Pickard [88] notes that, 'It is neither compatible with the European Directive nor sustainable in the long term…to expect two paediatric neurosurgeons to provide on-call cover permanently on a 1:2 basis.' Pickard goes onto state that the majority (60%) of total paediatric workload results from head injury and hydrocephalus with the remaining 40% of the workload not sufficient to gainfully employ four or five paediatric neurosurgeons, even in the largest units. Pickard suggests that the way forward with regard to the management of paediatric neurosurgery is through a combination of cross-referral between units and the establishment and implementation of safe paediatric neurosurgery guidelines, the start of which is the publication of 'Safe Paediatric Neurosurgey 2001'. With regard to cross-referral between units, this can usefully be understood from a MCN perspective.

From the above it can be seen that whilst recommendation of learned societies are highly valuable in guiding planning it is not always pragmatic nor indeed possible to deliver the model of care which specialist societies recommend. In practice NHS planners face a range of priorities and challenges and must take a pragmatic approach to balancing public expectations, professional advice and efficient use of NHS resources.

Report of the Short-life Working Party on Paediatric Neurosurgery

As part of the Acute Services Review, the Short-life Working Party on Paediatric Neurosurgery, established by the Chief Medical Officer to advise on reconfiguration of paediatric neurosurgery in Scotland, reported in 2001 [89] having undertaken extensive consultation on existing services. The Working Party presented a set of conclusions and recommendations, with the acknowledgement that,

'… this review was complex. Indeed the disparity of professional opinion made available during the working party's deliberation is such that few if any of the conclusions and recommendations are made with unanimity. In many areas consensus was an elusive commodity.'

The working party endorsed the importance of a paediatric environment for childcare with the appropriately trained staff involved in treatment at all sites and concluded that the existing configuration of paediatric neurosurgical services in Edinburgh and Glasgow were unsatisfactory and suggested that the relocation of paediatric stand-alone hospitals, adjacent to adult institutions, may be required to resolve identified deficiencies in the service.

The authors acknowledged that there is a general and increasing expectation of children's care to be delivered in a paediatric centre and concluded that the split site arrangement of neurosurgical care in both Edinburgh and Glasgow is therefore sub optimal. They also stated that the current transfer of critically ill children from one institution to another within Glasgow is highly undesirable. The authors acknowledged that the existing fragmentation of services makes adverse outcomes difficult to identify but suggested that preliminary investigation indicates that perioperative mortality to be at a rate comparable with other nations.

CORPORATE NEEDS ASSESSMENT

The working party went on to state that a single paediatric Neurosurgical Institute in Scotland would have distinct advantages for training and service development and stated that compliance with the European Working Time Directive could only be effectively achieved by condensation of activity in paediatric neurosurgery into one central institute that was co-located with an adult neurosurgical centre. All but one member of the working party supported the long term goal of a single lead neurosurgical unit at the centre of a managed clinical network, although they acknowledged that the immediate creation of such a unit would result in loss of the available expertise in the short-term. The working party did not reach agreement regarding the optimal future shape of the service and highlighted that any reconfiguration would have a significant knock on effect on other tertiary paediatric services in Scotland. They did however raise concerns regarding recruitment rates into neuroradiology, paediatric neurology and neuropathology as an issue that may impact the future provision of paediatric neurosurgical services in Scotland

In moving from the existing provision to a single unit, the working party variously supported an interim position, which ranged from immediate implementation of a single centre through an interim two centre model to a model which recommended the continuation of elective and emergency services as currently provided dependent upon the discretion of the involved clinician as regards onward referral of cases. The authors noted that Scottish paediatric neurosurgical activity requires an intensive care support of a maximum of three paediatric intensive care beds to be available year round if these beds were to be available on a single site and that, whatever model was eventually adopted, continued investment in Scottish paediatric intensive care units (PICU) would be required to retain the necessary capacity. They suggested that both a single centre and two centre model may allow this capacity to be retained, but acknowledged that a single centre placed in Edinburgh would best protect retention of existing PICU services, based on a two centre model for the delivery of PIC.

The working party concluded that as paediatric neurosurgery is considered as a significant subspecialty in Scotland. As such, paediatric neurosurgery needs to be able to assess activity and quality of outcome based on robust, accessible, clinically significant and contemporary data grouped through an appropriate collection method. At the time of writing, the working party acknowledged the current lack of national or international data available to correlate volume with optimal outcome in paediatric neurosurgical practice.

CORPORATE NEEDS ASSESSMENT

Based on their conclusions, the working party set out their recommendations for paediatric neurosurgery in Scotland. Key recommendations are included below;

- A managed clinical network (MCN) with a single lead site, co-located with an adult neurosurgical service is the preferred, long-term configuration to the service of paediatric neurosurgery in Scotland.
- The MCN will require active management along the lines of a national services framework, with a lead clinician supported by an appropriately funded management coordinator. This development should commence forthwith.
- Opinion on the timescale of implementation of the single centre was disparate but thought to be likely predicated by the rate of implementation of manpower regulations and the development of a co-located adult and children's hospital in the central belt.
- A robust database of activity as part of a managed clinical network is obligate.
- The working party recommends the appointment forthwith of a steering group to develop the MCN, appoint the lead clinician (preferably a neurosurgeon) and collect data that may inform decisions concerning the timescale of any future reconfiguration.

Corporate Views on Paediatric Neurosurgery

Whilst there is clear agreement that paediatric neurosurgery is appropriate for delivery as a sub specialty interest and fairly clear agreement that neurosurgery should be delivered from a single centre in Scotland there remains clear concern in the regional centres about the management of acute paediatrics emergencies.

There are particular concerns with regard to the potential time delay to transfer children to a national centre and a strong feeling that the volume of cases would make this impossible to achieve. Therefore whilst it is clear that there is a consensus and support for the recommendation that elective paediatric neurosurgery should only be undertaken by appropriately trained sub specialists there is a real need to maiantain sufficient skills in each of the Regional Centres to allow immediate management of paediatric emergencies. Both Dundee and Aberdeen staff have highlighted in feedback the need to maintain for example the capacity to manage blockage of simple paediatric CSF shunts locally.[90]

Transport and Travel

Preferred Mode of Transport

Given the wide geographic area covered by neurosurgical services in Scotland the issue of transport to a neurosurgical centre is an important consideration. Currently, patients requiring neurosurgical services may access such services via a road ambulance, an air ambulance or private transport, depending on the severity of their condition. Any future restructuring of neurosurgical services that reduces the number of neurosurgical units in Scotland may imply that there will be more need for transport of patients by air ambulance, however there are a number of issues to consider before moving to such a position.

Black, Ward and Lockey [91] present an algorithm to rationalize the process of selecting patients that would benefit and be appropriate to transport by air ambulance. The paper highlights the many variables that should be considered before opting to transfer a patient by air ambulance, such as access to types of transport, weather, contraindications, patient's physiological status, specific injury patterns, location access, availability to deliver pre hospital critical care, total transfer time, and resources at receiving hospital. This paper helps to elucidate the potentially complex decision making that is required to identify patients that are suitable and would benefit from transfer by air ambulance and highlights that in many scenarios transfer of the critically-ill to hospital is preferable via road ambulance as this means of transport affords flexibility in the pre hospital care that can be given to the patient en route.

In their paper on the impact of a new regional air ambulance service on a large general hospital, Jenkinson, Currie and Bleetman [92] highlight the considerable continuing controversy regarding the air ambulance service purported benefits in terms of patient survival and prognosis. In addition, the paper details the considerable costs in running an appropriately staffed air ambulance crew and maintaining a suitably located helipad. The paper also highlights the importance of having a helipad located adjacent to the neurosurgical unit, as any secondary transfer by road ambulance causes unnecessary delays.

It is not only mode of transport which needs to be considered in a review of treatment locations. In most cases the number of patient journeys and relative visits to a hospital or care centre greatly exceeds the volume of emergency admissions or even staff movements.

Locating specialist services in a remote location does not only introduce additional travel costs, delays and risks for the patient. All of these issues also arise with regard to all of the patients relatives, visitors and their subsequent returns for follow up and review. As hospital care moves increasingly to providing day case care and early discharge the volume of patient journey's is set only to increase.

In many instances transfer by road ambulance is preferable to transfer by air ambulance in terms of ability to provide en route treatment and with regard to on-going controversy regarding the benefits of air ambulance service for improved patient survival and prognosis.

Air Traffic Control report that there are approximately two days per year in each of the Scottish airports when flights cannot leave due to weather conditions. Whilst large commercial flights can fly into Glasgow even in adverse weather the small planes used for patient transport lack the instrumentation to safely land in poor visbility.[90]

Delays in Transferring Patients to a Neurosurgical Unit

Given the wide geographic area covered by neurosurgical units in Scotland, concerns may be raised that any moves to locate services more centrally may disadvantage local, rural populations by causing life-threatening delays in accessing neurosurgical services.

The actual transfer time is not the only cause of significant delay in the transfer and treatment of head injured patients, often it is local hospitals delayed identification of those requiring transfer to a neurosurgical unit that creates significant delay.

Marsh, Maurice-Williams and Hatfield [71] undertook a study to examine where delay occurred in the process of neurosurgical care. By analyzing the process of transfer from district general hospitals (DGH) to a neurosurgical unit (NSU), the researchers were able to identify that the actual travel time involved in transferring patients played little or no part in contributing to avoidable deaths. In addition, the researchers observed that actual distance from the NSU did not significantly impact on the time taken to transfer a patient. As such the researchers concluded that reducing geographic dispersal of services would have little effect on the outcome. Conversely improving transfer times by providing surgical retrieval teams or enhanced transport such as air ambulances would also have no impact on improving survival as it is having the local expertise on site with the patient which is the most important factor in improving survival.

Marsh, Maurice-Williams and Hatfield concluded that to improve neurosurgical services two measures may usefully be put in place; 1) DGH should be adequately equipped to assess patients with head injuries that may require transfer to a NSU. This could be the installation of a CT scanner in every DGH which admits head injuries with telemedicine linkages to the NSU. This would reduce the time taken to identify those patients requiring transfer and 2) Delay in actual process of transfer could be minimized by ensuring the immediate availability of transport at every DGH admitting head injuries.

In practice the geography of Scotland makes it highly unlikely that locating neurosurgical services in a reduced number of centres in Scotland could be achieved without significantly reducing the number of patients who could receive expert neurosurgical care within the suggested two hours of admission. This detrimental effect could not be overcome by improved ambulance services as diagnostic delays within and communications between hospitals also cause detrimental delays.

Patient and Visitor Travel

In assessing the impact of any particular service configuration it will be important to consider the impact on patient and visitor travel as well as the delivery of service. In-patient activity is only a small part of the work of the NHS and there are a very large number of out patient and visitor journeys to neurosurgery services.

CORPORATE NEEDS ASSESSMENT

As an example of the financial impact of travel the following are typical ticket prices as quoted in September 2007. (www.nationalrail.co.uk)

Aberdeen – Glasgow £44.90 (saver return) to £60.00 (standard open return)
Aberdeen – Edinburgh £44.90 (saver return) to £60.00 (standard open return)

Patients and patient groups have repeatedly stressed that health care services in Scotland should be provided as locally as possible.

'Looking at services from a patient's point of view underpins everything we are seeking to do in the health service. Patients are concerned about:

- **quality of care;**
- **treatment at the right time and in the right place;**
- **being treated with dignity and respect;**
- **having their say in decision making;**
- **having their feedback taken into account; and**
- **getting clear explanations at every stage.**

All this amounts to a massive cultural change in the health service compared to the first fifty years of its history.'

Partnership for Care: Scotland's Heath White Paper, The Scottish Executive 2003

The Temple Report stated the importance of keeping services as local as possible based around the patient journey.

Themes:

We learned that:

- ***The public*** expects to be treated by trained doctors who are competent to deliver a safe, quality service.
- ***The service*** should be as local as practicable and based around the *patient journey*.
- ***The profession*** expects a balance between quality of life and the demands of work.

Travelling to a remote location is not just potentially detrimental and distressing for the patient it has also been shown that having a loved one taken away to a remote location for health care can be much more stressful for families and loved ones than providing that care locally. Clearly such considerations must not over ride patient safety but there is a preference from patients to have health care delivered as locally as possible.

In assessing the transport impact of any proposed service it would be important to include not just the financial and emotional costs of travel but also an environmental impact assessment of the additional journeys required.

Environmental Impact

Whilst an environmental impact assessment would require to be part of any significant redesign of service it is beyond the scope of this document. We have been supplied with some examples of "carbon costs" for patient travel.

The carbon impact per person for flights are

Shetland Glasgow, 200 Kg CO2
Shetland Aberdeen, 100 Kg CO2
This is the per person impact, if there are more having to travel, say nurse or doctor with patient, then multiply by number of individuals.

Ambulance journeys, based on average 35 mpg, diesel.
Aberdeen Glasgow 150 miles, 53 Kg CO2
Aberdeen Inverness 103 miles 36 Kg CO2

Inter-hospital Transfers

Given the complex decision making process entailed in selecting patients for air ambulance transfer, the continuing controversy surrounding the use of air ambulances for the critically-ill and the costs inherent in appropriately staffing and equipping an air ambulance service and the findings that actual transfer time is not the most significant delay in the transfer and treatment of head injured patients, those charged with planning future neurosurgical provision in Scotland may wish to consider how DGHs can be appropriately equipped to identify patients requiring transfer more efficiently. In addition, consideration might usefully be given to a dedicated road ambulance service for the transfer of patients requiring neurosurgical services to a neurosurgical unit. In some instances, use of air ambulance may be deemed preferable and, therefore, consideration should be given to the specific location of the helipad in relation to the neurosurgical unit.

Multidisciplinary Practice

Clinical neuroscience specialists

Although the focus of this Report is future provision of neurosurgical services in Scotland, it is pertinent to consider current developments in allied specialties and health professions as the provision of safe neurosurgical care relies on the skills and expertise of a wider community of specialties and health professions.

In the Society of British Neurological Surgeon's report, 'British Neurological Workforce Plan 2000-2015'[14] the authors report that most neurosurgical units state that the specialties on which they rely directly for complementary services - pathology, radiology,

interventional radiology, anaesthetics, neurology, neuro-physiology and neuro-oncology - are largely sufficiently resourced for the current levels of neurosurgery. However, the authors go on to state that, all these specialties will need to be developed accordingly as neurosurgery's work rate increases. In addition, the authors report that there was almost universal comment from neurosurgical units on the need to develop neuro-rehabilitation facilities.

