

REVIEW OF NEUROSURGICAL SERVICES IN SCOTLAND

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1. REMIT, GROUP MEMBERSHIP, WAY OF WORKING

1.1 The short-life working group was established to examine neurosurgical services in Scotland following concerns expressed in the recent Acute Services Review about the sustainability of high quality services in all of Scotland's four centres. The report of the Review noted (paragraph 424) that it had encountered examples of services which were facing problems and where alternative dispositions might need to be considered. Neurosurgery was a specialty where rationalisation was hampered by lack of objective data but where there was unease about the sustainability of quality when small numbers of procedures were being undertaken in some centres.

1.2 Chapter 11 of the report of the Review dealt with issues related to Specialisation and Specialist Services. Neurosurgery was considered in paragraphs 282-284, the text of which is as follows:

282. Neurosurgery provides a prime example of a small volume specialty in which there are significant concerns about subspecialisation, critical mass and the need to sustain training programmes in a discipline which has a major emergency commitment and an integral role in the management of major trauma. Rational decisions about the disposition of services in Scotland is hampered by a lack of meaningful outcome statistics for mortality and morbidity. Neurosurgical care in Scotland is currently delivered from 4 centres, the largest Glasgow providing about 55% of the service requirement. While Scotland has a proportionately higher number of neurosurgeons and beds than is the average for the rest of the UK and Eire, its resources are not distributed equitably, and it is unusual in that it has two neurosurgical departments (Aberdeen and Dundee) which serve nominal catchment populations of less than one million people.

283. ...There must be concern about the number of low volume procedures being undertaken in some centres, but it must be emphasised that the data are not available on which to make an objective assessment of the quality of outcomes being achieved. The Review sees an urgent need to rectify this situation but appreciates that the very fact that small numbers of procedures are being undertaken will make it difficult to move quickly to draw firm conclusions about observed differences between centres.

284. The Review regards retention of acute neurosurgical services in Scotland's 4 largest cities as essential to the continued development of trauma centres in those locations (Chapter 10) but can see a potentially strong case for the concentration of less common conditions requiring highly specialised care. This does not necessarily mean centralisation of services in the Central Belt centres

and the Review sees the overall provision and resourcing of neurosurgical services as a matter for early strategic review.

1.3 The present short-life working group was set up with the remit:

“To examine aspects of neurosurgery in Scotland with particular reference to:

- the emergency management of neurosurgical patients;
- the relationship between volume and quality in respect of neurosurgical operations;
- the need for continuing audit of neurosurgical procedures within Scotland;
- the current disposition of neurosurgical units with particular reference to the sustainability of services;
- the implications of any changes in the provision of neurosurgery for related services;
- the potential for networking and use of new technologies in service organisation.

The membership of the group is given in Appendix A.

1.4 The group held 7 meetings between November 1999 and May 2000. The first meeting considered the terms of reference and scope of the review as well as establishing a way of working. The second meeting focused on the management of patients before they reached the neurosurgical unit and the contribution of telemedicine. It benefited from the participation of Professor R Newton (Postgraduate Dean, Dundee), Dr A Ward (GP, Lochgilphead), Dr D Bell (Consultant Physician, Royal Infirmary of Edinburgh), Dr A Dorward (Consultant Physician, Royal Alexandra Hospital, Paisley) and Dr J Ferguson (Consultant in A&E Medicine, Royal Infirmary of Aberdeen). The third meeting included a presentation from Dr D Beard of the Scottish Trauma Audit Group (STAG) and scrutinised data on neurosurgical activity that had been made available by the Information and Statistics Division (ISD) of the Common Services Agency. The Group was grateful to Mr S Heald of ISD who updated the data that had been available to the Neurosciences Sub-Group of the Acute Services Review.

1.5 The fourth meeting concentrated on paediatric neurosurgery, with presentations from Mr Steers and Dr Kirkpatrick. Dr G Farmer (Consultant Paediatrician, Raigmore Hospital, Inverness) and Dr D Simpson (Director of PICU, Royal Hospital for Sick Children, Edinburgh) presented work being undertaken concurrently by the short-life working group on

the transport of critically ill or injured children. The fifth meeting looked once again at the revised ISD data and considered the recommendations in *Safe Paediatric Neurosurgery* (1997) and *Safe Neurosurgery 2000*. It benefited from the participation of Professor G Teasdale (Professor of Neurosurgery, University of Glasgow and one of the authors of the latter report) and from the management perspective provided by Ms J Kells (Director of Commissioning, Lothian Health). Subsequent meetings were devoted to the development of the group's recommendations and the formulation of its report.

1.6 The group also visited each of the 4 neurosurgery units (including the neurosurgical facilities at the Royal Hospital for Sick Children, Edinburgh) and was given a detailed presentation of the work in progress as well as a tour of the unit.

1.7 In its discussions the group paid particular attention to the following key documents: *Safe Neurosurgery 2000: a report from the Society of British Neurological Surgeons* (February 2000); *Safe Paediatric Neurosurgery* (1997); the draft SIGN Guideline *Early Management of Patients with a Head Injury*; and the *Report of the Working Party on the Management of Patients with Head Injuries* published by the Royal College of Surgeons of England in June 1999.

2. BACKGROUND TO THE REVIEW

2.1 Neurosurgery is a technology-dependent inpatient specialty with a large acute element. The human resource, facilities and equipment required to deliver a modern neurosurgical service are expensive. The highly specialised and skilled medical and non-medical staff needed to provide a 24-hour service are a particularly precious resource that is relatively scarce. A balance has to be struck between providing neurosurgical services which are close to the population served and ensuring that the units concerned are well resourced and able to deliver services of consistently high quality. The difficulties of supplying neurosurgical services for children are even more pronounced because the number of patients requiring treatment per population base served is very much smaller than is the case in adult practice.

2.2 Many countries face difficulties in defining and committing the appropriate level of resource to provide and sustain modern neurosurgical services. Throughout the world, this has encouraged the increasing centralisation of neurosurgical care. Major factors contributing to this trend include:

- The relatively low volume of neurosurgical activity (caseload) per unit population.
- The development of sub specialisation within neurosurgery.
- The need for a critical mass of clinical activity to develop and sustain specialist expertise and provide adequate training opportunities.
- The need to maintain 24-hour emergency specialised cover in the face of changed working practises for junior and senior medical staff.
- A scarcity of skilled specialist nursing and therapy staff.

Neurosurgery in Scotland

2.3 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.

2.4 Each of Scotland's neurosurgical units is an integral part of a multidisciplinary neurosciences service. 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 physical presence is offset by functional integration in terms of service delivery, teaching and research. Each of the 4 neurosurgical units provides core neurosurgical services for their population.

2.5 Table 2.1 shows the size of the notional population (adjusted for cross-boundary flow) served by each centre together with the number of neurosurgical consultants, number of staffed beds and ITU beds. Workload is expressed in terms of number of discharges and operations.

Table 2.1 – Neurosurgical resources and activity in Scottish units in relation to the population served

	Notional Population ¹ Millions	Consultants WTE ² (per million)	Average Staffed Beds ³ (per million)	ITU Beds ⁴ (per million)	Discharges ⁵ (per million)	Operations ⁶ (per million)
Aberdeen	0.7	3.0 (4.3)	28 (40)	1 (1.3)	1099 (1570)	949 (1355)
Dundee	0.5	2.6 (5.2)	23 (46)	4 (8.0)	925 (1850)	700 (1000)
Edinburgh	1.3	4.7 (3.6)	46 (35)	4 (3.1)	2247 (1728)	1920 (1477)
Glasgow	2.6	6.9 (2.7)	89 (34)	8 (3.1)	3433 (1320)	2490 (958)
Scotland	5.1	17.2 (3.4)	187 (37)	17 (3.3)	7704 (1510)	6059 (1188)

1. General Register Office, Scotland – 1998 mid-year estimates allocated pro-rata the workload at each unit

2. ISD (Scotland) - Medical & Dental Census September 1998

3. ISD (Scotland) - ISD(S)1 - for Year ending March 1999. Bed numbers in Dundee are now 20 rather than 23

4. Includes available but not dedicated ITU beds in Aberdeen and Edinburgh. The number of dedicated ITU beds in Dundee is now 2 rather than 4, but as in Aberdeen there is the potential for access to a general ITU.

5. ISD (Scotland) - All hospital discharges from specialty Neurosurgery in 1998/99. Note that the unit in Dundee was moved from Dundee Royal Infirmary to Ninewells Hospital in the course of the year.

6. ISD (Scotland) - All hospital discharges from specialty Neurosurgery in 1998/99 with operation during episode.

Aberdeen

2.6 The adult and children's services are located at the Royal Infirmary at Foresterhill, the unit serving a notional population of some 0.7 million. At present, children are accommodated in the Sick Children's Hospital on the periphery of the campus but a new children's hospital is planned as a wing of the main hospital. The current accommodation is high-quality with proximity to related services including access to a shared ITU (allowing ITU bed availability to increase as outlined in Table 2.1), imaging facilities and one operating theatre which, while not dedicated to neurosurgery, is appropriately timetabled to be available. There is no sub-specialty trained paediatric neurosurgeon and 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. 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. Aberdeen's catchment area is extensive 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.

Dundee

2.7 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 0.5-0.6 million. Accommodation and facilities are modern and developed to a high standard. The adult unit is immediately adjacent to the new A&E Department, the key trauma service in Tayside, and close to high quality vascular imaging facilities (although currently there is no specialist interventional neuro-radiologist). There is a dedicated 2-bedded adult neurosurgical ITU (with access to a general ITU if necessary) and a dedicated operating theatre. There are no paediatric ITU beds and there is no sub-specialty trained paediatric neurosurgeon. There is currently a vacant neuropathology consultant post. There are good road links to the surrounding region and the hospital has helicopter landing facilities.

Edinburgh

2.8 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 may be 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, soon to move to its new but slightly more distant site at Little France. 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. The neurosurgical inpatients are managed in a ward shared with neurology; junior medical cover is provided by neurology SHOs. There is 1 sub-specialist paediatric neurosurgeon (0.5 WTE) supported by two neurosurgeons with extensive training and experience in paediatric neurosurgery (but whose main commitment is normally to adult neurosurgery). A further trained paediatric neurosurgeon (0.5 WTE) appointment is imminent.

Glasgow

2.9 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. Sixty percent of admissions are classified as emergency. 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 is undergoing a fundamental refurbishment programme 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.

2.10 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 resite 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 Institute offers a comprehensive spectrum of clinical neurosciences and an extensive portfolio of neurosurgical sub-specialty services through deployment of 3 surgical teams. 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.

3. EXISTING POLICY STATEMENTS, GUIDANCE AND STANDARDS

Acute Services Review

3.1 The Acute Services Review (ASR) devoted considerable attention to the relationship between the volume of service activity and the quality of outcomes with particular reference to small volume highly specialised services such as neurosurgery. It recognised specific concerns about the effects of subspecialisation, need to sustain critical mass and the importance of high quality training programmes in a discipline with a major emergency commitment and an integral role in the management of trauma. It reproduced data regarding the levels of activity in the 4 Scottish centres in respect of key high volume and low volume operations and spinal operations undertaken by neurosurgeons. Concern was expressed about the number of low volume procedures being undertaken in some centres but the ASR emphasised that sufficiently robust data were not available on which to base an objective assessment of outcome quality. It emphasised that comparisons between Scotland's centres will always be difficult, given the small number of operations being undertaken in a specialty such as neurosurgery but saw a pressing need to acquire more robust audit to inform the quality-outcome debate.

3.2 These concerns are by no means confined to neurosurgery. The ASR placed great reliance on the University of York Review (*Concentration and Choice in Provision of Hospital Services*, NHS Centre for Reviews and Dissemination, 1997) which questioned the automatic assumption that there is a positive relationship between volume of many services and their quality. Weaknesses in existing studies included failure to allow adequately for case-mix complexity, use of crude mortality statistics, and failure to allow for service improvement with time. While there was evidence of a volume:quality relationship in some areas, notably the treatment of cardiac disease and some aspects of surgery for cancer and vascular disease, a relationship has yet to be demonstrated in most areas of neurosurgery. This wording is important: simply because a relationship has not been demonstrated it does not mean that a relationship does not exist.

3.3 The ASR saw retention of acute neurosurgical services in Scotland's 4 largest cities as essential to the continued development of major trauma centres in these locations, but at the same time saw a potentially strong case for the concentration of less common conditions

requiring highly specialised care. This was not intended as a plea for centralisation of all such services in Edinburgh and/or Glasgow. The ASR's call for further strategic review of the overall provision and resourcing of neurosurgical services has been the main stimulus for the current appraisal of neurosurgical services in Scotland.

Safe Neurosurgery 2000

3.4 *Safe Neurosurgery 2000* was published in 1999 by the Society of British Neurological Surgeons. It sets out the Society's recommendations for standards of safety and quality. Recommendations that have particular relevance to this review of neurosurgical services in Scotland are as follows:

- Neurosurgical units should be situated within a multidisciplinary Neurosciences centre on a General Hospital site. Each unit should provide a core neurosurgical services before any subspecialties are developed.
- To maintain neurosurgical expertise and satisfactory training there must be adequate volume and diversity of work. A 1 million catchment population is regarded as the minimum. This must be reconciled with equity of access and surface journey times to neurosurgical units should be less than 2 hours.
- All neurosurgical units must provide a full 24-hour consultant-led service and should have a minimum of 6 WTE consultant surgeons, this number rising for larger populations.
- 30 neurosurgical and 4 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; those serving a population of more than two million need three.

The Report lists facilities and specialties that should be available within or immediately adjacent to a neurosurgical unit and lists those which should be located on the same site. Facilities in the latter category include orthopaedic and accident and emergency departments.

3.5 Each of Scotland's neurosurgical units is already an integral part of a multidisciplinary neurosciences service. The larger critical mass of the two larger centres (Glasgow and Edinburgh) means that there is a free-standing neurosciences complex (at the Southern General Hospital and the Western General Hospital respectively). Neither of these

units is on the same site as the city's major children's hospital. While plans in Glasgow may bring key related services together on a single site (para 2.9), anxieties continue to surround plans in Edinburgh which would leave adult neurosurgical services isolated from the main trauma hospital and the children's hospital. Although the two smaller neurosurgical centres (Aberdeen and Dundee) are not housed in a distinct neurosciences complex, their lack of a discrete physical presence is offset by functional integration in terms of single-site working, service delivery, teaching and research. Each of the 4 neurosurgical units can be seen to provide core neurosurgical services to their population.

3.6 According to *Safe Neurosurgery 2000*, Scotland has a better ratio of WTE consultant neurosurgeons to population (1:284,600) than any of the other parts of the United Kingdom or Ireland (range 1:372,500 to 1:467,000), although its staffing falls short of what is claimed to be the European average level (1:125,000). Assuming that a consultant performs some 180-250 operations a year, the Society of British Neurological Surgeons in 1993 advocated that 4 consultants were needed for a population of up to 1.5 million, with one further surgeon for every additional 0.5 million people served. The figure of 4 per 1.5 million was based on a maximum on-call commitment of 1 in 3 (with internal cover) and recognises that consultants need to perform enough operations a year to maintain competence and ability to train others.

3.7 According to these figures, Scotland with its population of 5.1 million people should have approximately 14 WTE consultant neurosurgeons, whereas in reality it has 17. However, because of Scotland's geography, population dispersal and development of 4 neurosurgical units, none of the units comply with the recommended targets **for 2005** set by *Safe Neurosurgery 2000*, although all have staffing levels that exceed or approximate to 4 consultants per 1.5 million. Aberdeen and Dundee, with their populations of less than 1 million (Table 3.1) each have 3 WTE consultants rather than the minimum of 6 recommended, while Edinburgh has 4.5 rather than 6. Glasgow serves the largest population (2.7 million) and has 6.5 WTE consultants rather than the 8 recommended. There must be real anxiety about the sustainability of services which depend on 3 consultants, given that much neurosurgical work is classified as urgent or emergency. On the other hand, there must also be serious misgivings about the workload needed to maintain surgical skills if 6 neurosurgeons were to be employed in Dundee or Aberdeen with their smaller catchment populations.

3.8 According to *Safe Neurosurgery 2000*, Scotland has 166 neurosurgical beds, just over the 30 beds per million population that the document recommends. However, the Society of British Neurological Surgeons still sees a need for a further 12 beds in Glasgow and 4 in Dundee (Table 3.2) although bed complements in Edinburgh and Aberdeen are currently greater than the recommended 30 beds per million (Table 2.1). With regard to Intensive Therapy Unit (ITU) beds, the situation is complicated by the fact that Edinburgh does not have a dedicated neurosurgical ITU, although as discussed earlier, staff estimate that on average, some 4-5 beds in the hospital's general ITU are occupied by neurosurgical patients. If Edinburgh is assumed to have 4 neurosurgical ITU beds, Scotland currently possesses 17 such beds, short of the 20-21 beds that would be needed to comply with the recommendations of *Safe Neurosurgery 2000* (Table 3.2). The arguments for and against a *dedicated* neurosurgical ITU were heard in the course of the current review. The argument for appears strongest for the two larger centres but seems less forceful in the case of Dundee and Aberdeen.

Table 3.1 Neurosurgical Consultant Staffing Levels (Current and Target for 2005) as Recommended in *Safe Neurosurgery 2000*.

Unit	Population served (millions) ¹	Target for 2005 (WTE)	Current staff (WTE)	Shortfall (WTE)
Aberdeen	0.8	6.0	3.0	3.0
Dundee	0.6	6.0	3.0	3.0
Edinburgh	1.3	6.0	4.5	1.5
Glasgow	2.7	8.0	6.5	1.5

¹ Note discrepancy between population sizes cited here and those based on General Register Office, Scotland and used in Table 2.1. It is recognised that specialist services in some units draw on wider populations than those contained within the region.

Table 3.2 Neurosurgical and Neurosurgical ITU Beds (Current and Target for 2005) as Recommended by Safe Neurosurgery 2000¹

Unit	Neurosurgical Beds (1999)	Neurosurgical Beds (2005)	Neurosurgical ITU Beds -1999	Neurosurgical ITU Beds -2005
Aberdeen	29	24	1	3
Dundee	20	24	4 ²	3
Edinburgh	48	39	0 ³	5
Glasgow	69	81	8	11

¹ The discrepancy between these bed numbers and those shown in Table 2.1 reflect changes with time. In the case of Glasgow, the number of beds shown here at the Institute of Neurological Sciences refer to adult neurosurgical beds only.

² Colleagues in Dundee report that they have 2 rather than 4 dedicated ITU beds.

³ The Edinburgh unit currently has access to 4-5 beds in a general ITU and does not have a dedicated neurosurgical ITU.

3.9 It should also be noted that Aberdeen and Dundee fall short of the recommendation that each neurosurgical unit should have at least two fully resourced operating theatres. Given the smaller populations served by these two units it would be an inappropriate use of resources to comply with these recommendations. While colleagues in the two centres concerned appear content with existing arrangements, theatre availability must continue to be assured, particularly in the case of Aberdeen where there is no dedicated neurosurgical theatre.

Safe Paediatric Neurosurgery

3.10 The Society of British Neurological Surgeons published this document in 1997. It is based on two main principles. Firstly, that children's care should be of the highest quality and delivered by recognised paediatric neurosurgeons supported by appropriate staff and facilities. Secondly, that children requiring neurosurgery should have the same degree of care and level of expertise that is currently available in adult neurosurgery. While all trainee neurosurgeons should have a period of at least 6 months in a unit undertaking a minimum of 100 neurosurgical operations in children a year, those wishing to become paediatric neurosurgeons have to spend a year training in such a unit.