With regard to organizational arrangements and staffing levels for nursing and clinical neuroscience specialists and again referring to Hardy [39], Hardy details that due to shortages of appropriately trained nurses and clinical neuroscience specialists there are considerable challenges to appropriately staff units. Hardy suggests that; 'In general, those units that are large enough to sustain a viable pool of trained staff to buffer recruitment difficulties, and unplanned staff shortages are more likely to absorb these pressures and difficulties without unacceptable, unplanned restrictions of capacity.'

Adult Neurology

The main impact of adult neurology services on neurosurgery need will be the greatly increasing number of neurologists in all parts of Scotland, including DGHs. These neurologists will want to engage with acute neurology, and some of acute neurology is still being been done by neurosurgeons (eg subarachnoid and intracerebral haemorrhage).[72]

The increasing number of neurologists might also take on out patient consultations for diagnosis and management of backs and necks, and so release neurosurgeons to do more operating. In some US units all patients are admitted/seen first under/by a physician except for trauma, this results in a system with many more neurologists than neurosurgeons. If the number of neurosurgical centres contracts then neurologists will have to take on increasing roles in diagnosis and management as neurosurgeons focus more on high volume operating and become less accessible to patients. Within the neurosurgical centres, very specialised neurologists could work with neurosurgeons on epilepsy surgery and functional neurosurgery for Parkinson's disease etc. What is often overlooked in planning is that neurology-only centres MUST have proper imaging and investigation, equivalent to that currently provided for neurosurgeon led units and ultra fast transport and other links to the neurosurgical centres.

Paediatric Neurology, Neuropathology, Neuro-anasthesia and Intensive Care, Neurophysiology and Neuro-rehabilitation

As part of the corporate needs assessment we also contacted specialists representing Paediatric Neurology, Neuropathology, Neuro-anasthesia and Intensive Care, Neurophysiology and Neuro-rehabilitation. All of these specialist services replied with specialist input and highlighting the important relationships with neurosurgery and the critical clinical linkages which exist. Despite stressing these relationships none of these important sub specialist groups returned advice either supporting or refuting a need to revise adult neurosurgery in Scotland. The general impression was a willingness to adapt to whatever pattern of neurosurgical service was proposed provided that the service included proper links with and support from these important clinical neuroscience specialists.

CORPORATE NEEDS ASSESSMENT

Managed Clinical Networks

NHS Scotland is a single health system and as such differs significantly from the health care commissioning environment in England and the private or insurance based health care systems in the US and in other European Countries.

NHS Boards are the organisations in Scotland charged with delivering health care for their local populations. The Temple Report identified that NHS Boards are not always the ideal size to plan services for rare conditions or which are more specialist in their nature. As such Professor Temple called for the introduction of larger health economies in Scotland. These larger groups have been delivered through the establishment of Regional Planning Groups in the South East, West and North of Scotland.

As a single healthcare system, delivered by a number of different agencies it is important to have a way of delivering services which are consistent, equitable and high quality across differing populations and between different health care providers. Managed Clinical networks are a significant component of NHS Scotland Health Care Policy for delivering the highest possible standards of health care within available resources and their importance was reinforced in the Temple Report.

"In many instances, we see service redesign supporting an integrated pattern of care involving several different facilities. Teamwork, new ways of working and changing professional roles: all will play an important role in supporting service redesign. Smaller units may need to work with larger units, and in this respect the principles underpinning Managed Clinical Networks should be adopted. These networks, however, will not be sustainable without specific workforce support designed to meet their needs. Most importantly the principles set out in the NHS Circular HDL(2002)6922 need to be pursued. Each network must be effectively managed, with clear accountability for the service each provides, and staffed by health professionals competent to work in this way."[3]

Managed clinical networks (MCN) are defined [54] as, ' linked groups of health professionals and organizations from primary, secondary, and tertiary care working in a coordinated manner, unconstrained by existing professional and [organizational] boundaries to ensure equitable provision of high quality effective services.'

The concept of MCNs was formalised by the report of the Acute Services Review (June 1998), as a way of building on the collaborative working which was already common amongst clinicians.

A wide range of MCNs are now in existence or under development in Scotland at NHS Board, regional and national level, with demonstrable improvements in service delivery to their credit. This approach should continue, since MCNs have a number of functions to perform. They should continue to be the engine room of quality and clinical improvement and re-design.[18]

It is important to note that MCNs in Scotland have a specific definition, purpose and structure as set out in various Scottish Executive Publications and Health Department

Letters. The language used to describe these networks differs between countries, even within the UK and Managed Clinical Networks in England and Wales will differ from those in Scotland because of the different commissioning structures there. The term Managed Service Network and Managed Care Network are also in common usage to describe alternative networking arrangements but within this document reference to MCN assumes the definition and function of a National MCN as set out in NHS HDL(2007)21. The HDL also recognises that whole system change is beyond the capability of any single organisation, and therefore encourages the continuing development of Managed Care Networks.[93]

In particular the HDL states that it is important to recognize:-

> ***Whole system change across complicated health and care organisations is unlikely to be achieved through refining traditional hierarchical structures in isolation. Local planning partners and RPGs therefore need to maximise the potential for MCNs to improve service quality and performance management throughout the patient pathway, by using them as planning fora in the relevant disease area or topic. Crucially, they also need to ensure that MCNs are fully integrated into local or regional operational and management structures if their potential to help deliver modern, sustainable services is to be realised.***
>
> ***NHS HDL (2007) 21.***

Given the range of clinical neuroscience specialists involved in the provision of neurosurgical and neurological care, the highly specialist nature of neurosurgical and neurological care and the geography of Scotland, a managed clinical network may be an appropriate manner in which to structure the service and ensure good access.

Edwards outlines the advantages of MCNs, as follows: a way of sustaining vulnerable services and maintaining access where the requirements of training or sub specialisation would otherwise mean complete closure of local services; avoid need to withdraw clinicians who form important parts of other services; a way of making the best of scarce specialist expertise, standardizing care, improving access, reducing any ‘distance-decay’ effects; create systems whereby patients receive a standard investigation and are referred on rather than being held in a local service that may not have the full range of expertise; networks can exploit any relationships between quality and volume and enable a faster spread of innovation; significant benefits as a result of being able to focus on the needs of their patients without the distraction of managing the less patient focused parts of the system, such as non-clinical support services; stimulate creativity and innovation by providing increased opportunities for interaction of people from different disciplines and organizations; and encouraging a focus on clinical issues. Edwards identifies that the main, potential disadvantage of MCN is if such structural reconfiguration is viewed simply as a structural change without embracing the important, cross-collaborative nature of MCN.

Having referred extensively to Hardy [39], throughout this Report, it is noteworthy that Hardy’s suggestion for addressing the various challenges outlined in his paper is through the establishment of a managed clinical network (MCN). There are various ways that such an MCN could operate ranging from complete integration of clinical work including a joint on call rota with sites rotating receiving days to models where clinical linkages are forged

for CPD, audit, clinical pathways and case conferences but both centres continue to provide 24/7 emergency cover.

The advantages of a MCN could be beneficial to a low-volume, highly specialized specialty like neurosurgery. It may be beneficial to consider in detail how a national neurosurgery MCN
could operate in Scotland to maximize expertise for patients' advantage in any future restructuring of neurosurgical service provision in Scotland. In developing a neurosurgical MCN, number of considerations should be borne in mind;

1) Many neurosurgical conditions are rare or very rare, so sub specialisation may be appropriate. All units within the MCN would be expected to deal with more common conditions with units with particular expertise handling rarer cases

2) It is suggested that by handling routine non-emergency work at a location that is not subject to the unpredictable nature of emergency work then a better quality of service could be provided and waiting times addressed – in effect a redistribution of workload. This is the model being introduced for elective procedures in many areas of England and Wales. Early indications would seem to suggest that these Ambulatory Care Centres only work well where they are able to serve a highly selected elective case load. This may be less appropriate for neurosurgery which is fairly low volume and largely unplanned in nature.

3) A MCN would be capable of planning necessary manpower for emergency and urgent conditions and provide suitable training opportunities for doctors across the network. In addition, by making use of appropriately trained clinical neuroscience specialists some of the concerns of reduced numbers of doctors in training could be alleviated.

Support for a Managed Clinical Network as a delivery mechanism for Neurosurgical services is by no means universal. Previous Reports such as that of the Neurosciences Action Team have considered the value of an MCN for collaborative work to address service improvement, sharing good practice, audit, data collection, research and developing action plans but in recommending that Neurosurgical services should be planned and commissioned on a national basis the report does not see an MCN as an adequate solution advising that as well as establishing and MCN *"the SEHD should assume strategic leadership responsibility for planning and commissioning neurosurgery on an all-Scotland basis, working with Regional Planning Groups and NHS Boards."*

> *"For Scotland where there has been discussion of rationalization of neurosurgical services for 9 years I believe that a managed clinical network covering the whole of neurosurgery will fail as the leadership of the network will consistently fail to get the stakeholders to act in the interests of network rather than their locality."*[1]

There is clearly a need to better join up the provision of neurosurgical care across Scotland. There is no evidence to suggest an MCN would be the optimum solution but it does offer one possible approach.

Patient Perspective

Another important perspective to consider in any future restructuring, and particularly given growing expectations from patients, is the patient experience and satisfaction.

Thorne and Kitchen [94] used an audit tool, developed by the Royal College of Surgeons of England Surgical Audit Unit, to assess patients' satisfaction with neurosurgical care. Through this process, they identified that, contrary to common perception, most people were satisfied with level of communication between themselves and their surgeons, however dissatisfaction existed regarding the time taken to receive biopsy results and with being transferred back to an original referring hospital.

The Neurological Alliance, a charitable organization which represents a wide range of neurological charities working on behalf of people in the UK with a neurological condition, details a range of principles that should underpin the provision of quality services for people with neurological conditions in the document 'Levelling Up' [16].

Key principles identified are;

- Service that promote independence and quality of life
- Quick access to specialist diagnosis, investigation and treatment by knowledgeable.
- Comprehensive assessment of need and by timely referral for appropriate treatment
- Access to high quality, easily accessible information about specific neurological conditions, appropriate services and relevant voluntary organisations.
- Care provided by well trained interdisciplinary professionals
- Prevention of avoidable death and disability and secondary complications.
- Easy, on-going access to services through one point of contact.
- Equity of service provision for all people with neurological conditions.
- Involvement of people with neurological conditions, and their carers, in treatment options and decisions, and in the management of their condition.
- Holistic rehabilitation
- Established care pathways to facilitate appropriate and timely movement from acute care to rehabilitation and through other transitional periods.

Those tasked with any restructuring of neurosurgical provision in Scotland should actively engage patient input to ensure services meet patient needs.

Training for Future

There are a number of challenges to the medical and nursing workforce that should be considered when planning future neurosurgical service provision.[14]

The continuing effects of the Calman training regime produce a number of real challenges in appropriately training middle level doctors to be prepared for consultant-level

responsibilities. For example, under Calman, Surgeons who gain their certificate of completion of specialist training (CCST) have been trained to a high level of knowledge but are relatively less experienced in practical terms than newly appointed consultants under the previous regime. The impact of this aspect of Calman has been to encourage the idea of two levels of consultants, a 'junior' level and a more 'senior' level, whereby the 'junior' consultant would remain under a degree of supervision until their practical experience reached a specified level. Such an idea is not helpful in supporting newly qualified consultants to fully inhabit their new role and responsibilities. Nor is it helpful in promoting a service which maximises the skills of all consultants.

Another significant effect of the Calman training regime, associated with the point above, is the impact it is having on existing consultants' responsibilities and workload. In practice, Specialist Registrars are now subject to greater supervision and restricted in amount and nature of the surgical work they may perform. Therefore, the time a consultant spends on training and supervising trainee staff has increased to the point where in overall terms the ratio of Consultant:SpReg must now be 1:1. The impact of this situation is not only to increase Consultant workload but also that the service is evolving as a consultant delivered one. This is in part because of the effects of a changed training regime but also because of public expectation and as a consequence of litigation and complaints. The net result of these changes is that consultant staff are required to take on more clinical and supervisory work since the onset of Calman.

Another consideration when thinking about training is the consultant/non-consultant career grade (NCCG)/ SpR/junior doctor mix. If NCCG doctors could be utilised in such a way as to relieve some pressure on Consultant colleagues this may enable Consultants to provide increase training opportunities to SpR and junior doctors.

As outlined by Hardy [39], potential solutions proposed by Royal Colleges of Surgeons to address these challenges are; provision of explicit training sessions for trainees; separation of training from service; and concentration of training programmes in larger units or the amalgamation of training units.

The Calman Reforms alongside the EWTD has produced a number of challenges in the training of future neurosurgeons. In any future reconfiguration of the service in Scotland, the ability to provide explicit training sessions for trainees, the separation of training from service, and concentration of training programmes in larger units or the amalgamation of training units would assist in addressing these challenges.

Corporate Needs Assessment Conclusion

This Corporate Needs Assessment has included

- A comprehensive literature review to assess evidence of clinical need for neurosurgery, in particular to examine any evidence for volume outcomes effects suggesting a patient benefit from centralised services.
- A review of the substantial body of work already undertaken in Scotland.
- A series of meetings to establish the views of the neurosciences community.
- Correspondence with clinicians and clinical neuroscience specialists, services and other interested parties.
- Consultation on a draft document with extensive written feedback.

Whilst it is not possible to include details of all the conversations, advice and written submissions received these have proved very helpful in shaping this text and the following conclusions.

Health and Social Policy in Scotland is rapidly evolving and many of issues covered in neurosciences reports over the past decade have already developed substantially since these reports were published.

Previous reports have proposed a number of changes or alternative service models for neurosurgery in Scotland, few of which have been implemented.

All neurosurgery should be undertaken by specialised neurosurgeons who are undertaking regular surgical lists and are experienced in that procedure.[82] This includes spinal surgery.

Whilst there is clear evidence of a volume-outcomes effect in many areas of surgery there have been very few published studies of volume-outcomes effect in neurosurgery. Benefits arising from manipulation of volume are likely to be most clearly apparent at a relatively low level of volume.[74]

Recent evidence suggests that all moderate and severe head injuries should be managed in a specialist neurosurgical unit.[46] If head injuries were to be routinely cared for by neurosurgeons this would be a substantial local neurosurgery workload and mitigate strongly against centralisation of the emergency general neurosurgery services.

Neurosurgery services, like most areas of medicine, are continually developing and not all future developments in clinical practice can be predicted.

The Glasgow Unit currently receives large numbers of telephone enquiries concerning possible transfers and request for advice. Similar advisory functions are performed in all four Scottish neurosurgery centres. These calls create a substantial workload largely managed by middle grade doctors. This is an example of the sort of activity which could be managed across all four units of a single national service.