3.11 The Report recommends that neurosurgical units offering a comprehensive service to children must be able to deliver a full 24-hour service with appropriate supporting staff and facilities. A minimum of two WTE consultants are needed to *undertake* planned paediatric neurosurgical work and *support* emergency paediatric neurosurgery (which the report accepts will be carried out by both paediatric and adult neurosurgeons for the foreseeable future). At present, only Glasgow and Edinburgh are regarded as having trained paediatric neurosurgeons on their staff, with support from neurosurgeons with considerable paediatric experience (paras 2.8 and 2.9).

3.12 The Report identifies the need for ‘some degree of rationalisation and co-ordination between Departments’ for the optimal delivery of paediatric neurosurgical services in some regions. Such rationalisation is already apparent in Scotland with its four neurosurgical centres and its widely dispersed population. There is general agreement that highly specialised paediatric neurosurgical procedures (eg. complex craniofacial surgery, epilepsy surgery, and vascular, spinal and functional surgery) should only be undertaken in settings where the necessary expertise and support is available. In acute life-threatening circumstances (eg some cases of head injury or blocked shunt) there is general agreement that it may be safer to provide emergency treatment in a regional neurosurgical unit which does not have a sub-specialty trained paediatric neurosurgeon (eg Aberdeen and Dundee), then transfer the child to a specialist paediatric neurosurgical team.

3.13 The Report recognises that paediatric neurosurgical beds may be available in a number of settings. These include a children’s hospital, a separate dedicated paediatric neurosurgical ward within a neurosurgical unit, or a paediatric ward in a department of Child Health in the same hospital as the adult neurosurgical department. The UK Childhood Cancer Services Group have made further specific recommendations in respect of children with cancer. Services must be able to provide accurate and timely diagnosis; multidisciplinary assessment and treatment planning; treatment and follow-up in an appropriate environment for children; easy access to other paediatric specialist facilities; quality assurance, audit, teaching and research; and effective communication.

3.14 Safe Paediatric Neurosurgery also emphasises the importance of audit of paediatric practice in areas such as insertion and maintenance of shunts, oncology and craniofacial surgery. At present Scotland participates in the UK Hydrocephalus Shunt Registry and the paediatric neurosurgical service in Glasgow participates in a UK-wide audit of craniofacial surgery. However, further development of audit is needed to assure the quality of paediatric neurosurgical practice in other key areas.

Report of the Working Party on the Management of Patients with Head Injuries

3.15 This report was produced in 1999 on behalf of the Royal College of Surgeons of England. Approximately one million people present annually to hospitals with head injuries and almost half are less than 16 years of age. The thrust of the report is that only the two groups of doctors trained in the early/immediate management of head injury (those working in Accident and Emergency (A&E) medicine or the neurosciences) should be responsible for the care of head injured patients.

3.16 The Report emphasises that general and orthopaedic surgeons should not normally be responsible for the care of patients requiring a short period of observation for an isolated head injury. Ideally a dedicated observation ward is needed within the A&E department or next to it. Local policies consistent with nationally agreed guidelines must be developed by the A&E Department in concert with the regional neurosciences unit, and the guidelines should underpin admission policy, management and discharge. Children under 16 requiring admission should be admitted under the care of a paediatrician or paediatric neurosurgeon.

3.17 The Report also considers pre-hospital care, criteria for receiving hospitals, criteria to identify patients requiring care in a neuroscience unit, the needs of patients with multiple injuries, the needs of those living in remote areas, rehabilitation, discharge and follow-up, and research and audit. It places great emphasis on the need for staff and resource development in A&E departments, a close working relationship between A&E departments and their regional neuroscience unit, and the importance of good communication including image transfer facilities.

Scottish Trauma Audit Group

3.18 The Scottish Trauma Audit Group (STAG) has been undertaking prospective audit of injured patients in Scotland since 1991. It involves 25 hospitals, deals with patients who are admitted following injury for at least three days or who die as a result of trauma, and has a national data capture rate of 96%. Patients are followed until discharge, death or three months from the time of injury. The audit uses an injury severity scoring system (the TRISS method) that combines the Abbreviated Injury Scale (AIS; measures anatomical damage) and the Revised Trauma Score (RTS; measures physiological derangement). The audit excludes patients over 65 with an isolated fracture of the neck of femur or pubic ramus and children under the age of 13.

3.19 The most recent report deals with 799 patients with serious head injury ($AIS \geq 3$) in the period 1 July 1998 to 30 June 1999. The pattern of injury differs in the catchment areas of the 4 neurosurgical units. The Glasgow unit deals with a lower proportion of road traffic accidents (26.7%) and a higher proportion of assaults (20%) than the other three units. In Aberdeen and Dundee, 48-49% of the patients were involved in road traffic accidents, the mechanism of injury most likely to result in multiple injury. The proportion of multiply injured patients in the four centres ranged from 17.7% in Glasgow to 51.7% in Dundee.

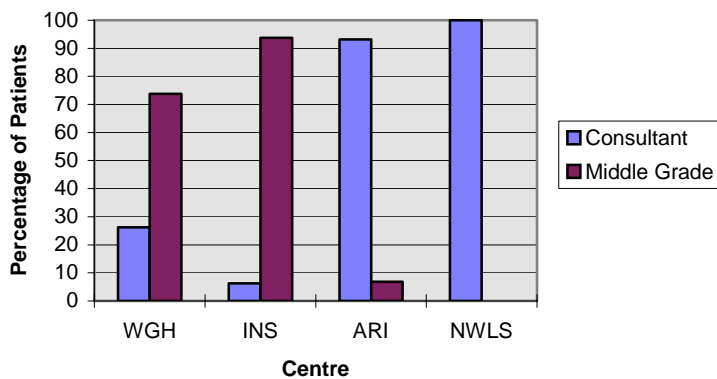
3.20 Whereas the hospitals containing the neurosurgical units in Aberdeen, Dundee and Glasgow also contain an Accident and Emergency (A&E) department, the hospital housing the Edinburgh unit does not. More than half the head-injured patients admitted to the neurosurgical unit in Edinburgh did not present to the city's A&E department; in Glasgow the vast majority of such patients presented initially to A&E departments other than that located at the Southern General Hospital. This is reflected in the observation that with two exceptions, patients admitted to the neurosurgical units in Glasgow and Edinburgh were not seen by a neurosurgeon while they were in the receiving A&E department. In the case of patients presenting to Ninewells Hospital and Aberdeen Royal Infirmary, neurosurgeons attended the resuscitation room in 32.8% and 31.8% of cases respectively.

3.20 There were marked differences between the four units in terms of the recorded presence of a consultant neurosurgeon at the time of operation for acute trauma (Fig 3.1). It should be emphasised that lack of 'recorded presence' probably underestimates the degree of

consultant involvement and supervision, and does not imply lack of consultant availability. The relative lack of a consultant presence in Edinburgh and Glasgow may reflect the fact that they are major training centres with experienced trainees whereas Aberdeen and Dundee each have only one trainee (see section 9.3). Differences in terms of the *recorded* presence of a consultant anaesthetist were less marked (Fig. 3.2).

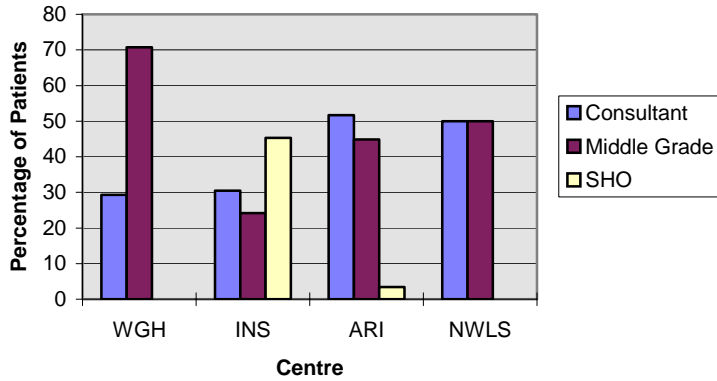
3.21 There was little discernible difference between the four neurosurgical units in the proportion of patients who survived after relatively minor injury, that is an Injury Severity Score of 9-15 (ISS; see Fig. 3.3). The slightly lower survival rates in Aberdeen and Dundee following severe injury (ISS 16-75) may well reflect the greater proportion of patients with multiple injuries following road traffic accidents in those two centres. When patient survival was analysed according to Glasgow Coma Scale grouping (Fig 3.4), there was remarkable consistency across the four units.

Figure 3.1 Grade of Surgeon in Theatre - Neurosurgical Procedure as First Operation.



Note: The grade of surgeon is taken from the operation and anaesthetic records. A consultant might have been supervising a trainee but if he/she was not recorded as being present, their presence will not be reflected in this data.

Figure 3.2 Grade of Anaesthetist in Theatre - Neurosurgical Procedure as First Operation.



Note: The grade of anaesthetist is taken from the operation and anaesthetic records. A consultant might have been supervising a trainee but if he/she was not recorded as being present, their presence will not be reflected in this data.

Figure 3.3 Percentage of Patients Surviving when Grouped according to Injury Severity Score (ISS).

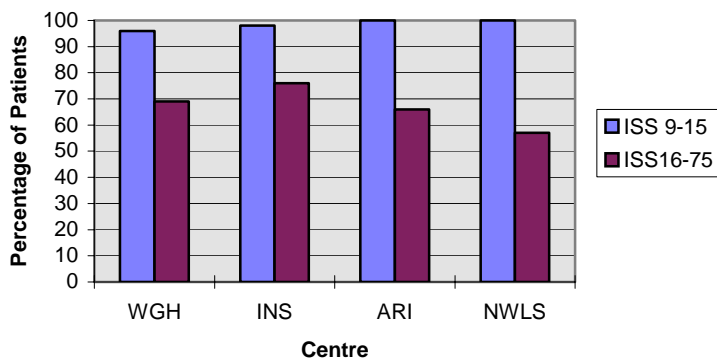
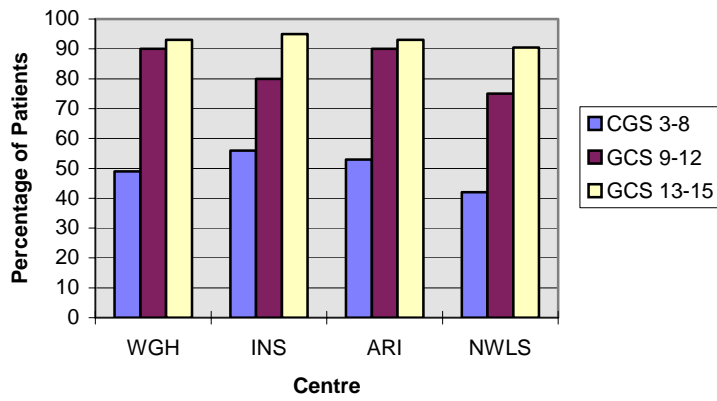


Figure 3.4 Percentage of Patients Surviving when Grouped according to the Glasgow Coma Scale (GCS).



4. DATA

4.1 Neurosurgery is a classic example of a specialty that is technologically and technically demanding and in which assessment of quality is hampered by the relatively small volumes of activity and the pressures of subspecialisation. The present review process has been hampered by a lack of robust outcome data and databases which are sufficiently large to allow meaningful comparisons between Scotland's four neurosurgical centres, and between Scottish centres and those elsewhere. The same problem was encountered by the Acute Service Review, a review which commented specifically on the need for mortality and morbidity data on which to base rational decisions about the disposition of neurosurgical services in Scotland.

4.2 Tables 4.1 and 4.2 illustrate some of the limitations of existing databases. From the outset it is apparent that volumes of activity in Dundee and Aberdeen are small, reflecting their smaller catchment areas. Whereas procedures such as craniotomy for traumatic haematoma appear sufficiently common to allow meaningful assessment based on an analysis of one year's data, others operations such as those involving acoustic neuroma or the pituitary gland appear to require data accretion for ten years or more before analysis becomes meaningful. However, such long-term accretion of data is undermined by the fact that neurosurgical practice may change substantially with time, while adjustment for case-mix complexity may mean that apparently large databases become inadequate for objective comparisons. Furthermore, the interface between neurosurgery and other disciplines may be dynamic and/or subject to rapid change. For example, the number of operations undertaken for lumbar degenerative disease in 1998/99 is proportionately smaller in Glasgow and Edinburgh (7.5% and 12.4% of workload respectively) than in Aberdeen and Dundee (21.3% and 25.6% of workload respectively). This may reflect differing capacity and a different working boundary between neurosurgery and orthopaedic surgery, particularly in respect of lumbar degenerative disease. Similarly, developments in interventional neuroradiology are undoubtedly influencing the amount of surgery being undertaken for intracranial aneurysm.

4.3 A major limitation to existing databases is their concentration on volumes of activity and mortality. For example, the Scottish Audit of Surgical Mortality has limited utility in assessing neurosurgical services where quality of outcome is highly dependent on morbidity

and disability. Similarly, data from ISD offer little insight into service quality. By contrast, the audit undertaken by the Scottish Trauma Audit Group (STAG) provides a substantial body of valuable comparative information on the management of head injured patients.

4.4 During the course of its visits to Scottish neurosurgery centres, the Review Group was impressed by the effort that had been put in to documenting and benchmarking specific areas of unit activity. While this reflects a piecemeal approach to comparative audit, we appreciate that there is also some Scotland-wide audit activity as reflected in the Scottish contribution to the UK Hydrocephalus Shunt Registry (a Registry of cerebrospinal fluid diversionary procedures). However, the Review sees a pressing and urgent need for the Scottish Neuroscience community in general and Scottish neurosurgeons in particular to collaborate with ISD in a coherent audit. This will require an agreed set of definitions, uniform coding practice and production of agreed datasets. Assuming that the work of STAG and the Shunt Registry will continue, we also see the need to audit other specific areas of activity such as the management of intracranial aneurysm, glioma and spinal degenerative disease. Careful thought will need to be given to auditing the quality of paediatric neurosurgery (over and above the Shunt Registry) where volumes of activity are even smaller than in many areas of adult practice, and to the value of a rolling programme of audit which moves periodically to consider new topics.

4.5 ISD have already signalled their enthusiasm for the principle of coherent neurosurgical audit and are aware of the willingness of Scottish neurosurgeons to participate. We see the Clinical Resource and Audit Group (CRAG) as an appropriate source of funding for this activity, leading as it would to assurance of the quality of neurosurgery, improved understanding of the factors influencing clinical performance, and enhancement of the capacity for Scottish neurosurgical research and development. We would hope that this coherence would be reflected in an increased sense of community among Scottish neurosurgeons (and those working in related disciplines) and a constructive approach to regular peer review. As in all audit activity, it will be essential to encourage a climate of constructive peer review and ensure that audit leads to improved clinical effectiveness and is not seen as an end in itself. We commend the approach taken by disciplines such as Obstetrics and Gynaecology where CRAG has agreed to a rolling programme aimed at improving clinical effectiveness (based on agreed audit) rather than piecemeal audit activity.

4.6 We appreciate that as part of their clinical governance activities, Trusts offering neurosurgical services will wish to be assured that the services are of appropriate quality. We also appreciate that in time, the Clinical Standards Board for Scotland may also concern itself with aspects of the quality of neurosurgical services.

Table 4.1 – Neurosurgical operations/procedures undertaken in Scotland’s four neurosurgical units in the year 1998/99. Data refer to patients of all ages.

	No. of Discharges (percent ¹)				
	Aberdeen	Dundee	Edinburgh	Glasgow	Scotland
Discharges from neurosurgery with an operation	949	700	1920	2490	6059
Craniotomy for Intracranial Aneurysm	43(4.5)	20(2.9)	31(1.6)	113(4.5)	207(3.4)
Ventricular Shunts/Revisions					
Total	45(4.7)	32(4.6)	134(7.0)	156(6.3)	367(6.1)
With diagnosis of hydrocephalus	30(3.2)	14(2.0)	74(3.9)	71(2.9)	189(3.1)
With another diagnosis	15(1.6)	18(2.6)	60(3.1)	85(3.4)	178(2.9)
Ventricular Endoscopic Procedures					
Total	1(0.1)	1(0.1)	2(0.1)	16(0.6)	20(0.3)
With diagnosis of hydrocephalus	0(0.0)	1(0.1)	1(0.1)	12(0.5)	14(0.2)
With another diagnosis	1(0.1)	0(0.0)	1(0.1)	4(0.2)	6(0.1)
Operations for Trigeminal Neuralgia	5(0.5)	9(1.3)	8(0.4)	45(1.8)	67(1.1)
Craniotomy for Haematoma					
Total	35(3.7)	36(5.1)	110(5.7)	249(10.0)	430(7.1)
Spontaneous	18(1.9)	25(3.6)	68(3.5)	173(6.9)	284(4.7)
Head Injury	16(1.7)	7(1.0)	28(1.5)	70(2.8)	121(2.0)
Operations for Spinal Degenerative Disease – Cervical	56(5.9)	65(9.3)	127(6.6)	131(5.3)	379(6.3)
Operations for Spinal Degenerative Disease – Lumbar	202(21.3)	179(25.6)	239(12.4)	187(7.5)	807(13.3)

¹Percentage of all neurosurgical operations/procedures undertaken in each centre.

Table 4.2 – Neurosurgical operations/procedures undertaken in Scotland’s four neurosurgical units in three periods between 1990-1999

	Number of Discharges				Scotland
	Aberdeen	Dundee	Edinburgh	Glasgow	
Operations on Pituitary Gland					
1990-92	31	30	44	129	234
1993-95	20	31	43	122	216
1996/7-98/9	31	26	70	178	305
Operations on Acoustic Neuroma					
1990-92	10	11	24	50	95
1993-95	13	20	25	65	123
1996/7-98/9	15	26	21	44	106
Craniotomy for Meningioma					
1990-92	30	24	62	75	191
1993-95	39	33	67	63	202
1996/7-98/9	34	30	82	120	266
Craniotomy for Arteriovenous Malformation					
1990-92	2	3	13	26	44
1993-95	2	8	9	18	37
1996/7-98/9	2	8	6	20	36
Lobectomy (with a diagnosis of Epilepsy)¹					
1990-92	0	4	2	21	27
1993-95	0	9	11	11	31
1996/7-98/9	3	8	23	14	48
Lobectomy (other diagnosis)					
1990-92	16	2	10	39	67
1993-95	13	7	10	39	69
1996/7-98/9	12	1	7	28	48

¹ Members of the Working Group have questioned whether all patients categorised as undergoing lobectomy with a diagnosis of epilepsy will have been classified appropriately.

5. SYNERGIES & INTERFACES

5.1 Close collaborative working with other neuroscience disciplines is critical to the effective delivery of high quality neurosurgical practice (both adult and paediatric), and there is general agreement that full integration of neurosurgery within Clinical Neuroscience Departments is the ideal arrangement. Also vital to the continuing success of regional services, teaching hospitals and research and teaching activity is close and effective linkage between neurosurgical departments and disciplines lying outwith the neuroscience constellation.

5.2 The important links between neurosurgeons, Accident and Emergency staff and general surgeons has already been emphasised in the referral of patients with head injury. Such links are critical to modern clinical care of the head injured patient, and must be underpinned by continuing dialogue and the development/re-appraisal of guidelines and care pathways. The important contribution of modern imaging and communication techniques are discussed later in this report.

5.3 Within neurosciences centres, neurosurgeons function in close clinical collaboration with those in related disciplines, notably neurologists, neuro-anaesthetists, neuro-radiologists, neuro-physiologists and neuro-pathologists. The Review Group heard much of the contribution that such synergies make to the specialist care of neurosurgical patients in all four Scottish centres. Whereas Edinburgh and Glasgow have the advantage of possessing a discrete multidisciplinary Neuroscience Centre, functional links between disciplines are well developed in Aberdeen and Dundee.