CORPORATE NEEDS ASSESSMENT

Critical clinical linkages between Neurosurgery and other allied neuroscience services such as neurophysiology, neurology, neuropathology and neuroradiology depend upon the presence of regionally based neurosurgeons. All of these services need to be provided within EWTD compliant contracts, not just neurosurgeons.

Although a single centre model was included in the Neurosciences Action Team option appraisal the Team also indicated that such a model was not possible due to obstacles such as transport infrastructure which are outwith the control of the NHS.

CORPORATE NEEDS ASSESSMENT

Corporate Needs Assessment Summary

There has been a focus on out of hours activity and middle grade staffing driving the case for change. NHS Scotland should be working towards a service delivered by fully trained doctors managing this through innovative approaches, new technologies and rota changes.[3;39]

Contrary to popular opinion most routine neurosurgery workload is not particularly highly specialized.

Much of the Volume outcomes data from the USA is not relevant to the Scottish context.

In interpreting volume outcome studies, especially those from outside the UK, great care must be used in drawing conclusions of relevance to UK neurosurgical practice.

Wherever possible specialist surgery such as neurosurgery should only be undertaken by specialist neurosurgeons, not by general surgeons.

Future neurosurgical provision in Scotland should be structured to enable SBNS Standards for Neurosurgical Care to be met.

There are considerable perceived pressures on the current centres in Glasgow and Edinburgh relating primarily to middle grade staffing and waiting times.

The staffing arrangements and distribution and organisation of work differ significantly between the existing centres.

Access is a significant component of satisfactorily addressing patient need. Typical In and out patient waiting times are currently widely variable between centres and this should be addressed to improve equity of access. There is potential to revise catchment populations to achieve this.

Spinal surgery is no longer routinely undertaken by orthopedic (or "back") surgeons and should only be provided in neurosurgery centres by appropriately skilled neurosurgeons.

The evidence suggests that to deliver optimum and equitable clinical outcomes for a population of 5.5 Million that specialist services could either be delivered from a single national neurosurgical centre or from a number of similarly sized, staffed and equipped regional centres the location of which should be dictated by the geography and demography of the population served.

Within Scotland there are significant obstacles to a one centre model which are outwith the control of the NHS. [85 95]

There is a continuing need for a local neurosurgery service for patients from the North and North East of Scotland.

CORPORATE NEEDS ASSESSMENT

There is a degree of consensus that highly specialized services should be offered in only one centre although all neurosurgical care need not take place in the same unit. This issue is complex and not exclusively related to volume of cases. Services may be specialized because they are unusual and low volume (which limits the potential case volume of each surgeon) for example neurosurgery for mental disorder or because they require highly specialized equipment or personnel (endovascular coiling). A third factor is where a specialist service must be available 24/7 then it may not be possible to staff that service across more than one centre in Scotland (paediatric neurosurgery).

All four regional centres have changed since 2002 when there was broad clinical consensus that the best way to address the challenges facing neurosurgery was to combine all four units on a new site in central Scotland.[11]

The proposed model of a new build national centre of excellence in a central location which was perceived as attractive in 2002 would not deliver the minimum standards set out by SNBS such as co-location with both a children's hospital and university teaching hospital.

There is support for a networking solution to establish a single national neurosurgery service on four sites. This could follow the managed clinical network model.[6;7;39;54]

Neither Dundee nor Aberdeen would support a move to reduce the number of centres unless this achieved a single national centre of excellence on a purpose built central site as proposed in Professor Teasdale's 2003 report to the then CMO.[11]

The 2004 Neurosciences Action Team Report considered that the current NHS and public transport infrastructure would not support any reconfiguration in neurosurgical services and would require review in advance of any revised service disposition being implemented.

Transfer of ill patients to a national centre in both emergency and planned situations would require exploration of increased use of air transport and dedicated transport teams with appropriately trained staff. Additionally support for families, carers and visitors through improved public transport links, provision of accommodation and other support whilst attending the specialist centre would need to be strengthened.

This situation has not changed and any significant development of the public transport infrastructure is beyond the control of the NHS.

It is important for emergency neurosurgical care to be accessible to as many of the population as possible.[36-38] The current distribution of neurosurgical centres gives a good geographical coverage with 92.2% of the population within 2 hours of a neurosurgical centre. Currently, over 50% of the population live within less than 30 minutes.

CORPORATE NEEDS ASSESSMENT

The standards of care and facilities in all four Scottish neurosurgical centres are generally felt to be of high quality but evidence and information to support this is lacking. A National MCN could begin to address this information deficit as well as important issues such as differing pathways of care, variable standards, inconsistent application of clinical governance, clinical audit and research.

Whatever the volume of activity required it should be delivered only in centres able to sustain both the overall hospital volumes and the individual surgeon volumes to consistently achieve optimum clinical outcomes for patients.

The review of volume/outcomes studies supports theSBNS recommended ideal level of between 180 and 250 operations per year. This needs assessment has found no evidence to contradict that recommendation. Minimum volumes for sub specialist procedures should be at least 20 procedures per sub specialist if clinically possible.

There is a single national spinal injury unit based at the Southern General Hospital in Glasgow and this should be maintained.

A Hub and Spoke model where a national centre is supported by smaller less specialized units might fuel health inequalities.

The financial costs of centralising general neurosurgery services onto one or two sites would need to be carefully considered against the cost of the existing units and what patient benefits could be achieved by direct investment in those units.

There are many critical clinical linkages between Neurosurgery and other allied neuroscience services such as neurophysiology, neurology, neuropathology and neuroradiology.

All four neurosurgical centres are co-located (Aberdeen and Dundee) or are close to (Glasgow and Edinburgh) Major Trauma Units and provide a valuable service in support of A&E services.

Future trends in head injury management, stroke care and endovascular therapies will increase demands on neurosurgery.

Some interventions require the identification of sub specialists at a whole Scotland level for example stereotactic radiosurgery.

Some interventions currently delivered by sub specialists may become more common place, for example, endovascular therapies.

Some developments such as stem cell research and neuro-regeneration will have no impact in the next 10 years.

Workforce Summary

CORPORATE NEEDS ASSESSMENT

Neurosurgery in Scotland should be delivered by trained doctors and the population should not rely on doctors in training for service delivery.

A shift towards planning for and delivering a trained-doctor based service must be made;

Although Consultant numbers compare favourably with England and Wales there is demonstrable need to increase the Consultant Workforce.

The past decade has seen a reduction in the typical consultant working week from 60 hours to 44 hours.

In 2004 the Consultant workforce was 21.6 Whole Time Equivalents.

If NHS Scotland is to move to a fully consultant delivered service which does not rely on doctors in training for service delivery this number may be too low.

Various reports have anticipated a need to increase consultant numbers by between 4 and 6% per annum.

Based on SBNS recommendations, activity of 6600 procedures per annum would suggest an ideal workforce of around 34 Neurosurgeons

There are also operations currently delivered by other specialists which could be delivered by Neurosurgeons if there were more in post. These operations include spinal surgery and peripheral nerve surgery.

There may be an important role for Non-Consultant Career Grade doctors in Scottish neurosurgical units.

Worforce considerations need to also include discussion of the clinical specialist and nursing workforce.

Comparative Needs Assessment

England, Wales and Ireland

There are 27 Neurosurgery Units in England serving a population of just over 40 Million and 36 across the UK and Ireland serving approximately 65 Million. The average population served is therefore 1.8 Million. There are few units serving over 2.5 Million and no units serving 5 Million.[96] Most neurosurgery units appear to comprise between 6 and 10 neurosurgeons. In the Eastern Region of England, a considerably more compact area than Scotland, there are 20 acute hospitals and 4 regional neurosurgery units serving 6 million population.[38] Worldwide, most neurosurgery units appear to comprise around 6-10 neurosurgeons. [38, 97,97]

In 1999, across the UK, thirty-three percent of A&E departments without on-site neurosurgery facilities were within ten miles of the nearest neurosurgical unit. However, 12% of A&E departments were over 50 miles from the nearest neurosurgical unit. The national average was 23 miles but there were significant regional variations.[52]

In "Safe Neurosurgery 2000" the Society of British Neurological Surgeons suggest the following levels of Neurosurgical Provision.[15]

Table 20. Levels of Neurosurgical Provision recommended in Safe Neurosurgery 2000.

Recommended Level	Scotland Equivalent	Actual
30 beds per Million population	132 adult beds	
4 ITU beds per Million	18 beds	
2 Operating Theatres per Million	8 or 9 operating theatres	7 Theatres

At the time of this publication recommendations were still including minimum levels of middle grade "training" staff for the safe provision of services. Since that time with the move to introduce EWTD and Modernising Medical Careers, training grades are now considered to be super-numerary and so minimum levels are no longer appropriate. In principle all NHS services are consultant led and should be staffed to allow full function without dependence on training grade doctors. This has been more readily achieved in smaller units than the larger traditional teaching centres.

COMPARATIVE NEEDS ASSESSMENT

Organisation of Services

In England and Wales 36 specialised services are covered by a Specialised Services National Definitions Set.

The definitions were developed through national working groups (one for each service). The definitions identify the activity that should be regarded as specialised and therefore subject to collaborative commissioning arrangements. The definitions provide a helpful basis for service reviews and strategic planning and enable commissioners to establish a broad base-line position and make initial comparisons on activity and spend.

In most definitions, the existing pattern or model of service provision is described as well as the clinical service. Each definition includes a list of relevant national guidelines, such as DoH or Royal College of Publications, and identifies any national databases containing health outcomes information.

The following is an extract from the Specialised Services National definitions for England:-

Introduction
The clinical neurosciences services are undergoing a period of great change. New drugs, new surgical procedures and new investigative techniques are changing the relationships between specialties, the use of facilities and the site of treatment. Sub-specialisation is now well advanced within neurosurgery, neurology, neuroradiology, neurophysiology and neuropathology and there is increasing involvement of neuropsychology and neuropsychiatry in assessment and care. As a result, the interdependence of the individual specialties necessary to deliver an integrated service is increasing.

At the same time there is growing pressure for an increase in the number of consultants and specialist nurses and a lively debate on the appropriate role and siting of neurologists. Because of the interrelationship it is not possible to plan these services separately. A strategic plan for neurosurgery services that did not take into account plans for neurology services would be fundamentally flawed. Planning for neurosciences must take into account the whole care pathway, including neuro-rehabilitation and any key support services such as neurophysiology.

General Description
The broad group of services known as neurosciences includes both medical and surgical specialties as well as diagnostic support services. The services are all interdependent and the care pathway for many patients with neurological problems will span several neurosciences subspecialties.

For these reasons, as well as other more pragmatic reasons (listed below), this definition covers almost all of the services that could be described within the broad heading of neurosciences services. Services for people with stroke are specifically excluded from this definition to enable stroke services to be considered separately and in the context of local services.

COMPARATIVE NEEDS ASSESSMENT

Thus specialised neurosciences services includes all activity in the following disciplines:

- Neurosurgery
- Neurology (excluding stroke
- Neurorehabilitation
- Neuropathology
- Neurophysiology
- Neuroradiology
- Neuro ophthalmology
- Neurootology
- Neuropsychology accessed through Neurosurgery, Neurology or Neurorehabilitation

Rationale for the Service being included in the Specialised Services Definitions Set

The reasons why the full range of neurosciences services are included in this definition are set out below:

- To allow the patient's experience of care to be considered as a continuous process
- To accommodate the variation in the different ways in which these services are provided in England
- Because of the close integration of the in-patient neuroscience services in some localities
- Because much neurology is out-patient activity and there is currently no basis in coding to differentiate between reasons for referral or type of opinion given: the site/locality of the activity does not seem to be a reliable indicator of the type of activity
- Because most diagnoses are infrequent and ill-understood, yet require multidisciplinary involvement and multi-sectoral planning over prolonged periods
- Because further work is needed to understand the relationships necessary for the provision of continuous care for people with neurological disease
- Because discussions on the detail of definitions and commissioning processes will only be possible when the issues listed above have been properly taken into account

Links to Other Services in the Specialised Services Definitions Set

No.6, Specialised Spinal services (all ages) – Surgery is performed by orthopaedic surgeons and neurosurgeons and is provided by both spinal injuries and neurosurgery services. This activity should be extracted from Orthopaedic and Neurology specialised services and identified separately under specialised spinal services.

No.7, Complex Specialised Rehabilitation for Brain Injury and Complex Disability (adult) – Complex neurorehabilitation activity.

No.8, Specialised Neurosciences Services (adult) – Peripheral nerve surgery may be performed in neurosurgery, orthopaedic surgery or plastic surgery departments but with the exception of simple procedures (see section 4.1) should be recorded under the specialised neurosciences services.

COMPARATIVE NEEDS ASSESSMENT

Comparative Needs Literature Search

We searched for published papers detailing services in other comparable regions but found only one relevant paper by Servadei.[98] Servadei et al.'s objective was to measure incidence and epidemiological factors associated with traumatic brain injury in the north eastern region of Italy and correlate those parameters with neurosurgical imaging and related clinical features.

Much of the data in this paper, published in 2002, is too old to be of direct relevance in comparing countries but the paper does conclude that brain injury in Italy is similar to other published series and makes a number of points that are pertinent to service provision planning in Scotland.

1. Workload in neurosurgical units serving less than one million pop. is limited.
2. Management of neuro-trauma patients requires regional organization.
3. Local implementation of treatment guidelines and continuous epidemiological monitoring of neuro-trauma is recommended.
4. If neurosurgical expertise is limited to a few centers, then those centers must coordinate trauma care to wherever the patients are located.

Neurosurgery has been proven to be a highly cost effective intervention with cost per Quality Adjusted Life Year comparing very favourably with other clinical services.[29;30]

The Neurosurgery Unit in Glasgow is already one of the largest in the United Kingdom. Despite the suggestion, in Hardy's editorial of 2003, that neurosurgery centres might need to move to serving populations of 2.5 Million or more, this editorial went on to suggest that in practice a managed clinical network approach between existing centres could probably deliver all the same benefits.[39] Comparing current practice in Scotland with the rest of the UK and Europe there is little evidence of neurosurgical centres merging or being forced to close.

There are 5 Neurosurgery Units in Greater London.

There are 7 Neurosurgery Units in Paris which operate on an alternate take basis.

All neurosurgery should be undertaken by specialised neurosurgeons who are undertaking regular surgical lists and are experienced in that procedure. This includes spinal surgery. Whilst there is clear evidence of a volume-outcomes effect in many areas of surgery evidence for such a linkage is lacking for neurosurgery. Such studies as have reported an effect have taken place in large US hospitals which are "magnet hospitals" functioning in an insurance funded system and published by units which depend upon attracting referrals from smaller units. In addition the surgeon volumes reported exceed those which would be achieved in any balanced UK neurosurgery service.