5.4 Multi-disciplinary teamwork (often extending beyond the neuroscience disciplines), is key to the management of many neurosurgical conditions such as cancer, syndromic cranio-facial anomalies and hydrocephalus. Again, effective teams have been established for the collaborative management of such small-volume complex conditions and the management of patients with such conditions has tended to become concentrated. For example, the management of the small number of patients with syndromic cranio-facial abnormalities has been concentrated in Glasgow. On other hand, the small number of patients requiring neurosurgery for mental disorders has been concentrated in one of the smaller centres, namely Dundee.

5.5 While objective evidence to support the concentration of all highly specialised services in a smaller number of Scottish centres or single centre is not currently available, the Review Group nevertheless sees it as sensible to advocate that not all of Scotland's neurosurgical units should attempt to offer the same comprehensive range of services. We take the view that the management of highly specialised, very small volume, complex neurosurgical conditions should normally be undertaken in one centre rather than 4 centres. These considerations apply particularly to paediatric practice where numbers of patients presenting with given conditions are often even smaller than in adult neurosurgical practice. When centralisation is needed in adult neurosurgical practice, it does not necessarily follow that the movement of patients must always be towards Edinburgh and/or Glasgow and we appreciate that in the past some specialised services (eg stereotactic neurosurgery, neurosurgery for mental disorder) have developed outwith the Central Belt. However, we take the view that the larger units with their larger regional populations will usually be better placed to sustain such highly specialised services. This means that the argument to centralise a specialist service or develop a novel service in Dundee or Aberdeen will usually have less force than the argument in favour of Glasgow or Edinburgh.

5.6 In the ideal world, decisions about the range of services to be undertaken in each Scottish neurosurgical unit would be made by professional consensus against a backdrop of robust evidence. Given that the evidence base is not sufficiently robust and the understandable desire of each centre to develop services, a mechanism must be defined to allow rational service development (see sections 10 & 11). We emphasise that the audit activity discussed earlier (paras 4.4-4.6) is the key to informing rational and objective decision and the National Services Division could play a key role in defining the way in which new services should develop.

5.7 Like many specialties, neurosurgery does not have a sharply defined boundary around its area of clinical activity. Areas already mentioned where there is a significant overlap with other disciplines include lumbar spinal surgery, a proportion of which is performed by orthopaedic surgeons, and interventional neuroradiology where there is a shifting border with interventional neurosurgery. In both cases the supply and demand of clinical time and clinical skills is the major determinant of the proportion of work that is carried out by neurosurgeons and by orthopaedic surgeons/interventional neuroradiologists. So, for

example, the proportion of lumbar spinal surgery varies between 7.5% of overall neurosurgical work in Glasgow and 25.6% in Dundee. In national terms it is estimated that some 50% of lumbar degenerative disease coming to surgery is dealt with by neurosurgeons; for cervical disease the figure is approximately 90%.

5.8 Management of hydrocephalus is another area where there has been uncertainty regarding boundary demarcation. For example, in Glasgow some children with hydrocephalus are treated by paediatric neurosurgeons by paediatricians, although this is atypical of Scotland and the UK as a whole, and may well change in the near future (following a review of working arrangements linked to a new consultant neurosurgical appointment).

5.9 The Review Group recognise that the boundaries between neurosurgery and other disciplines will continue to change as services evolve. It recommends that these boundaries are kept under review as part of the continuing audit of neurosurgical practice so that appropriate decisions can be taken regarding service disposition, resource, manpower and training needs.

6. PRE-HOSPITAL AND EARLY HOSPITAL MANAGEMENT OF HEAD INJURY

6.1 It has been estimated that around one million people attend hospital every year in the UK with a head injury; almost half are children under 16. The common causes of injury are falls (41%), assaults (20%) and road traffic accidents (13%), the last cause accounting for one-third of patients requiring transfer to neurosurgical care and for 58% of all deaths. Overall, some 20% of patients with head injury require hospital admission. Head injury accounts for 1% of all deaths (fatality rate 9 per 100,000), but for 15-20% of deaths in the age group 5-35 years¹.

6.2 A number of important documents have given recent consideration to the early management of head injured patients, their retrieval and transfer to an appropriate hospital setting. These documents include the report of the Working Party on the Management of Head Injuries (Royal College of Surgeons of England; June 1999); the report of the Scottish Paediatric Intensive Care Audit (SPICA) (1999), the work of the short-life working group considering the transport of critically ill or injured children; and the draft guideline produced by Scottish Intercollegiate Guideline Network (The Early Management of Patients with a Head Injury). While each of these documents contains useful guidance and recommendations they have to be viewed collectively. For example, pre-hospital care is not dealt with in the draft SIGN Guideline, while the Report from the Royal College of Surgeons of England deals with specific issues in England. The Review group remain anxious about the need for authoritative guidance on pre-hospital care and the continuing work of SIGN could fill this important gap.

6.3 The report of the Acute Services Review (paragraphs 247-255) also sets out a number of recommendations regarding the transport of critically ill patients, with particular reference to the role of the Scottish Ambulance Service. The Review Group also heard presentations by Mr Andrew Marsden (role of the Scottish Ambulance Service), Dr Adrian Ward (role of the general practitioner) and Dr Dermot McKeown (anaesthetic considerations).

¹ Teasdale GM. Head Injury. *J Neurol Neurosurg Psych* 1995; **58**: 526-539

Immediate Care of the Patient with a Head Injury

6.4 Prehospital care is almost exclusively the province of the ambulance service; its staff are skilled in establishing and maintaining the airway using basic techniques and adjuncts. Deeply comatose patients may tolerate endotracheal intubation without the need for drugs. Whereas more responsive patients with at-risk airways or significant head injury require anaesthesia and muscle relaxation if safe intubation is to be facilitated. The current view of anaesthetists is that Rapid Sequence Intubation (RSI) should be only be undertaken by doctors with training in anaesthesia or intensive care. In remote areas it is particularly important to ensure that general practitioners have had appropriate training and the Review group recommends Advanced Trauma Life Support (ATLS) training for all GPs working in community hospitals in such areas. It echoes the Acute Services Review in commending the work of the British Association of Immediate Care (BASICS) in providing training in immediate care, pre-hospital emergency care and major incident management.

6.5 Continued funding of BASICS training courses is recommended as is maintenance of the necessary GP skills, especially in regard to airway management. Health Boards and Primary Care Trusts have a key role to play in ensuring that time and funding is made available for training, while the Remote & Rural Areas Initiative could further develop the delivery of effective immediate care following injury and other emergencies. In remote areas, an appropriately trained general practitioner, supported by advice from the regional A&E department or neurosurgical unit (obtained by telephone or telemedicine) needs to be able to institute emergency care and decide on the need for retrieval (see below) or escorted transfer to hospital.

Transport of the Patient with Serious Injury

6.6 The standard of **interhospital** transfer has undoubtedly improved over recent years. Protocols are set out in *Recommendations for the Transfer of Patients with Acute Head Injuries to Neurosurgical Units*, published by Neuroanaesthesia Society of Great Britain and Ireland and the Association of Anaesthetists of Great Britain and Ireland (1996). Key principles are that;

- A patient with persistent hypotension should not be transferred until all possible causes of hypotension have been eliminated and the patient stabilised.

- Only in exceptional circumstances should a patient with a significantly altered level of consciousness be transferred without intubation.
- that a doctor with at least 2 years' experience in an appropriate specialty, usually anaesthesia, should accompany the patient.

Although these principles can be adopted readily in hospitals with major A&E departments, considerable difficulties may be encountered when contemplating the transfer of patients from smaller hospitals in more remote settings.

6.7 Escort facilities for head injured patients can be provided by the referring hospital (or trained general practitioner in the case of remote areas) or by a retrieval team sent out from the hospital that will ultimately receive and care for the patient. Both approaches have strengths and weaknesses. The *referring hospital approach* has the advantage of speed and the carers at the referring centre are already fully aware of the patient's condition and management to date. On the other hand, referring clinicians may lack specialist skills and their own hospital is deprived of their services for a significant period. The *retrieval team approach* employs a skilled retrieval team and means that the ambulance used has a round-trip rather than a one-way journey. On the debit side, retrieval teams may be expensive to establish and maintain; the team has not been involved in the initial resuscitation of the patient; and time is often of the essence in the face of a deteriorating head injury.

6.8 In practice, the decision to retrieve or transfer is often difficult and depends crucially on the urgency of the condition and availability of resources. Where time is of the essence, the referring hospital should almost always organise and conduct the transfer. Where retrieval is appropriate, excellent arrangements already exist in many areas. Examples include the Glasgow Shock Team, the Paediatric ICU Teams based in the Royal Hospitals for Sick Children in Edinburgh and Glasgow, and the team based on the Royal Alexandra Hospital, Paisley which can retrieve patients from rural Argyll and Clyde. Tayside and Edinburgh operate a pre-hospital trauma response team that assists ambulance personnel and BASICS trained doctors and provides safe escort to the regional trauma centre. Transfer of critically ill and injured children will be considered further below (para 6.15).

6.9 There is universal agreement about the need to use a standard referral letter when transferring patients with head injuries. The recent SIGN Guideline (The Early management

of Patients with a Head Injury) endorses the use of the proforma developed by the Scottish Trauma Audit Group. The Review Group also endorses the use of this proforma and stresses the importance of discussion between the referring clinician and the receiving neurosurgeon when transfer is contemplated.

In-hospital Assessment of the Patient with head Injury

6.10 Responsibility for the care of head injured patients who require hospital admission but not transfer to a neurosurgical unit has rested traditionally with general and orthopaedic surgeons. The Review group sees great merit in the recent report from the Royal College of Surgeons of England and its recommendation that patients with isolated head injuries who require observation (rather than discharge or immediate transfer to a neurosurgical unit) should be cared for under the auspices of the A&E department. This implies that there must be a dedicated observation ward within or adjacent to the A&E department, and the report recognises that an implementation programme (lasting perhaps some 5 years) will be needed. Currently, 11 of the 29 major A&E departments in Scotland possess beds or a short stay facility; in some centres such as Aberdeen and Dundee, the short stay wards are an integral part of the A&E department. Extension of this provision throughout Scotland will require resources to provide both facilities and staff.

6.11 If patients with isolated head injury are no longer to be admitted in the first instance to orthopaedic or general surgical wards, a problem may develop when patients subsequently transferred to a neurosurgical unit complete their neurosurgical management. To date, such patients have frequently required a period of care back in the orthopaedic or general surgical ward prior to hospital discharge. It will not be appropriate to transfer such patients back to an A&E short stay unit once they no longer require care in the neurosurgical unit. To ensure that the work of neurosurgical units is not compromised by their having to retain patients inappropriately, step down facilities in the referring hospital or enhanced neuro-rehabilitation facilities will need to be identified.

6.12 Conventional routes to specialist medical services involve patients first passing through a series of 'gates' or 'triage points'. Head injured patients may be seen by a variety of staff including a GP, paramedic, junior A&E doctor, senior A&E doctor, anaesthetist and general surgeon before referral for neurosurgical assessment and care. The early intervention

of specialists can markedly improve the quality of care and decision-making². The role of the neurosurgeon is often perceived as identifying those patients who need neurosurgical intervention. In reality, this is a very small group of patients and the perception underestimates the potential role of neurosurgeons in trauma management. A STAG audit in 1997 found that in Aberdeen Royal Infirmary there were no deaths when laparotomy was carried out as the first operation in trauma patients, a situation that did not pertain in other Scottish centres. The explanation lay in the fact that effective resuscitation room triage involving the duty neurosurgical consultant had ensured that patients who had sustained brain injury that was not compatible with survival were not subjected to inappropriate and futile laparotomy. Given that Scotland has 29 major A&E departments and only 4 neurosurgical units, it is not possible to extend this practice widely; nevertheless, the experience underlines the value of early involvement of specialists in the management of seriously injured patients.

6.13 Consultant or suitably trained and experienced junior anaesthetists must also be involved early in the management of patients with significant head injury. Rapid Sequence Intubation (RSI) may be performed in controlled circumstances prior to transfer to other parts of the hospital for radiological investigation and/or surgery. In patients with life-threatening injury, RSI may have to be undertaken by suitably trained and experienced A&E staff pending the arrival of anaesthetic or ICU staff. A register of intubations in A&E departments in Scotland is currently being compiled as part of the work of the Scottish Trauma Group.

Head Injuries in Children

6.14 As almost half of the 100,000 patients who present to hospital each year in Scotland with head injuries are under 16 years, this condition forms a significant problem for our children's services. The SIGN Guideline, *Early Management of Patients with a Head Injury*, emphasises that children requiring admission should be under the care of a paediatric neurosurgeon or a paediatrician with experience of head injured children, and that they should be observed in a children's ward. Children under 3 who have sustained a head injury are particularly difficult to evaluate and serious consideration should be given to their transfer to a specialist paediatric surgical or paediatric neurosurgical unit. Specialist anaesthesia is critically important in the event that such children require operation or neuroradiological intervention.

² Copes WS et al. *J Trauma* 1995; **38**: 432-438

6.15 A working group convened following the Acute Services Review is currently examining the transfer of critically ill or injured children in Scotland. In taking forward their work the group have considered the recommendations contained in the Scottish Paediatric Intensive Care Audit Report (1999), the National Confidential Enquiry into Perioperative Deaths (NCEPOD; 1999) and the Association of Anaesthetists Report (1996). We understand that the Working Group will recommend the establishment of 2 retrieval teams based in Glasgow and Edinburgh, and providing cover for the whole of Scotland. This will ensure the continued safe transfer of children requiring level 2 or 3 intensive care to specialist children's units based in Edinburgh and Glasgow. We also appreciate that development of such retrieval teams will do a great deal to address anxiety about the transfer of children with neurosurgical conditions.

7. TELECOMMUNICATION AND TELEMEDICINE

7.1 The Acute Services Review emphasised the emerging contribution of telemedicine to the equitable delivery of high-quality integrated clinical care. The contribution of telemedicine was acknowledged as particularly important given the geography of Scotland and the dispersal of our population. The Review described a technological "tidal wave" in communication and argued that, if the technology exists, its availability should be channelled and directed so that the most effective and efficient use is made of it.

7.2 As discussed earlier greater involvement of specialists at 'triage points' improves the quality of care and helps to ensure appropriate investigation, referral and treatment. The traditional model of telephone consultation remains a vital means of communication between referring clinicians and neurosurgeons. Up to 70 such calls may be handled daily by a busy neurosurgical department such as that located in Glasgow, and there is clearly a recognition of the value of an informed neurosurgical opinion. Early active participation by a neurosurgeon can best define the optimal care pathway for a given patient and ensure the efficient use of resources.

7.3 While the continued importance of telephone consultation must not be downplayed, telemedicine now enables the neurosurgeon, neuroradiologist and neuropathologist to have a "virtual presence" in distant settings such as the A&E department or imaging department of a general hospital. Image transfer has already proved its value in providing a range of Neuroscience services, including the management of patients with head injury. Effective links require digital storage and transmission of radiological images and agreed methods for communication to ensure optimal clinical decision-making. Formal developments in image transmission in the north-east (Peterhead-Aberdeen) and the west of Scotland have clearly demonstrated the potential for the creation of telemedicine links to support an integrated neurosurgical/neuroradiological network.

7.4 Although the technology is of course necessary if the benefits of telemedicine are to be secured, the real key to success lies in the successful development of a team approach. The

Acute Services Review recognised that clinical need rather than the availability of technologies should be the determinant of service development. There is a considerable risk that existing communication networks may break down if new arrangements involving telecommunication are perceived to be unhelpful or overly complex. All collaborators must be “signed up” and have a sense of ownership of any new arrangements. This can best be achieved through participation in the design phase of new communication links. Practitioners in general hospitals must be prepared to make regular contact and learn from the direct interaction with neurosurgeons and neuroradiologists in the centre. Similarly specialists must acknowledge the anxiety which non-neurosurgeons often encounter when handling head injuries and appreciate and adapt to the constraints experienced in even the best equipped and staffed accident and emergency departments. Agreed and documented protocols for the assessment and referral of head injury patients should be used and should cover the detailed arrangements for the transmission, handling and reporting of image material.

7.5 Participating clinicians must have confidence in the communication arrangements and the educational needs of participants are extremely important. In general, busy clinicians do not have the expertise to understand or co-ordinate the technical aspects of the communications links and appropriate technical support is essential. Both the technological and the clinical standards of such a system need to be maintained and developed over time, ensuring that systems can be upgraded when appropriate without any loss of compatibility.

7.6 Telemedicine represents an opportunity to develop novel methods of clinical supervision and training. The Review Group is aware of the interest of Scottish Postgraduate Deans in such applications of telecommunication and commends work in progress in this area.

7.7 The medico-legal implications of the application of telemedicine links are substantial and must be borne in mind. Issues include the process of selecting and securing distant opinions across Trust and Health Board boundaries, clinical accountability for opinions offered and accepted, the security of transmitted and stored electronic images and data, and retention of electronic records. Authoritative bodies are currently developing essential guidelines and legislation to provide a sound basis for telemedicine links. There will be a

need to review and revise operating guidelines in response to such developments and growing experience with the technology.

7.8 Evaluation of telemedicine-facilitated collaborative care is essential. Ongoing quality issues are likely to include the establishment of best practice, consistency and co-ordination of clinical care, outcomes of care, the quality of the communication and network interface including image capture and viewing facilities, and the acceptability of the arrangements to patients and clinicians.

7.9 On the basis of the above, each neurosciences centre should have clear plans developed in collaboration with colleagues in its network of referring general hospitals, to maintain or establish technology-based communications links. The starting point in such a planning process must be an awareness of the patient's journey through the care process and the clear need to optimise decision-making and management by clinicians in the hospital of presentation and the regional neurosciences centre. Centres can benefit greatly from the experience gleaned by existing projects and, in turn, should be prepared to share their own experience with other centres. The Telemedicine Initiative currently being chaired by Professor Ray Newton (Postgraduate Dean, Dundee) will provide a useful national perspective and advice on further developments.

8. REHABILITATION

8.1 The effectiveness of neuro-rehabilitation has a profound effect on outcome following many neurosurgical operations and has a crucial effect on the efficiency of services. The Neurology and Neurosurgery Sub-Group of the Acute Services Review devoted considerable attention to this subject. The need for neuro-rehabilitation is exemplified by the problems faced by individuals recovering from traumatic brain injury. Earlier estimates³ assumed an annual incidence of moderate/severe traumatic brain injury of some 200 cases per million of population and a prevalence of resulting disability of 1500 per million, suggesting that around 7500 individuals in Scotland will be suffering from disability at any given time. More recent estimates⁴ from Glasgow show that moderate or severe residual disability was actually as common after mild head injury (47%) as after moderate or severe injury (48%) and suggested that annually in Glasgow, some 1400 adults will still be disabled one year after head injury. There is good evidence that rehabilitation programmes are both clinically effective and cost effective. Investment in such programmes is amply repaid in the medium term in that dependence on state or insurance monies is minimised and injured individuals are more likely to return to wage earner and taxpayer status.

8.2 While the present review of neurosurgical services is not primarily concerned with neuro-rehabilitation, it recognises the growing importance of such services if outcomes are to be optimised and neurosurgical resources are to be used efficiently and effectively. There is a strong sense that further development of Scottish neuro-rehabilitation services is both necessary and desirable, and that a wide range of patients (including those suffering from chronic progressive/relapsing neurological disorder as neurosurgical patients) would benefit.