Making comparisons with other European Countries has proved extremely difficult as health systems and medical training are not alike. Britain has fewer neurosurgeons per Million than our Western European neighbours although Scotland does better in this table than England and Wales. Great care must be taken in interpreting staffing levels from

countries with differing health systems. Few countries operate with fully trained consultant staff providing general neurosurgery in a national health system for example.

Table 21. Neurosurgeons per Million.

Country	Reported Neurosurgeons per Million[34]
UK	4
France	8
Germany	8
Holland	8
Greece	25

Conversely, there is evidence from the USA that small (often under resourced) local units do not produce good outcomes and can promote health inequalities as it is the deprived who are least likely to be referred on to a specialist centre.[85;86;86;87] Centralising Scottish services in a national centre might promote health inequalities as referral to such a specialist centre would be highly unattractive for deprived populations who lack the transport or finances to travel for their care or to visit relatives. Faced with referral to a distant centre such patients might opt for less specialised local care.

New guidelines suggest that all moderate and severe head injuries should be managed in a neurosurgery unit. If head injuries were to be routinely cared for by neurosurgeons this would both create substantial pressures on neurosurgery beds and mitigate strongly against further centralisation of general neurosurgery services.

Neurosurgery services, like most areas of medicine, are continually developing. The needs assessment considered developing areas such as stem cell research, neuro-regenertation and functional neurosurgery but did not find significant changes likely to impact on routine neurosurgical practice in the next decade. Converseley significant changes are to be expected in stroke care, stereotactic radio-surgery and head injury management.

COMPARATIVE NEEDS ASSESSMENT

Comparative Needs Assessment Conclusions -

Neurosurgery has been proven to be a highly cost effective intervention with cost per Quality Adjusted Life Year comparing very favorably with other clinical services.[29;30]

The Neurosurgery Unit in Glasgow is already one of the largest in the United Kingdom.

It has been suggested that in practice a managed clinical network approach between existing centres could probably deliver all the same benefits as a large centre serving 2.5M population.[39]

Comparing current practice in Scotland with the rest of the UK and Europe there are examples of adjacent units merging for a variety of reasons but there is little evidence of neurosurgical centres merging or being forced to close to achieve catchment populations as large as 5 million.

There are also examples of closely adjacent and fairly small units which have been unable to merge for various reasons including public opinion and are developing alternative solutions.

There are 27 Neurosurgery Units in England serving a population of just over 50 Million and 36 across the UK and Ireland serving approximately 65 Million.[38;96] The average population served is therefore 1.8 Million. There are few units serving over 2.5 Million and no units serving 5 Million.

Worldwide there does seem to be a trend towards increasing numbers of neurosurgeons per unit although literature review found few neurosurgery units appearing to comprise more than 10 neurosurgeons.

There are 5 Neurosurgery Units in Greater London serving a population of over 7 million.

There are 7 Neurosurgery Units in Paris who operate on an alternate take basis.[38]

UEMS figures state that Britain has one neurosurgeon per 250,000.

European countries have different health care systems which are not directly comparable but France, Germany and Holland for example are estimated to have approximately one neurosurgeon per 125,000 population. It is difficult to interpret these data as it is not clear what level of doctor is equivalent to a consultant neurosurgeon in the UK sense.[34]

The organization of neurosurgical care in Scotland is broadly similar to the provision in other comparable populations.

COMPARATIVE NEEDS ASSESSMENT

Although some UK neurosurgical services have merged into larger operating units this review found no evidence of a widespread move to merging or enlarging neurosurgery units in any other European Country.

If neurosurgery is limited to fewer centres then these centres must continue to be capable of providing rapid emergency trauma care to patients wherever they are located in Scotland.

Whilst a hub and spoke model would appear to provide a good solution whereby outcomes for complex procedures performed within the hub might be improved there are indications that such a model might fuel health inequalities by providing differing standards of service. In particular there would be a danger that older, poorer and sicker patients might elect to remain in a regional hospital which no longer hosted a specialist neurosurgery service leaving only the more younger, fitter more privileged or more demanding to receive the care of the national centre.

OVERALL CONCLUSIONS

Overall Conclusions

This Needs Assessment has found no conclusive evidence of patient need or patient benefit from a centralisation of general neurosurgery services.

Neurosurgery should continue to be practiced by specialist neurosurgeons who undertake neurosurgical procedures regularly. General Neurosurgery should not be performed by general surgeons nor by sub specialists who are not regularly undertaking general neurosurgical procedures.

Pressures to centralise services peaked in 2002/2003 in the face of concerns over the European Working Time Directive, implementation of the 2003 Consultant Contract and dramatic changes in Medical Training and Junior Doctors hours of work. None of these factors relate to patient need and many have now been resolved in some or all of the existing centres. These pressures may however relate to patient safety if surgeons are overworked or unavailable to supervise patient care for example. Where these pressures have been resolved the case for change is greatly reduced.

There would appear to be a clear case for this highly specialised service to be managed nationally as one service with common clinical pathways, care standards, teaching, audit and research. This could be readily achieved by the Managed Clinical Network Model set out by Carter in 1998 and developed subsequently in various low volume high cost specialties.

Tele-medicine links could readily be used to facilitate clinical networking between geographically distinct centres and good examples of this already exist in Scotland.

All four Scottish Neurosurgical centres feel they could benefit from additional investment to improve services and staffing. The opportunity cost of such developments would need to be measured against the business case cost for establishing any alternative configuration of services such as a single national neurosciences centre. Proposals already exist, for example, for the appointment of an additional consultant in Aberdeen and for greater clinical networking between Aberdeen and Dundee. To secure funding these proposals would need to demonstrate eveidence of patient benfit and be co-ordinated with development in other centres but this will be difficult in the absence of an MCN to improve data collection.

This Needs Assessment recommends that consideration be given to supporting and improving the existing four neurosciences centres, through the establishment of a single national management structure, managed clinical networking and service redesign to address the varying service pressures within the existing units. This should also include a review of the catchment populations for each unit and the specialist services provided to better balance demand across the four units.

There is likely to be a steady increase in demand for neurosurgery procedures of between 4 and 6% per annum.

OVERALL CONCLUSIONS

Neurosurgery services should be moving to a service delivered by trained doctors without reliance on doctors in traning. This will require an expansion of the trained surgeon workforce from the current level.

We estimate that the ideal staffing for Scotland would be up to 34 neurosurgeons to cover the existing 6600 procedures per annum.

Elective paediatric neurosurgery should be conducted only in one of the four units and this should commence as soon as possible.[13;37;88;89] Where there are emergency conditions which may require frequent or immediate management for example paediatric CSF shunts or conditions which can safely be managed locally there should be agreed national care pathways and a network approach to ensure the highest possible quality of care.

Highly specialised neurosurgery should only take place within the appropriate specialist service, for example the AI/NMD service in Dundee now has designation as a National Service and is the only recognised centre for AI/NMD in NHS Scotland.. This change in status took effect on 1 April 2006 and is not therefore reflected in the available ISD data.[56;56;57]

This Needs Assessment is not a business case or model for future neurosurgery services. The future organization and delivery of neurosurgery services in Scotland is a matter for the Neurosurgery Implementation Group and the Scottish Government. A final decision on the future provision will need to balance the complex issues ranging from resources, training, staffing, professional standards and guidelines, patient needs and public expectation. This Needs Assessment aims to provide useful information to assist the NIG in taking forward their discussions on future provision of neurosurgery service in Scotland.

Note:
As stated above, these recommendations relate only to delivering services to best address *patient needs*. The role of the Neurosciences Implementation Group is to consider the results of this needs assessment against all the other relevant factors and pressures and to recommend the most appropriate way forward in the light of all the relevant issues.

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Appendix 1

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Appendix 2

The National Advisory Group on the National Framework for Service Change in the NHS in Scotland, Neurosciences Action Team.

Remit

- consider the future requirements for tertiary care in specialist centres (in this context we see tertiary services as those which are highly specialised and usually delivered in a few national or regional centres),
- identify the scale and scope of such activity during the day and at night,
- consider the relationships between the provision of tertiary and specialized care and 24 hour emergency care,
- have regard to the direction of travel signalled in reviews of acute services underway or about to get underway at the NHS Board level,
- have a particular focus on the planning and provision of highly specialized care such as neurosurgery services and paediatric tertiary services.

The National Planning Team was to report on the following;

- what health care services should be provided in the future in tertiary centres,
- the implications for the number and location of tertiary centres,
- the planning methodologies relevant to mapping tertiary and highly specialised care,
- to what extent specialised care services need to be planned at a national, regional or Board level,
- the implications for the planning and provision of neurosurgery (and neurosciences) and of tertiary children's services of the proposed planning methodology,
- the impact on the provision of intensive care and emergency care of any proposed reconfiguration of highly specialised or tertiary care,
- specific issues affecting remote and rural areas

Neurosciences Action Team, 2005 List of Recommendations

1 The recommendations from the work of this Action Team should be remitted to identified accountable body(ies) to take forward. An implementation Team led by a Chief Executive or equivalent senior NHS Manager should be established to oversee the implementation. Implementation should not be taken forward in isolation, but in the context of clinical neurosciences and with patient involvement.

2 A needs assessment for neurosciences should be undertaken to support future planning of services. This should initially be undertaken by the implementation team identified to take forward the recommendations of this report and thereafter should form part of the planning arrangements.

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3 Patients should continue to be involved in the future planning of neurosurgical services, both locally and in the service model adopted for NHS Scotland. Patients and patient representative groups should be at the centre of future development and decision making.

4 Explicit standards for the neurosurgery service should be agreed and set out in the service model. This should also include a mechanism for assessment against these standards and action plan to address areas for improvement. Patients should be involved in this process.

5 The standards should be based on the SBNS standards currently being used elsewhere in the UK and the service should work with the SBNS in their further development. The service should make them relevant to Scotland whilst ensuring comparison with other units and address the issues identified through the process of self assessment in Scotland carried out as part of the work of the Action Team.

6 The neurosurgery centres should work collaboratively to address areas for improvement, sharing good practice and develop action plans.

7 A common minimum data set of activity information should be agreed, collected and reported back to the service to inform planning and performance management. The data set should be relevant to the service and based on the Department of Health definitions.

8 A planned audit programme for the service should be developed, agreed and maintained; there should be a procedure register in each centre.
9 Arrangements, including funding, for clinical audit and data collection, analysis and reporting should be mainstreamed into the future model for neurosurgery.

10 The future planning of neurosurgery should take account of evidence in the field of associations between volume and health outcome.

11 The evidence base should continue to be developed based on agreed audit, research and data collection which is mainstreamed as proposed previously.

12 The NHS transport infrastructure should be reviewed to support future models of care including:
a. The role of the Scottish Ambulance Service and in particular the air ambulance service, is critical to achieving satisfactory response times. The Scottish Executive Health Department should ensure that the Scottish Ambulance Service is strategically positioned to support rapid transfer of expert teams from specialist centres to stabilise patients in remote and rural areas and the transfer of increasing numbers of ill children and adults over long distances to appropriate specialist centres.
b. The protocols for transfer of head injured patients should be reviewed with the Scottish Ambulance Service.
c. The model of retrieval teams, used in paediatric and neonatal intensive care should be explored to ascertain whether a similar model might benefit the transfer of ill neurosurgical patients.
d. A transport service for the transfer of patients back to local care should be explored.

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13 The NHS through the Scottish Executive Health Department, Regional Planning Groups and NHS Boards should develop plans to develop a public transport infrastructure with Local Authority partners and transport providers.

14 A strategy for the application of telemedicine should be developed using the findings of pilots, and implementation prioritised to support the maintenance of specialised services locally.

15 NHS Scotland should develop the SBNS consultant workforce tool appropriate to Scotland to support future planning of neurosurgery and to consider its application for other staff groups and specialties. It should develop the tool to reflect the service model identified and the needs of the other staff groups, particularly nursing staff and clinical neuroscience specialists. It should also be developed to incorporate the requirements of employment legislation and regulations and the implications of different levels of intensity in units.

16 Future investment decisions on staff appointments to neurosurgical services should be made on a single service approach, ie decisions should not be taken by individual NHS Boards and staff may be appointed to geographic areas wider than individual NHS Boards.
17 Adult and paediatric neurosurgery should be regarded as a single service for Scotland, delivered on a number of sites and through managed clinical networks. Future decisions concerning investment in staff, facilities, equipment should be taken through the planning and commissioning model described in this report.

18 NHS Scotland should adopt the service model for neurosurgery as described in thisreport.

19 The Service Description, which include the key criteria, should form one element of the planning assumptions for future neurosurgical services.

20 National sub-specialisation on a planned and managed basis should be continued and be an immediate next step.

21 Neurosurgical services should be planned and commissioned on a national basis.

22 The Team recommends that the SEHD should assume strategic leadership responsibility for planning and commissioning neurosurgery on an all-Scotland basis, working with Regional Planning Groups and NHS Boards.

23 NHS Scotland should move towards providing adult and paediatric neurosurgical intervention on one prime site for the whole of Scotland within the service model described in this report.

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Appendix 3

Diagnosis / Procedure Table Neurosciences Implementation Group -

Patient Group	Diagnosis	Procedure
1. Brain Tumour		
1a. Benign	1. Meningioma	Craniotomy & Excision
	2. Pituitary adenoma	Craniotomy & Excision Trans-sphenoidal hypophysectomy
	3. Acoustic neuroma	Trans-cranial approach and excision Trans-labyrinthine approach and excision
	4. Other benign intracranial tumours	Craniotomy & Excision
1b. Malignant	5. Glioma	Craniotomy and decompression Biopsy (stereotactic or free-hand)
	6. Cerebral metastasis	Craniotomy and decompression
	7. Primitive neuro-ectodermal tumour	Craniotomy and excision
	8. Other malignant intracranial tumours	Craniotomy and decompression Biopsy
2. Cerebro-vascular disease	9. Ruptured cerebral aneurysm	Open approach, clipping of aneurysm Endovascular approach, coiling of aneurysm
	10. Arteriovenous malformation	Craniotomy and excision of AVM Stereotactic radiosurgery
	11. Subarachnoid haemorrhage (unidentified cause)	No procedure
	12. Spontaneous intracranial haemorrhage	Craniotomy and evacuation of haematoma CSF Drainage Procedure
	13. Carotid stenosis	Carotid Endarterectomy
	14. Cerebral / cerebellar infarct	Decompressive hemicraniectomy
	15. Unruptured cerebral aneurysm	Open approach, clipping of aneurysm Endovascular approach, coiling of aneurysm
3. Head Injury	16. Extradural haematoma	Craniotomy and evacuation of haematoma
	17. Acute subdural	Craniotomy and evacuation of

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	haematoma	haematoma Intracranial pressure monitoring
	18. Intracerebral haematoma / burst lobe	Craniotomy and evacuation of haematoma Intracranial pressure monitoring
	19. Chronic subdural haematoma	Burr-hole drainage
	20. Diffuse brain injury	Decompressive hemicraniectomy
	21. Concussion	
	22. Depressed skull fracture	Debridement and elevation of fracture
	23. Skull base fracture	Skull Base repair
	24. Surgical skull defect	Insertion of cranioplasty
	25. Cerebral contusions	Craniotomy and evacuation of haematoma Intracranial pressure monitoring
	26. Traumatic subarachnoid haemorrhage	
	27. Injury to cranial nerve	Repair to cranial nerve
	28. Scalp Injury	
	29. Penetrating wounds to head	
4. Functional Neurosurgery	30. Epilepsy	Craniotomy and resection of epileptic focus Callosotomy
	31. Trigeminal neuralgia	Microvascular decompression Percutaneous procedure on trigeminal nerve
	32. Complex pain disorders	Stereotactic procedure
	33. Movement disorders	Stereotactic procedure
	34. Psychiatric disorders	Stereotactic procedure
5. Spinal Surgery	35. Spinal Injury	Decompression of spinal cord / nerve root Internal fixation for fracture-dislocation
	36. Rheumatoid spine	Decompression of cervical cord Internal fixation of unstable spine
	37. spinal tumour	Open approach, excision of tumour Decompression of tumour, fixation of spine

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	38. Cervical degenerative disease	Anterior cervical decompression / fusion Posterior decompression / fixation
	39. Lumbar degenerative disease	Lumbar disectomy / microdisectomy / laminectomy
	40. Thoracic degenerative disease	Thoracic disectomy
6. Peripheral Nerve Surgery	41. Carpal tunnel syndrome	Carpal tunnel decompression
	42. Ulnar nerve syndrome	Ulnar nerve decompression
	43. Polyneuropathy	Peripheral nerve biopsy
7. Paediatric and developmental surgery	44. Neural tube defects	Closure of spina bifida Closure of encephalocoele
	45. Other spinal disorders	
	46. Arnold-Chiari syndrome	
	47. Congenital hydrocephalus	Insertion of CSF shunt system Revision of CSF shunt system
	48. Craniosynostosis	Opening of sutures Craniofacial reconstruction
8. CSF Circulation	49. Acquired hydrocephalus	Insertion of CSF shunt system Revision of CSF shunt system
9 Infection		
10. Complications		

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Appendix 4

Patients discharged from Scottish Hospitals with a neurological / neurosurgical condition diagnosis by NHS Board of residence, sex and age. Incident cases. Calendar year 2005.

Table 22. Number of Procedures by Age Group 2004

Diagnosis	Procedure	15 and under	16 to 64	65 to 79	80 and over	All Procedures	No procedure
Brain tumour – benign	Procedures	18	483	192	26	719	
	Other proc	31	510	192	36	769	
	No proc. done	5	478	186	38		707
Brain tumour - malignant	Procedures	21	377	154	2	554	
	Other proc	27	315	114	5	461	
	No proc. done	14	370	128	5		517
Cerebrovascular – head	Procedures	2	638	88	2	730	
	Other proc	26	1266	197	11	1500	
	No proc. done	24	1709	394	20		2147
Cerebrovascular – neck	Procedures	0	0	0	0	0	
	Other proc	0	0	0	0	0	
	No proc. done	0	0	0	0		0
Head trauma	Procedures	47	373	149	77	646	
	Other proc	131	1003	249	112	1495	
	No proc. done	111	1001	248	80		1440
Functional neurosurgery	Procedures	3	214	111	11	339	
	Other proc	29	328	183	37	577	
	No proc. done	13	192	72	7		284
Spinal - Trauma	Procedures	1	11	0	1	13	
	Other proc	4	100	21	5	130	
	No proc. done	1	91	23	8		123
Spinal - Degenerative disease	Procedures	3	527	168	25	723	
	Other proc	33	3107	643	91	3874	
	No proc. done	10	476	170	39		695
Peripheral Nerves	Procedures	0	839	190	50	1079	
	Other proc	0	80	26	2	108	
	No proc. done	0	37	10	1		48
Paediatric	Procedures	184	0	0	0	184	
	Other proc	174	0	0	0	174	
	No procedure performed	90	0	0	0		90
CSF	Procedures	0	311	58	7	376	
	Other proc	0	177	46	6	229	
	No procedure performed	0	151	28	1		180
Infections	Procedures	21	53	13	1	88	
	Other proc	54	180	37	3	274	
	No procedure performed	13	84	28	0		125
Complications	Procedures	1	53	11	1	66	
	Other proc	20	281	80	12	393	
	No procedure performed	10	138	35	0		183
Total						15501	6539

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Table 23. Age specific incidence rates for admissions with these main diagnoses calculated using GRO population data for 2004.

SCOTLAND 2005	Age-specific rate	Age-specific rate	Age-specific rate	Age-specific rate
	0-15	16 to 64	65 to 79	80 and over
	per 100,000	per 100,000	per 100,000	per 100,000
Brain tumour – benign	1.2	7.2	18.7	17.5
Brain tumour – malignant	2.1	25.7	129.7	129.3
Cerebrovascular - head	1.8	49.7	361.8	869.3
Cerebrovascular - neck	0.0	0.2	1.6	0.0
Head trauma	32.5	34.5	61.4	131.2
Functional neurosurgery	84.8	65.7	214.7	520.4
Spinal - Trauma	3.0	14.5	24.5	73.9
Spinal - Degenerative disease	1.7	51.8	113.3	113.7
Peripheral Nerves	0.9	81.3	140.0	155.5
Paediatric	7.2	0.0	0.0	0.0
CSF	0.0	3.1	5.8	2.9
Infections	1.1	1.3	4.2	1.5
Complications	36.5	92.4	249.5	247.3

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Table 24. Total Incidence of Neurological/ Neurosurgical Diagnoses by NHS Board of Residence (Source: SMR 01 – Procedures undertaken within NHS Scotland)

Area	Total Incidence of Neurological/ Neurosurgical Diagnoses [1]	Total Incidence of Neurological/ Neurosurgical Diagnoses as %	Population as a % [2]
Scotland	28,666	100%	100%
Ayrshire & Arran	2,562	8.90%	7.16%
Borders	765	2.67%	2.15%
Dumfries & Galloway	109	0.38%	2.89%
Fife	2,243	7.80%	7.01%
Forth Valley	1,230	4.29%	5.59%
Grampian	3,136	10.93%	10.36%
Greater Glasgow	6,563	22.89%	23.29%
Highland	1,912	6.67%	5.99%
Lanarkshire	2,809	9.79%	10.91%
Lothian	4,163	14.52%	15.66%
Orkney	114	0.39%	0.39%
Shetland	No data	No data	0.43%
Tayside	2,090	7.29%	7.65%
Western Isles	168	0.58%	0.51%

1. ISD data
2. General Register Office for Scotland – Mid 2006 Population Estimates Scotland

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Table 25. Age specific prevalence rate for hospital admissions with these diagnoses by NHS Board Area.

SCOTLAND 2005	Age-specific rate	Age-specific rate	Age-specific rate	Age-specific rate
	0-15 per 100,000	16 to 64 per 100,000	65 to 79 per 100,000	80 and over per 100,000
Brain tumour - benign	1.817	10.252	25.452	19.923
Brain tumour - malignant	3.207	31.450	147.882	135.576
Cerebrovascular - head	2.245	57.412	408.206	956.805
Cerebrovascular - neck	No data	0.181	1.611	No data
Head trauma	33.353	37.269	66.209	138.491
Functional neurosurgery	108.183	90.490	352.629	796.447
Spinal - Trauma	2.993	14.866	24.808	75.320
Spinal - Degenerative disease	4.062	62.327	128.229	123.427
Peripheral Nerves	0.855	99.657	160.930	172.507
Paediatric	20.739	No data	No data	No data
CSF	No data[5]	4.010	7.249	2.916
Infections	1.069	1.598	5.316	2.430
Complications	36.774	98.661	267.734	258.517

[5] Paediatric CSF shunts are included in paediatric surgery admissions.

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Table 26. Prevalence data – Disharges by age group and NHS Board area of residence by population size.

	15 and under	16 to 64	65 to 79	80 and over	Total Population	% of Pop	Discharges	% of Disch.
Scotland	935,456	3316390	620,765	205,789	5,078,400	100%	34296*	
Ayrshire & Arran	68313	234486	48,769	16,022	367,590	7.16%	3,089	9.01
Borders	20271	68014	15610	5375	109,270	2.15%	892	2.60
Dumfries & Galloway	26294	91797	22579	7260	147,930	2.89%	135	0.39
Fife	66524	229354	43481	15160	354,519	7.01%	2,669	7.78
Forth Valley	54253	183133	33649	10729	281,764	5.59%	1,473	4.29
Grampian	96017	345850	61344	20809	524,020	10.36%	3,673	10.71
Greater Glasgow	216,188	785670	142,781	46,656	867,083	23.29%	7,870	22.95
Highland	56,621	194241	39,312	12,608	211,340	5.99%	2,382	6.95
Lanarkshire	108751	364413	64547	18403	556,114	10.91%	3,357	9.79
Lothian	139625	530624	86612	30643	787504	15.66%	4,905	14.30
Orkney	3675	12407	2518	900	19,500	0.39%	139	0.41
Shetland	4588	14115	2339	898	21,940	0.44%	150.9024	0.44
Tayside	69522	246117	53411	18858	87,908	7.65%	2,455	7.16
Western Isles	4813	16168	3812	1467	26,260	0.51%	205	0.60

*due to data matching process and patients moving between NHS Board of residence this number is larger than the total by NHS Board

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Appendix 5

Table 27. Estimated Number of Procedures by Age Group 2017

Number of Procedures by Age Group 2017							
Diagnosis	Procedure	Under 16	16 to 64	65 to 79	80 and over	All Procedures	No procedure
Brain tumour – benign	Procedures	17	480	211	27	735	
	Other proc	29	507	211	41	789	
	No proc. done	4	475	205	40		724
Brain tumour – malignant	Procedures	20	374	172	2	569	
	Other proc	25	313	129	6	473	
	No proc. done	14	367	146	6		533
Cerebrovascular – head	Procedures	2	635	92	2	731	
	Other proc	24	1258	212	13	1507	
	No proc. done	23	1699	421	21		2164
Cerebrovascular – neck	Procedures	0	0	0	0	0	
	Other proc	0	0	0	0	0	
	No proc. done	0	0	0	0		
Head trauma	Procedures	43	369	170	95	677	677
	Other proc	121	992	284	135	1532	
	No proc. done	103	990	284	98		
Functional neurosurgery	Procedures	3	212	121	11	348	348
	Other proc	27	326	199	39	592	
	No proc. done	12	190	79	7		
Spinal - Trauma	Procedures	1	11	0	1	13	13
	Other proc	4	99	24	6	133	
	No proc. done	1	90	27	10		
Spinal - Degenerative disease	Procedures	3	523	188	27	740	
	Other proc	31	3084	707	104	3926	3926
	No proc. done	9	473	182	45		
Peripheral Nerves	Procedures	0	835	206	54	1095	
	Other proc	0	80	28	2	110	110
	No proc. done	0	37	11	1		
Paediatric	Procedures	174	0	0	0	174	
	Other proc	165	0	0	0	165	165
	No proc. done	85	0	0	0		
CSF	Procedures	0	309	62	8	380	
	Other proc	0	176	49	7	231	
	No proc. done	0	150	32	1		183
Infections	Procedures	20	52	15	1	88	
	Other proc	52	179	42	4	276	
	No proc. done	12	83	31	0		127
Complications	Procedures	1	53	12	1	67	
	Other proc	19	279	90	15	403	
	No proc. done	10	137	39	0		186
Total						15754	9157

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Appendix 6

Table 28. Detailed breakdown of surgical activity within Neurosurgery Centres

Diagnosis Group	Procedure Type	Southern General Hospital	Royal Hospital for Sick Children (Glasgow)	Aberdeen Royal Infirmary	Aberdeen Royal Children's Hospital	Western General Hospital	Royal Hospital for Sick Children (Edinburgh)	Ninewells Hospital
Brain tumour - benign	Procedures	310	-	98	-	265	2	44
	Other procedures	331	-	134	-	237	3	64
	No procedure performed	152	-	229	-	312	1	10
Brain tumour - malignant	Procedures	221	-	95	-	193	9	36
	Other procedures	158	-	97	-	139	17	50
	No procedure performed	73	-	168	1	260	3	12
Cerebrovascular - head	Procedures	403	-	29	-	295	-	3
	Other procedures	586	-	234	1	579	7	93
	No procedure performed	810	-	336	2	792	2	204
Cerebrovascular - neck	Procedures	-	-	-	-	-	-	-
	Other procedures	-	-	-	-	-	-	-
	No procedure performed	-	-	-	-	-	-	-
Head trauma	Procedures	351	-	54	-	213	14	14
	Other procedures	601	-	251	-	453	53	137
	No procedure performed	386	-	362	4	587	11	86
Functional neurosurgery	Procedures	112	-	21	-	70	-	136
	Other procedures	199	-	80	-	124	6	168
	No procedure performed	98	-	43	-	82	-	61
Spinal - Trauma	Procedures	-	-	3	-	10	-	-
	Other procedures	12	-	42	-	57	-	19
	No procedure performed	8	-	41	-	65	-	8
Spinal - Degenerative disease	Procedures	277	-	191	-	243	1	11
	Other procedures	1,223	-	854	3	1,473	11	310
	No procedure performed	255	-	141	-	264	2	28
Peripheral Nerves	Procedures	39	-	386	-	431	-	223
	Other procedures	33	-	33	-	19	-	23
	No procedure performed	22	-	3	-	14	-	9
Paediatric	Procedures	93	-	3	-	1	75	12
	Other procedures	72	-	2	2	4	89	5
	No procedure performed	75	-	-	2	4	9	-
CSF	Procedures	157	-	49	-	142	5	23
	Other procedures	93	-	20	-	102	4	10
	No procedure performed	101	-	23	-	47	-	9
Infections	Procedures	39	-	12	-	24	8	5
	Other procedures	147	-	22	-	76	21	8
	No procedure performed	77	-	13	-	30	-	4
Complications	Procedures	40	-	15	-	9	-	2
	Other procedures	151	-	83	-	125	8	26
	No procedure performed	97	-	39	-	34	-	12
Total Discharges from Neurosurgical Departments		7,802	-	4,206	15	7,775	361	1,865

APPENDICES

Appendix 7.

Table 29. Neurosurgical/neurological Activity taking place across all Scottish Hospitals, 2005.