8.3 We endorse the view of the Neurology and Neurosurgery Sub-Group of the Acute Services Review that specialist input is the key to successful neuro-rehabilitation and that patients need access to a range of services. While certain forms of neuro-rehabilitation can only be carried out in a specialist centre, every effort must be made to provide as much of the rehabilitation programme as close to the patient's home as possible. This may mean planned

³ Wade DT, Hower RL. *Int Rehabil Med* 1987; **8**: 129-137

⁴ Teasdale GM. Personal communication. Data derived from report to Chief Scientist Office, Scottish Executive Health Department (K/OPR/2/2/D229). Publication pending.

rehabilitation in a general hospital, community hospital or therapy centre, or the use of domiciliary programmes. Whichever setting is chosen, services must be of appropriately high quality.

8.4 We see the retention of four neuroscience centres in Scotland as helping to sustain an appropriate balance between specialised inpatient services and outreach facilities. Retention of four regional neurosurgical centres will maintain crucial neurosurgical input to regional neuro-rehabilitation services and help to ensure that as many neurosurgical patients as possible have ready access to rehabilitation services when they need it. While the primary function of neuro-rehabilitation specialists is expert assessment and prescription of a package of rehabilitation, a further key role is to foster a managed regional network of outreach services. This involves supporting, advising and training professionals who work in primary care, secondary care and community settings outwith the neuroscience centre and often at a distance from it.

8.5 Scotland currently has no facility for paediatric neurorehabilitation, and children requiring specialised services have to travel to Manchester. While the need to travel such distances is highly undesirable for patients and family alike, the number of children requiring this service annually is very small, averaging some 4-6 children. England possesses three paediatric neuro-rehabilitation units for its population of over 50 million people and it is difficult to argue the case for establishing a comparable facility in Scotland. If a Scottish centre were to be established it would have difficulty in sustaining staff skills and inevitably, most of the children and their families would still have to travel significant distances. Assuming that Scotland does not develop a centre, continuing emphasis must be placed on ensuring that high quality services are available when step-down from a specialist rehabilitation service becomes appropriate. In this context, the Review commends the type of outreach paediatric neuro-rehabilitation service established in Glasgow. This nurse-based service helps to integrate inpatient and community care, with particular reference to education, and is an excellent model on which to base resourced development of neuro-rehabilitation services.

9. TRAINING ISSUES AND RESEARCH

Scotland's academic strengths

9.1 Scotland has a long tradition in the training of neurosurgeons and its international reputation in academic neurosurgery is reflected in the number of neurosurgical chairs within the UK (and further afield) that are occupied by those who have trained here. Our neurosurgical units and Neurosciences departments continue to make a substantial contribution to the academic strength of Scotland's four medical schools. For example, in the University of Edinburgh in the academic session 1998/99, the research income of the Department of Clinical Neurosciences was £5.27 million, attesting Scotland's standing in this area of clinical research. Further evidence is provided by leading edge work on the pathophysiology of brain injury and its management; the universal adoption of the Glasgow Coma Scale is a lasting testimony to the quality and impact of Scotland's neurosurgical research.

9.2 The perception of the Review Group is that the integrated presence of academic neurosurgery (including a Professor of Neurosurgery) in Glasgow and Edinburgh has been a major factor in the academic development of neuroscience in those medical schools. On the other hand, the neurosurgical departments in Dundee and Aberdeen have seen themselves principally as service departments, although contributing to some degree to the academic base of their medical school. In the present climate, major national grant-giving bodies such as the Medical Research Council, Wellcome Trust and our own Chief Scientist's Office are looking increasingly to collaboration between centres in the formulation and delivery of internationally competitive research programmes. The Review can see great potential for collaboration between Scotland's four neurosurgical centres in various spheres of research and development activity. Not only could this continue to underpin and strengthen Scotland's profile, it could also enhance the attractiveness and sustainability of neurosurgical (and related neuroscience) posts in all four medical schools.

Neurosurgical trainees

9.3 Educational approval is currently available for 10 specialist registrars in training in Scotland (disposition; Glasgow 6, Edinburgh 2, Aberdeen 1 and Dundee 1). While trainees

are based for the most part in Glasgow or Edinburgh, they rotate through the Aberdeen and Dundee units. While the smaller units have lower overall volumes of activity and cannot offer formal sub-specialty training in paediatric neurosurgery, they nevertheless offer valued training and an experience that is different to that on offer in the Central Belt. Smaller size and the presence of fewer trainees may mean that Dundee and Aberdeen can offer more dedicated teaching from a service that does not depend on the trainees for its delivery. This contention is supported in part by the analysis of STAG data discussed earlier (para 3.20). Furthermore, exposure to the type of mainstream neurosurgery on offer in smaller centres may help trainees to define whether they wish to pursue a consultant career in this type of environment as opposed to the more specialised environment of larger units.

Undergraduate and postgraduate training

9.4 All of Scotland's medical schools lay emphasis on the integrated teaching of neurosciences, and neurosurgery is a key component of neuroscience units. The importance of the contribution of all neuroscience disciplines is underlined by the increasing move to small group teaching and assisted learning as opposed to the more didactic undergraduate courses of the past. Each of Scotland's medical schools sits at the core of a Regional Postgraduate Training Programme and loss of neurosurgery from any medical school would have a devastating impact on the ability of that school to sustain comprehensive programmes in related areas such as neurology, trauma, radiology, anaesthesia and pathology.

10. RECOMMENDED DISPOSITION OF SERVICES

ADULT NEUROSURGERY

10.1 In framing its recommendations for the disposition of adult neurosurgical services in Scotland, the Review Group has attempted to make due allowance for a number of key factors. These include volume of activity, quality of outcomes, equity, ease of access, sustainability of services, and the importance of neurosurgery to undergraduate and postgraduate activity in Scotland's four medical schools.

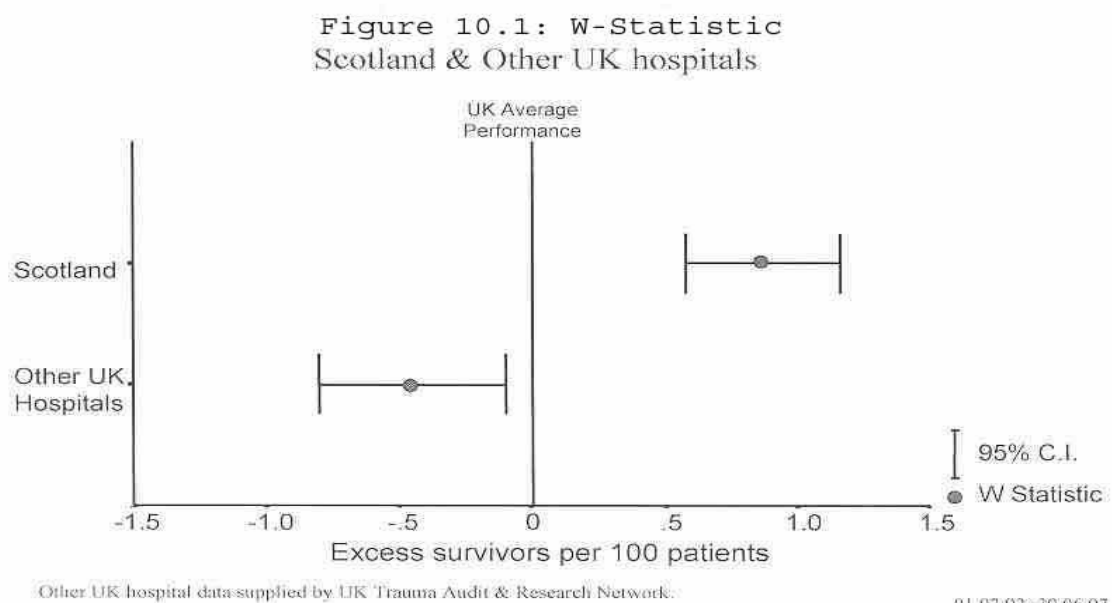
Volume of activity

10.2 As mentioned earlier, neurosurgery is characterised by a relatively low volume of activity but the operations and procedures undertaken are frequently highly demanding in terms of technical requirement, resource and time. While the overall pattern of procedures being undertaken by neurosurgeons is changing (eg the increased use of interventional neuroradiology to replace or complement surgery in the treatment of aneurysms and arteriovenous malformation), the Review Group saw little evidence of a diminution of overall levels of neurosurgical activity. In particular, there is no significant fall in the number of inpatients, day case surgical patients or number of procedures being undertaken. While concern must continue to surround the fact that Dundee and Aberdeen both have relatively small catchment areas (see *Safe Neurosurgery 2000* and its recommendations for a minimum catchment area of 1 million), both centres can demonstrate levels of activity that provide reassurance about their sustainability. It is stressed that these considerations are based on existing consultant complements; there would be real anxiety about the sustainability of surgical skills if in accordance with the recommendations of *Safe Neurosurgery*, 6 neurosurgical consultants were to be employed in Dundee or Aberdeen.

Quality of outcome

10.3 As discussed in Section 4, existing databases do not allow an objective and fully comprehensive judgement on the quality of clinical performance of Scotland's four neurosurgical units. However, within these limitations there is no obvious source for concern regarding the quality of neurosurgical services in any of the centres. For example, in 1998/99 the Scottish Trauma Audit (STAG) found little difference between units in terms of survival rates following relatively minor head injury, while observed survival differences following

severe injury can be explained by the different pattern of injuries presenting to the various centres. It is reassuring to note that there were no survival differences between the centres when head injured patients were classified using the Glasgow Coma Scale. In general, seriously injured patients in Scotland in the period 1992-97 fared significantly better than those injured in other parts of the United Kingdom (Fig 10.1)⁵. These data must be reviewed against a background of continuing improvement and it should be emphasised that the most recent report from the UK Trauma Audit Research Network for 1989-97 shows significant recent decline in the probability of death after admission with injury in England and Wales.⁶



10.4 With respect to elective neurosurgery, the existing national database does not allow value judgements on the quality of outcomes, either in terms of morbidity or mortality. However, in the course of its visits to neurosurgical units, the Review Group heard presentations in which the results of individual units for various neurosurgical conditions were compared favourably with international best practice. Examples of the conditions and procedures discussed included acoustic neuroma (Dundee & Aberdeen), shunt procedures (Dundee), subarachnoid haemorrhage (Edinburgh), neuroendocrine surgery (Aberdeen & Edinburgh), and spinal surgery, arteriovenous malformations, brain tumours (Glasgow).