	Brain tumour - benign	Brain tumour - malignant	Cerebrovascular - head	Cerebrovascular - neck	Head trauma	Functional neurosurgery	Spinal trauma	Spinal degenerative disease	Peripheral nerves	Paediatrics	CSF	Infections	Complications
Crosshouse Hospital					1				464				
The Ayr Hospital				3	1				571				
Carrick Glen Hospital									7				
Borders General Hospital									547				
Lorne & Islands DGH									109				
Vale of Leven DGH									147				
Inverclyde Royal Hospital									365				
Royal Alexandra Hospital									334				
Golden Jubilee National Hospital									86				
Victoria Hospital									334				
Queen Margaret Hospital				2	2				535				
Canniesburn Hospital									170				
Glasgow Royal Infirmary				1					832				
Stobhill Hospital									48				
Victoria Infirmary									502				
Southern General Hospital	314	227	406	8	355	113	-	279	1,024	93	157	39	40
Ross Hall Hospital									8				
Royal Hospital for Sick Children (Glasgow)								1	54	1	1		

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Western Infirmary/ Gartnaval Hospital	1			5				2	721				
Caithness General Hospital									55				
Lawson Memorial Hospital									37				
Raigmore Hospital								1	876				
Belford Hospital									57				
Mackinnon Memorial Hospital									28				
Monklands Hospital									361				
Law Hospital									32				
Hairmyres Hospital									401				
Stonehouse Hospital									11				
Wishaw General Hospital				2					298				
Aberdeen Royal Infirmary	98	96	33	8	88	23	3	194	534	3	52	14	17
Albyn Hospital									2				
Woodend General Hospital									1,368				
Royal Aberdeen Children's Hospital									6				
Dr Gray's Hospital									301				
Balfour Hospital									85				
Roodlands General Hospital									2				
Western General Hospital	265	194	316	-	221	71	10	244	433	1	149	26	9
Princess Margaret Rose Hospital									31				
Royal Hospital for Sick Children	2	10	-	-	14	-	-	1	-	76	6	8	-

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(Edinburgh)													
Royal Infirmary of Edinburgh				2					43				
St John's Hospital at Howden									1,979		1		1
Royal Infirmary of Edinburgh at Little France				3					109				
Ninewells Hospital	44	37	3	4	22	136	1	11	818	16	23	5	2
Fernbrae Hospital									18				
Perth Royal Infirmary									452				
Stracathro Hospital									586				
Falkirk & District Royal Infirmary									437				
Stirling Royal Infirmary				4					286				
Western Isles Hospital									87				
Uist & Barra Hospital									1				
Garrick Hospital									37				
Gi bert Bain Hospital									148				

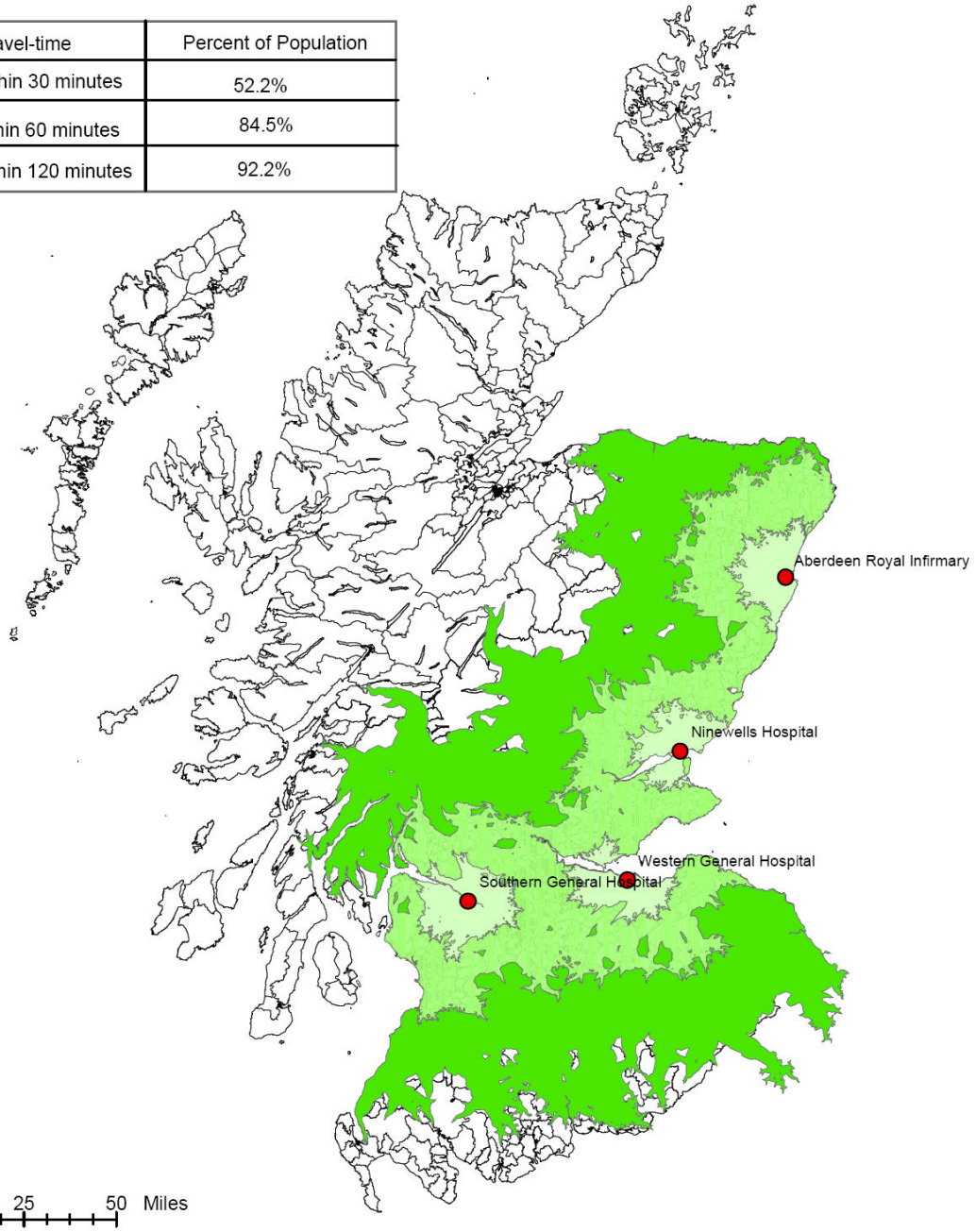
Note

1. Neurosurgical procedures are undertaken at the Southern under 7 specialties, incl. neurosurgery, with neurosurgery undertaking with neurosurgery undertaking 67% of this workload and orthopaedics undertaking a further 32% of this workload. All of this orthopaedic work was to address peripheral nerve conditions.
2. 4 specialties undertake neurosurgical procedures at the Royal Hospital for Sick Children in Glasgow, however the neurosurgery department does not undertake any of these procedures. 94% of such procedures are undertaken by surgical paediatrics.
3. 11 specialties undertake neurosurgical procedures at Aberdeen Royal Infirmary, incl. neurosurgery, with neurosurgery undertaking 82% of this workload and orthopaedics undertaking a further 11% of this workload. All of this orthopaedic work was to address peripheral nerve conditions.
4. 2 specialties undertake neurosurgical procedures at the Aberdeen Royal Children's Hospital, however neurosurgery is not one of these specialties. 5 of the 6 recorded procedures was undertaken by medical paediatrics.procedures are undertaken
5. 5 specialties undertake neurosurgical procedures at the Western General, incl. neurosurgery, with neurosurgery undertaking 98% of this workload.
6. 3 specialties undertake neurosurgical procedures at the Royal Hospital for Sick Children in Edinburgh, incl. neurosurgery, with 97% of this workload undertaken by neurosurgery.
7. 7 specialties undertake neurosurgical procedures at Ninewells Hospital, incl. neurosurgery, with 97% of this workload undertaken by neurosurgery.

APPENDICES

Current Neurosurgery Scenario: Figure 11.
Percentage of Scottish Population within 30, 60 and 120 minutes

Travel-time	Percent of Population
Within 30 minutes	52.2%
Within 60 minutes	84.5%
Within 120 minutes	92.2%



Legend

Current Scenario
- <30 mins
- 30-60 mins
- 60-120 mins

- Health Board Area Boundary
- Aberdeen Royal Infirmary
- Ninewells Hospital
- Southern General Hospital
- Western General Hospital

source: ISD Scotland
date of creation: 17/11/04
author: Jillian Campbell

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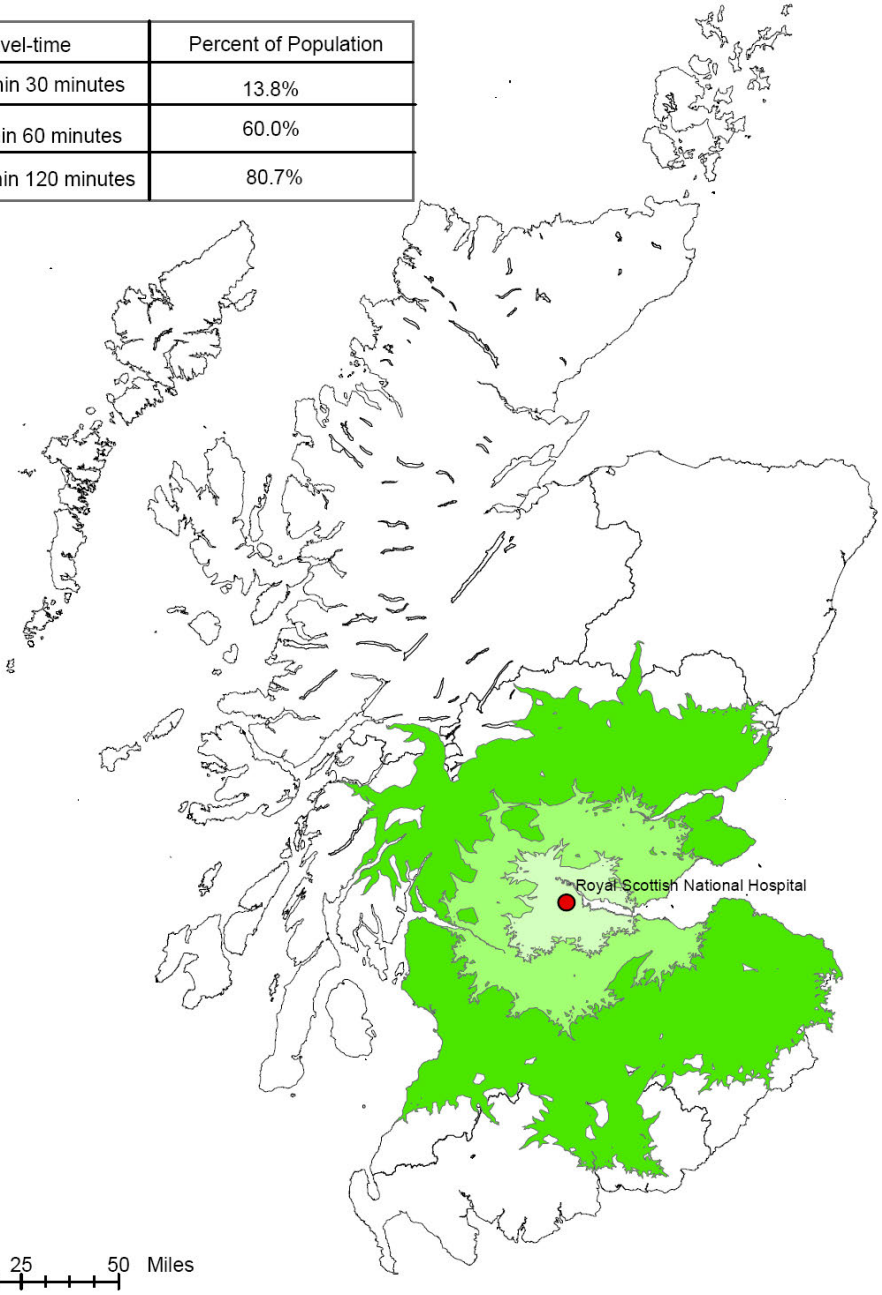
APPENDICES

Royal Scottish National Hospital: Figure 12.
Percentage of Scottish Population within 30, 60 and 120 minutes

Travel-time	Percent of Population
Within 30 minutes	13.8%
Within 60 minutes	60.0%
Within 120 minutes	80.7%



Legend

Royal Scottish National Hospital
- <30 mins
- 30-60 mins
- 60-120 mins

Health Board Area Boundary
Royal Scottish National Hospital

source: ISD Scotland
date of creation: 17/11/04
author: Jillian Campbell

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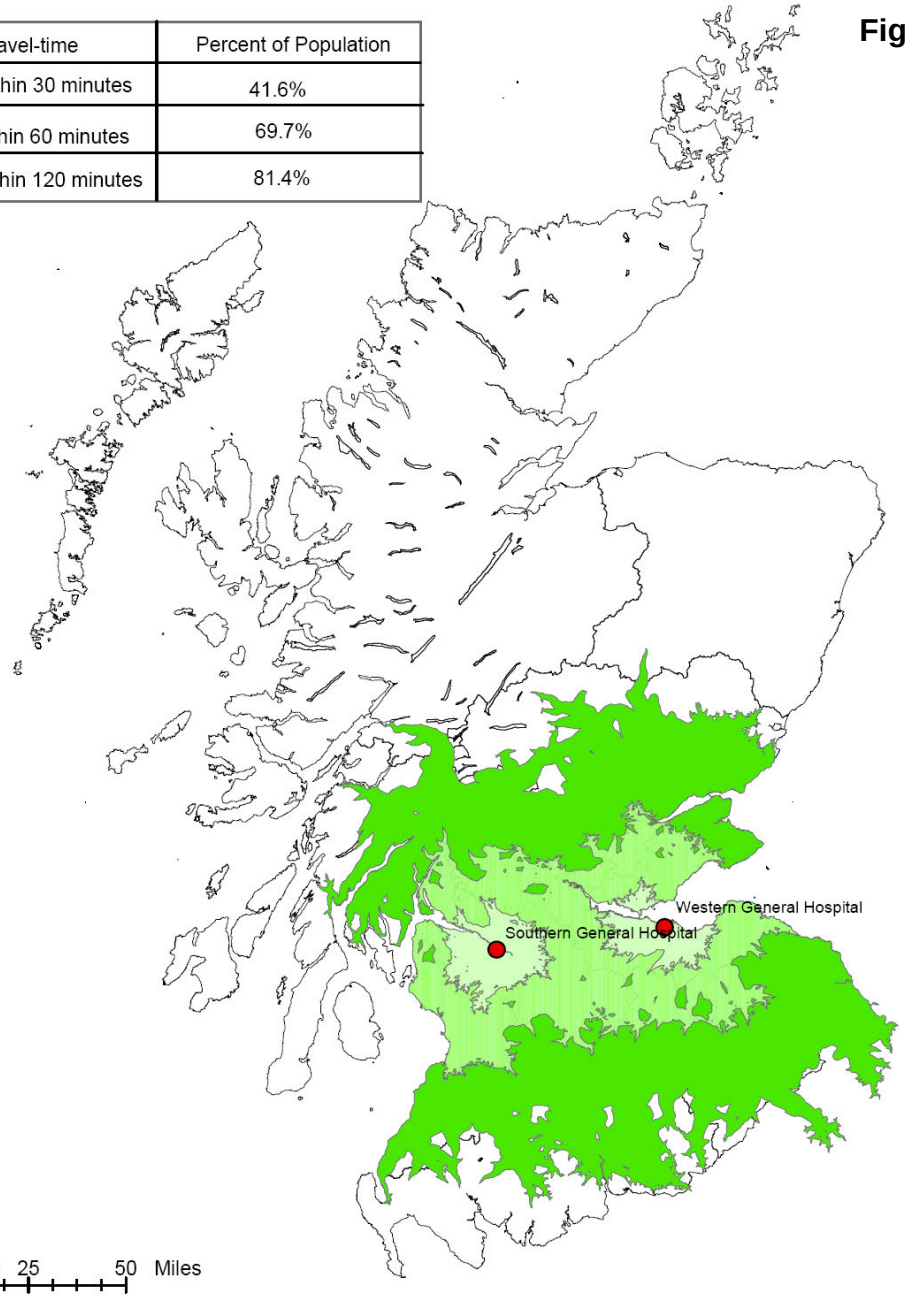
APPENDICES

Southern General Hospital / Western General Hospital Scenario: Percentage of Scottish Population within 30, 60 and 120 minutes

Figure 13.

Travel-time	Percent of Population
Within 30 minutes	41.6%
Within 60 minutes	69.7%
Within 120 minutes	81.4%



Legend

Southern General Hospital / Western General Hospital

- <30 mins
- 30-60 mins
- 60-120 mins

- Health Board Area Boundary
- Southern General Hospital
- Western General Hospital

source: ISD Scotland
date of creation: 14/12/04
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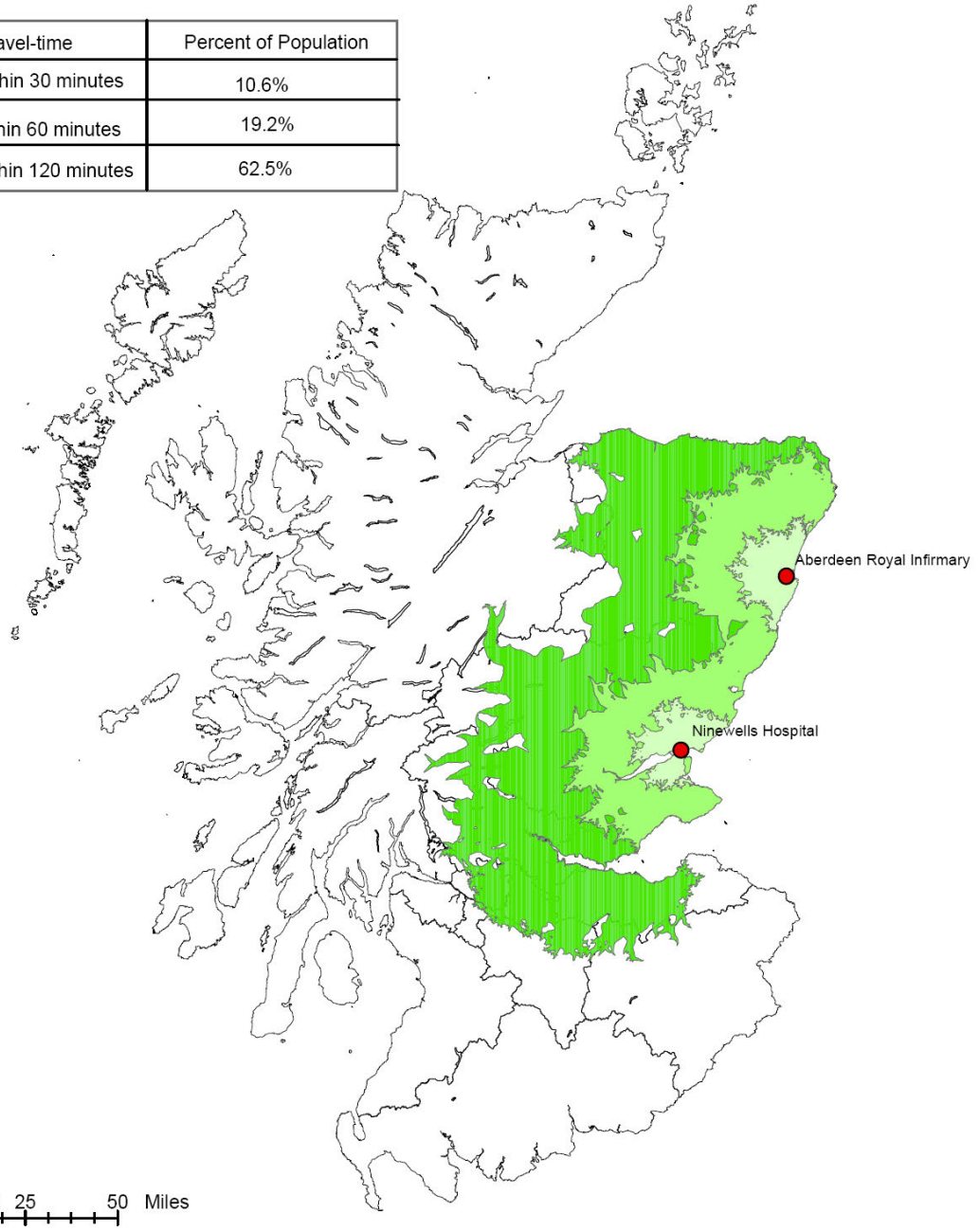
APPENDICES

Aberdeen Royal Infirmary / Ninewells Hospital Scenario: Percentage of Scottish Population within 30, 60 and 120 minutes **Figure 14.**

Travel-time	Percent of Population
Within 30 minutes	10.6%
Within 60 minutes	19.2%
Within 120 minutes	62.5%



Legend

Aberdeen Royal Infirmary / Ninewells Hospital

- <30 mins
- 30-60 mins
- 60-120 mins

- Aberdeen Royal Infirmary
- Ninewells Hospital
- Health Board Area Boundary

source: ISD Scotland
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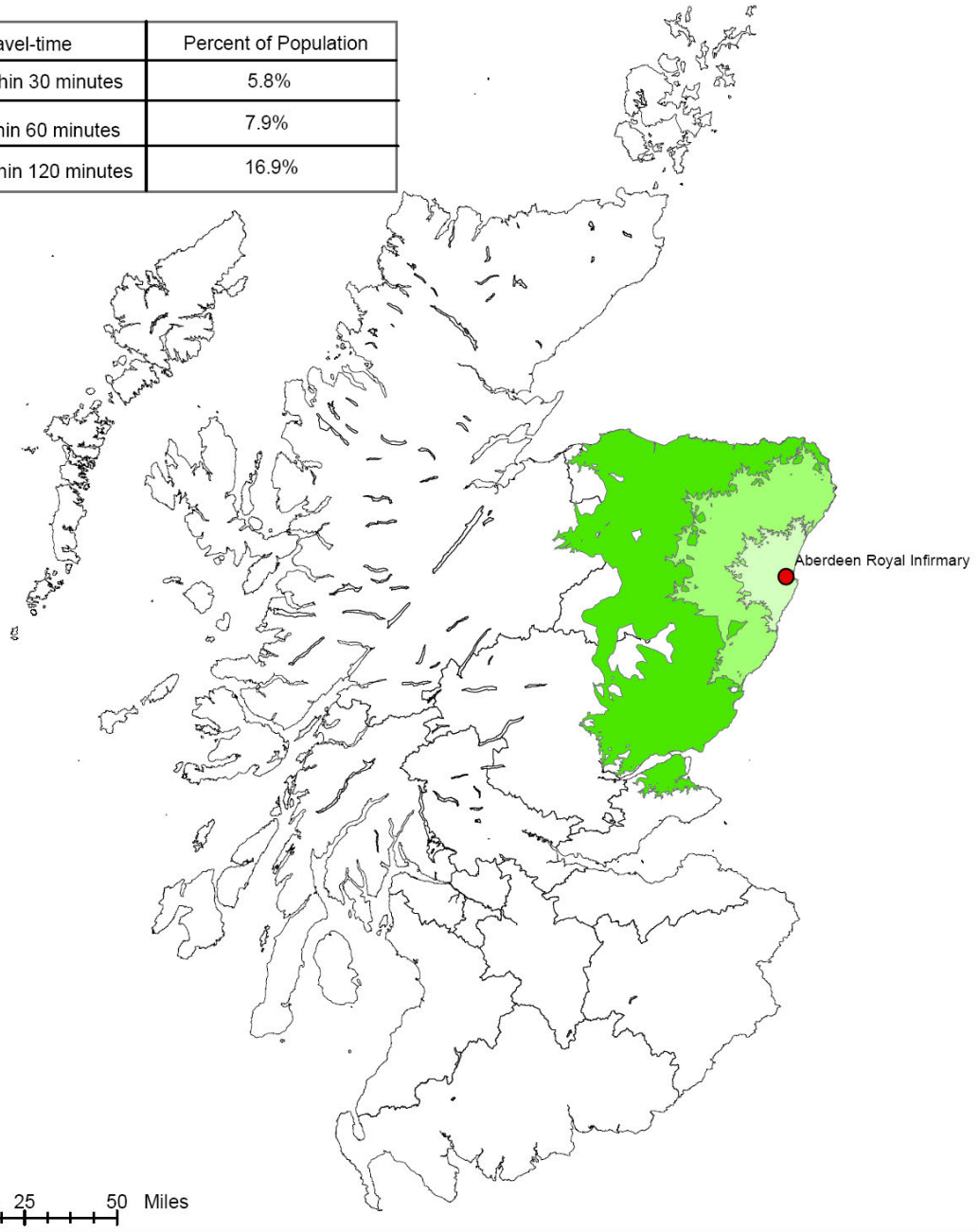
APPENDICES

Aberdeen Royal Infirmary: Figure 15.
Percentage of Scottish Population within 30, 60 and 120 minutes

Travel-time	Percent of Population
Within 30 minutes	5.8%
Within 60 minutes	7.9%
Within 120 minutes	16.9%



Legend

Aberdeen Royal Infirmary
- <30 mins
- 30-60 mins
- 60-120 mins

Aberdeen Royal Infirmary
Health Board Area Boundary

source: ISD Scotland
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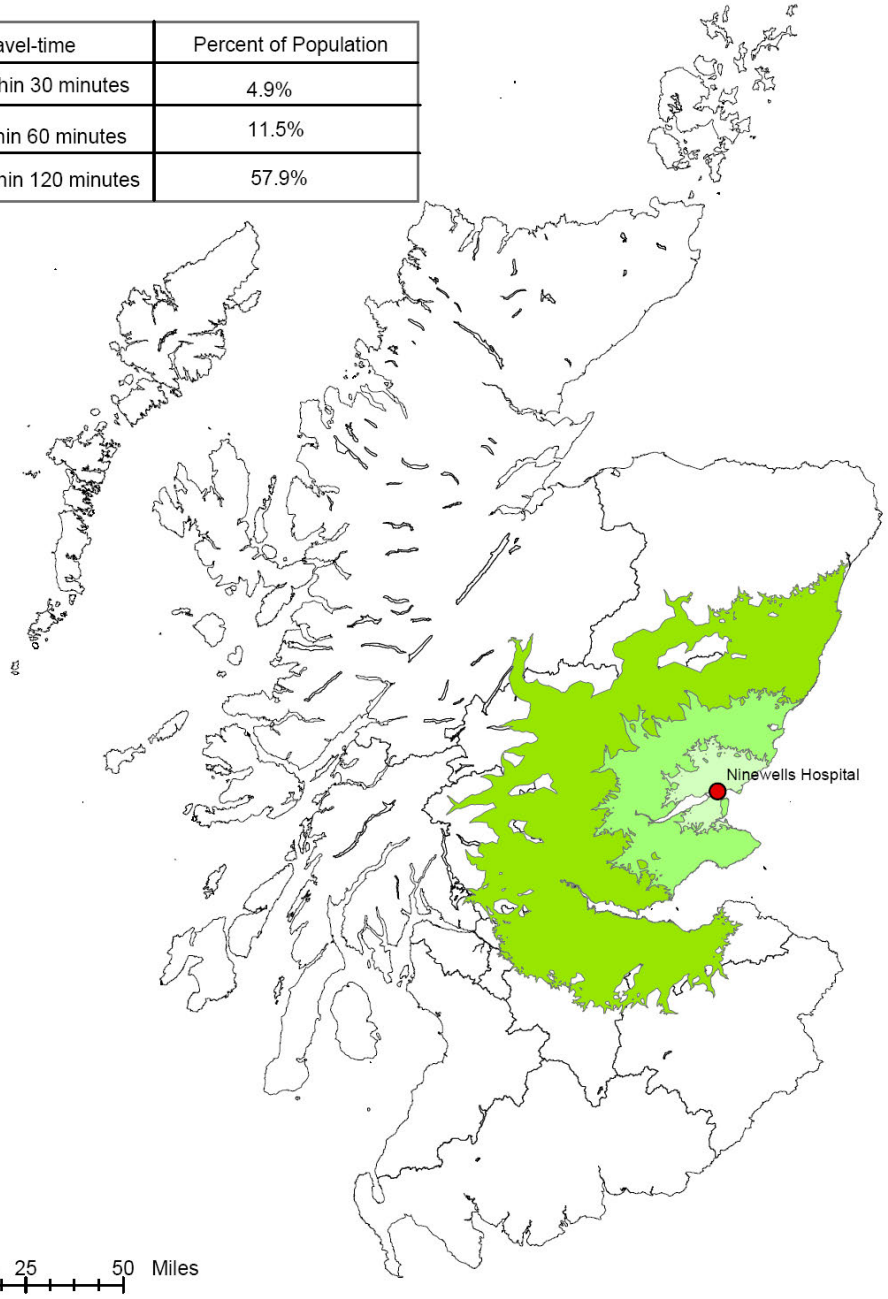
APPENDICES

Ninewells Hospital: **Figure 16.**
Percentage of Scottish Population within 30, 60 and 120 minutes

Travel-time	Percent of Population
Within 30 minutes	4.9%
Within 60 minutes	11.5%
Within 120 minutes	57.9%



Legend

Ninewells Hospital
<30 mins
30-60 mins
60-120 mins
Health Board Area Boundary
Ninewells Hospital

source: ISD Scotland
date of creation: 17/11/04
author: Jillian Campbell

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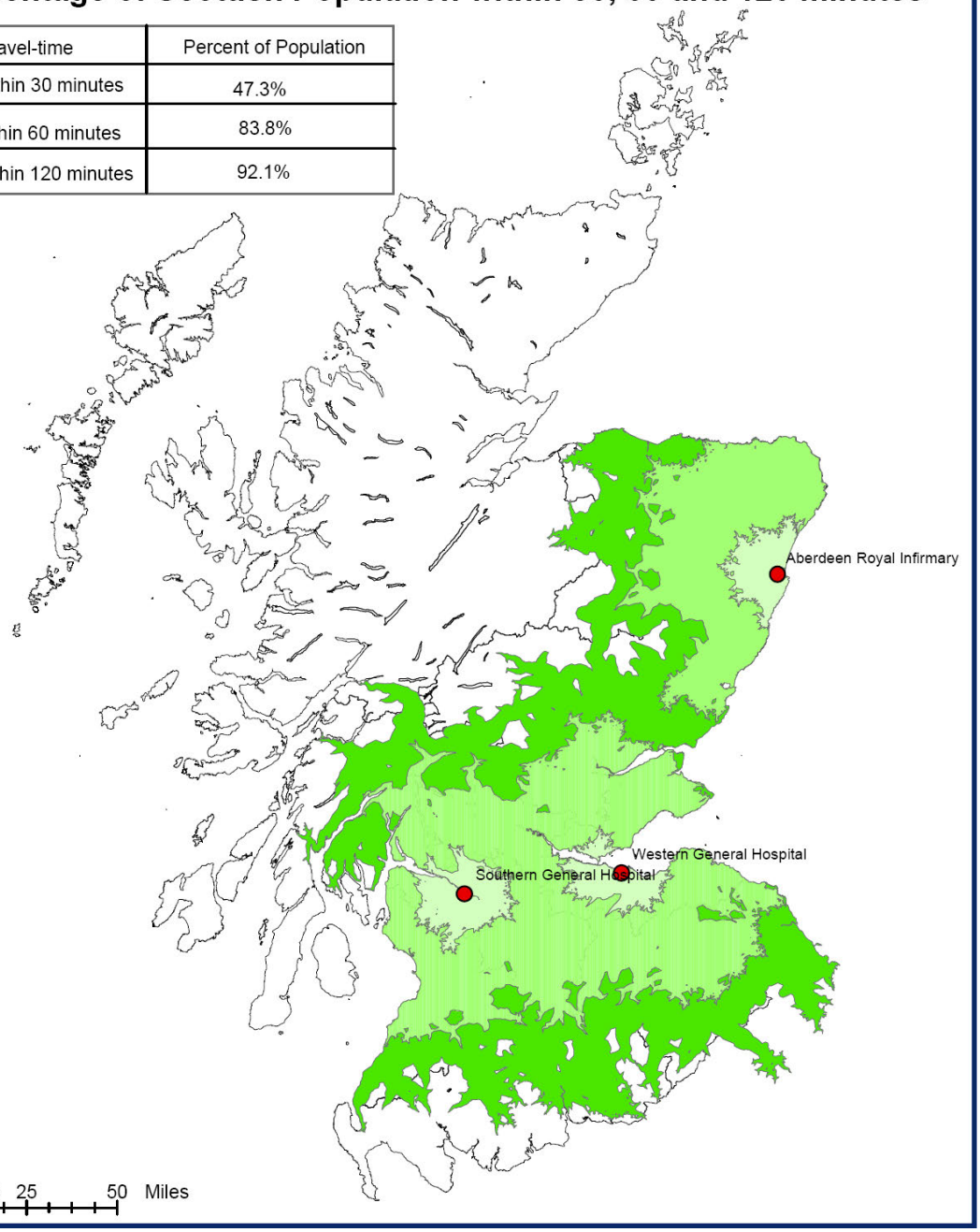
APPENDICES

Southern General Hospital / Western General Hospital / Aberdeen Royal Infirmary Scenario: Percentage of Scottish Population within 30, 60 and 120 minutes

Figure 17.

Travel-time	Percent of Population
Within 30 minutes	47.3%
Within 60 minutes	83.8%
Within 120 minutes	92.1%



Legend

Southern G.H / Western G.H / Aberdeen R.I

- <30 mins
- 30-60 mins
- 60-120 mins

- Southern General Hospital
- Western General Hospital
- Aberdeen Royal Infirmary
- Health Board Area Boundary

source: ISD Scotland
date of creation: 14/12/04
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APPENDICES

STANDING ADVISORY COMMITTEE ON NEUROSURGERY FOR MENTAL DISORDER (NMD) SERVICES IN SCOTLAND
REPORT OF VISIT TO THE
DUNDEE ADVANCED INTERVENTIONS (AI)/NMD SERVICE
TUESDAY 20 JUNE 2006

This report has been prepared for the AI/NMD service providers and the Scottish Executive. A copy is with the Minister and Deputy Minister for Health and Community Care and is available to all with an interest via the the web site of the Mental Health Division of the Scottish Executive – http://www.scotland.gov.uk/Topics/Health/health/mental-health/servicespolicy/publications

The SAC:

- Dr Andrew Fraser, Head of Health, Scottish Prison Service, and Chair
- Dr Cameron Stark, Consultant in Public Health Medicine, Highland NHS Board

In attendance:

- **Dr Adam Bryson, Medical Director, NHS National Services Scotland**
- **Mrs Deirdre Evans, Director, NHS National Services Scotland**
- Mrs Nan Whetton, Mental Health Division, Scottish Executive Health Department - Secretariat

The AI/NMD service providers:
- Dr Sharon Butler, Specialist Registrar in Psychiatry
- Dr David Christmas, Clinical Lecturer/Specialist Registrar in Psychiatry
- Dr Robert Durham, Senior Lecturer in Clinical Psychology
- Mr M. Sam Eljamel, Consultant Neurosurgeon
- Dr Alison Livingstone, Chartered Clinical Psychologist
- Mr Bob McVicar, Clinical Nurse Specialist
- Professor Keith Matthews, Honorary Consultant Psychiatrist
- Dr Richard Roberts, Clinical Group Director, Specialist Services
- Mr John Swan, Clinical Lecturer/Clinical Nurse Specialist in Cognitive Behaviour Therapy
- Ms Dawn Weir, Clinical Group Manager Specialist Services
- Mrs Kath Yates, Top Grade Adult Psychotherapist

Service user
- A former patient also participated in the visit.

Apologies
- SAC member, Ms Hilary Patrick, Honorary Fellow, Faculty of Law, the University of Edinburgh

Background

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In 1996 the CRAG Working Group on Mental Illness published its report (*Neurosurgery for Mental Disorder*) on neurosurgical service provision in Scotland for the treatment of chronic mental disorder. The report recommended and approved continuation of the service provided from Ninewells Hospital, Dundee, which still remains the only service provider in Scotland. Further recommendations were that reports on the service be published and that a Standing Advisory Committee (SAC) be established to *review the activity, assess the relevance and fitness for purpose and processes of referrals for the NMD service and provide support to the service providers.*

A Standing Advisory Committee (SAC) was appointed in December 2001. It has conducted two previous visits to the NMD service providers - on 2 October 2002 and 26 January 2004. The outcome reports visits and the recommendations made should be read alongside this latest report.

Reports on the NMD service, including patient activity, have been published in December 2001, October 2003 and January 2006.

All documents are available on the publications page of the web site of the Mental Health Division of the Scottish Executive –
http://www.scotland.gov.uk/Topics/Health/health/mental-health/servicespolicy/publications

Organisation and future of the AI/NMD service

The SAC is pleased to commend the continuing commitment and dedication to the service by all who are involved. This has resulted in the growth, development and maturity of a small, but impressive and highly specialist service over the lifetime of the SAC.

The service has adopted the organisation title *Advanced Interventions/NMD Service* to better reflect the range of treatment options offered for treatment resistant depression and obsessive compulsive disorder - from medication and specialist psychological therapies to ablative neurosurgery for a select few.

The service has also been successful in an application for designation as a National Service. This change in status took effect on 1 April 2006 and has provided added financial and other security for this distinct, unique and now well established service. The Director and Medical Director of the National Service Division which “sponsors” all national services took part in this visit to gain added insight into the role of SAC.

Referrals

The pattern and frequency of referrals continues to show little change from previous years – around one new referral each week amounting to 40 or 50 each year. Referrals continue to follow word of mouth recommendations from particular NHS Board areas rather than

Scotland-wide. Some other referrals are received from Ireland, England and from further afield including Greece, Norway and Poland.

There is little improvement in the pre referral consideration process by the parent health care systems. As in previous years only a small number of patients were accepted for treatment, the remainder being referred back to their parent area with recommendations for further interventions and treatments. Much of the discussion between the referring clinicians and the service is on reaching a consensus for when the service's involvement is appropriate and ensuring those that are to be accepted are referred at the correct stage in their care progression.

The level of referrals from out with Scotland highlights the national and international standing of the service. The ability of the service to cope with such referrals and to be able to obtain full costs is part of the ongoing discussions between the service and NSD.

There are also capacity issues around the equity of access for patients from within Scotland. These issues too are under consideration.

Procedures

Specialist service status has been approved for the provision of anterior cingulotomy and anterior capsulotomy – the two ablative NMD procedures carried out at the centre.

The service also offers Vagus Nerve Stimulation (VNS), an experimental procedure, for those patients who meet criteria for ablative NMD but where preference is expressed for the less invasive procedure. In the first 6 months of 2005 (the latest position reported in the 2006 AI/NMD report) from 41 referrals received, 5 VNS procedures were carried out. There were no Anterior Cingulotomies or Anterior Capsulotomies carried out in the same period.

As mentioned above, VNS is still considered an experimental treatment option for treatment resistant depression with, as yet limited, but nonetheless promising reported outcomes.

The SAC finds re-assurance in hearing that the Dundee service is the only health provider in Scotland offering VNS. In its 2004 report it made the recommendation that such experimental treatments be properly evaluated as part of a national or international framework of collaborative study, and this service pattern offers a good opportunity to achieve the maximum knowledge from a small caseload.

NSD also recognises that this is a rapidly developing area and an evaluated evidence base needs to be built up. It is therefore supporting a clinical decision on the part of the AI/NMD service to provide VNS for patients that meet the criteria where this can be achieved within the current funding. In addition, it has asked that there should be full documentation of clinical outcomes for patients who receive this procedure to add to worldwide experience.

The service confirmed that it continues to view the procedure of Deep Brain Stimulation for the treatment of treatment resistant depression and Obsessive Compulsive Disorder with caution (as set out in its 2006 report). Any future introduction of this technique by the

AI/NMD service will be subject to the scrutiny and governance of a formal, ethically approved, research proposal.

Pre and Post procedure process; Patients' experiences; Advocacy
The Clinical Nurse Specialist, Bob MacVicar, who has been in post since October 2003 continues the role of working with patients, referring authorities pre and post procedure and all key players in the AI/NMD service.

As previously mentioned, the basis for referrals continues to be variable with the majority of patients being assessed as not having received adequate previous treatment to merit consideration for neurosurgery. These patients are returned to their referring clinician with recommendations for further interventions and treatments. There are instances where the capability of the parent health care system to carry out these recommendations is a matter of concern.

It is also a pre-requisite of accepting a patient for treatment that a multi-disciplinary care plan is in place for the patient's return.

The SAC was grateful to the former patient for sharing with such honesty experiences of illness and involvement with the service. The person spoke highly of the care received both before and after the procedure from all involved in the process and was extremely appreciative of the abundance of comprehensive information received about the treatment options, both in written form and orally. The former patient offered that the treatment had resulted in no adverse effects either to memory or to personality.

Outcomes
The service continues to play its part in research and contributes to the evidence base for neurosurgical interventions for treatment resistant depression and Obsessive Compulsive Disorder.

It is currently analysing the outcomes of a detailed clinical and neuropsychological assessment of 28 out of 30 former patients who received neurosurgery in Dundee. A final report is expected to be published early next year with more comprehensive outcome information than any previous published study. Evidence available to date suggests a 40% remission rate at long-term follow-up. In this context "remission" is defined as no longer meeting the diagnostic criteria for a specific condition, e.g. depression.

Consent
The Mental Health (Care and Treatment) (Scotland) Act 2003 provides safeguards for the use of ablative surgery, DBS and VNS. It also allows such treatments to be carried out where an order to approve the treatment for an incapable patient has been made by the Court of Session. This does not interfere with the discretion of practitioners not to carry out such procedures and the service providers continue to offer NMD and VNS only to patients capable of providing informed consent. Though it has not yet carried out DBS, it would take the same stance and offer this treatment only to patients capable of providing informed consent.

The Mental Welfare Commission for Scotland is involved in the assessment and monitoring of all cases where NMD is proposed.

The Future role of the SAC
The SAC is pleased that NSD has taken NMD into its portfolio and is confident that it will continue to develop. It is aware that NSD has its own overview arrangements that mirror many aspects of the role of the SAC. Subject to Ministerial agreement, it is the intention of the SAC to defer its remit to the NSD which in turn will set up an Advisory Committee to deliver an ongoing independent assessment of the service.

Findings
The SAC continues to be impressed by the rigorous approach and commitment of those involved in providing this service. As on previous visits, a former patient spoke highly of their experiences throughout the process. Continued commitment of staff, stability of the team and research resource have resulted in the growth, development and maturity of a small, but impressive and highly specialist service.

Recommendations
- On science and evidence – the SAC recommends that the service continues to build the evidence-base for neurosurgical interventions designed to benefit people with serious mental disorders; critically review available knowledge, and link with other service providers across the world to make maximal use of clinical experience.

- On communications – the SAC recommends that the service develops and maintains a communications plan using appropriate media for patients, the interested public and professionals, with the purpose of promoting understanding of neurosurgery for mental disorders, and equity of access to care for severe disabling treatment resistant depression and obsessive compulsive disorder.

- On the scope of service provision – the SAC recommends that the service review regularly, with its commissioners, fellow specialists and service users' organisations, the service's definition, its boundaries, the quality of care before and after referral and clinical assessment, and types of clinical intervention. Such reviews should be made available to the public.

Thanks
Finally, the SAC would like to thank all who took part in the visit and, in particular, offer their appreciation to the former patient for her helpful and insightful contributions.

Standing Advisory Committee
August 2006

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