⁵ Beard D, Henry JM, Grant PT. *Health Bulletin* 2000; **58**: 118-126

⁶ Lecky F et al. *Lancet* 2000; **355**: 1771-1775

10.5 The Review Group concludes that there is no evidence to suggest that any of the four neurosurgical units are achieving suboptimal results. Indeed, there is evidence that there are many areas of excellence in the quality of Scotland's neurosurgical services. This statement must not be allowed to detract from the need to ensure robust data collection that will allow objective and continuing comparison of each of Scotland's units with each other and with international comparators. This is not to say that every neurosurgical procedure will be audited continually and in detail; rather a planned programme is needed in which specific procedures are audited at any given time as markers of the overall quality of neurosurgery. As suggested earlier (para 4.4) marker procedures could include the management of head injury, cerebrospinal fluid diversion, spinal degenerative disease, subarachnoid haemorrhage and arterio-venous malformation. Opinions vary as to the utility of auditing outcome following the treatment of acoustic neuroma given the time needed to accrete a large enough database to allow meaningful analysis. Peer review already takes place at unit level; this process now needs to be extended to open up the work of each unit to review by peers working in other Scottish centres. Such peer review will need to be conducted in a constructive open manner that takes fuller advantage of the collective strength and potential of all Scotland's neurosurgeons.

Equity and ease of access

10.6 Ease of access to a neurosurgical unit has profound importance. For example, prompt transfer of the head injured patient may be lifesaving while every effort must be made to avoid unnecessary travel or prolonged travel times on the part of patients (and their relatives) when elective treatment or rehabilitation is required. *Safe Neurosurgery 2000* recommends that neurosurgical units should be so located that surface journey times are less than two hours, an objective that is manifestly unattainable for all of the inhabitants of Scotland. For patients living outwith these journey times, air travel may be the solution when urgent transfer is indicated but there are continuing implications for the training of those healthcare professionals (and in particular, surgeons) working in remote and rural areas. Initiatives such as the BASICS training scheme, retrieval teams and the electronic transfer of images (telemedicine and teleradiology) are discussed elsewhere in this Report (section 7), and the newly established Remote and Rural Areas Initiative may define further ways to improve the neurosurgical care of those living in remote areas.

10.7 While neither of Scotland's two smaller neurosurgical units serves a population of more than one million (the minimum population size recommended in *Safe Neurosurgery 2000*), both provide ready access for a significant number of people. In the case of Aberdeen there is the added consideration that services are provided to major parts of the Highlands and Islands. While ease of access in itself might not provide overwhelming justification to retain neurosurgical services in Aberdeen and/or Dundee, when taken in conjunction with the other variables discussed in this section, access issues add strongly to the argument for retaining 4 adult neurosurgical units.

Sustainability of services

10.8 All four of Scotland's neurosurgical units provide a full 24-hour consultant-led, and in the case of Dundee and Aberdeen, the units provide what is essentially a consultant-delivered service. Each of the neurosurgical units forms part of a multidisciplinary Neurosciences constellation although in some instances, careful planning is needed to ensure on-site integration with key related specialties (para 3.4). Each provides a core neurosurgical service with variable development of subspecialty areas. As indicated earlier, the recommendations of *Safe Neurosurgery 2000* are not achieved with respect to minimum population size (1 million) or minimum number of WTE consultant neurosurgeons (6) in Dundee, Aberdeen and Edinburgh. Furthermore, Glasgow would require a further 2 WTE consultants to comply with the recommendations, bringing its consultant complement to 8 WTE.

10.9 Against these apparent shortfalls must be set the realisation that all four units have a staffing ratio which exceeds or approximates to the 4 consultants per 1.5 million recommended by the Society of British Neurological Surgeons. This is not to argue that it is a simple matter to sustain a demanding round-the-clock service with a major emergency component on a consultant complement of less than 6. In the case of Dundee and Aberdeen, the rota is currently staffed by three consultants with all of the attendant hardship. Significantly, colleagues in Dundee and Aberdeen recognise that there is a delicate balance to be maintained between workload, sustaining clinical and technical skills, and the demands of the on-call rota. The Review Group gained the strong impression that inability to move to a 6-strong consultant neurosurgical workforce is seen as an acceptable price to pay for the perpetuation of neurosurgical services in Dundee and Aberdeen. The hardship of sustaining

an emergency rota with a small number of consultant staff appears to be compensated by job satisfaction and the maintenance of a personal skill base.

10.10 During the course of this review, the Review Group considered the possibility of closer functional linkage between various neurosurgical centres. We can see a good case for strengthened links between Aberdeen and Dundee and between these centres and Edinburgh, as a means of helping to sustain centres with smaller catchment populations and smaller critical mass. We are struck by the fact that the total population served by these 3 centres would be roughly equal to that served by the Glasgow unit.

Implications for medical schools

10.11 Removal of the neurosurgical unit from any of Scotland's clinical medical schools would have a detrimental effect on undergraduate and postgraduate activity, on teaching and research, and on the strength and sustainability of other key services such as neurology. Teaching, training and research in neurosciences are integrated in all four medical schools with neurosurgery forming a key component. For example, in Dundee neurosurgery is a major contributor to phase II undergraduate teaching on the nervous system, to phase III clinical teaching and to the development of specialist study modules. In respect of clinical services, neurosurgery in all centres is fully integrated with related neuroscience disciplines and with other specialist services such as pain clinics. The role of neurosurgery and integrated Neuroscience departments in research has been alluded to earlier (paragraph 9.1).

Conclusions

10.12 The Review concludes that any of our medical schools would be weakened and undermined by removal of neurosurgical services. Scotland should retain a neuro-surgical unit in Aberdeen, Dundee, Edinburgh and Glasgow. All four centres appear to have sustainable departments with a workload that can justify retention of critical mass while retaining the core skills of the neurosurgeons involved. This is not to say that all four centres are easily sustainable and there will be a continuing concern about the two smaller units, particularly if they were to exist in isolation. Closer functional links between Aberdeen, Dundee and Edinburgh should be encouraged as a means of supporting the two smaller northern units. There is no need for Scotland to maintain equally large, equally specialised neurosurgical departments, all offering a comprehensive range of neurosurgical services to both adults and children (see below). However, all four must retain core neurosurgical

services if their continuation is to be justified. It is also important to stress that the performance of all four units should be audited so that the quality of services can be assured and any residual anxieties about volume:quality relationships can be laid to rest.

PAEDIATRIC NEUROSURGERY

10.13 At present, only Glasgow and Edinburgh possess a specialist paediatric neurosurgeon, and it is anticipated that both centres will shortly provide a paediatric service based on the equivalent of 1 WTE paediatric neurosurgeon supported by 2 colleagues who are recognised as having continuing involvement in the neurosurgical care of children. This does not mean that no paediatric neurosurgery has been carried out in Dundee or Aberdeen. For example, the data compiled for the Acute Services Review, show that the number of paediatric neurosurgical operations performed in the 4 centres in 1996 was Aberdeen 31, Dundee 40, Edinburgh 113 and Glasgow 187. Around one-in-three children admitted to neurosurgical units will undergo surgery and of the operations undertaken, approximately one in four are classified as emergency rather than elective. All of these reflections of annual workload show upward drift. For example; in 1999 there were 300 paediatric neurosurgical admissions in Edinburgh with 105 surgical procedures; comparable figures for Glasgow were 474 and 214.

10.14 There appears to be general agreement that the treatment of children with clamant life-threatening conditions (notably those with head injury or blocked shunts) remains within the competence of neurosurgical units that do not possess a specialist paediatric neurosurgeon. In such situations, emergency treatment in the Dundee or Aberdeen unit may well be safer than transfer to a Central Belt unit. The Review Group recognises that this is a very controversial area and that anxieties must surround the question of skill sustainability when neurosurgeons operate only occasionally on children. However, the volume of emergency paediatric neurosurgical activity is already very small in Aberdeen and Dundee. Furthermore, it is anticipated that the work of the Group examining the transfer of critically ill and injured children will recommend a robust retrieval service so that these children can be transferred expeditiously to units offering level 3 paediatric intensive care in Glasgow and Edinburgh. Appropriate consultation between senior staff at the receiving and referring hospital is vital when transfer is being contemplated.

10.15 We appreciate that controversy also surrounds the very definition of childhood in neurosurgical practice and that judgement and flexibility needs to be exercised. For example,

one working definition suggests that children older than 13 should be admitted to an adult unit but much hinges on the physical and intellectual development of the individual when deciding between admission to an adult or children's unit. All agree that infants and young children should be dealt with by paediatric specialists working in a hospital setting appropriate for children's care. The availability of appropriate specialist neuro-anaesthetic skills is of paramount importance, particularly in respect of children beneath the age of 3.

10.16 As in adult neurosurgery, existing databases do not allow firm pronouncements on whether there is a relationship between volume and quality in all aspects of paediatric neurosurgery, but we are mindful of and endorse the recent report of the Paediatric Forum of the Royal College of Surgeons of England (*Children's Surgery - A First Class Service*). We agree strongly that 'occasional practice is unacceptable except in the treatment of life-threatening emergencies or minor problems' and that 'the surgery of childhood should be concentrated in the hands of appropriately trained designated surgeons with a paediatric surgical sub-specialty commitment and a workload of sufficient volume to maintain competence'. We also agree strongly with the recommendation that 'surgeons treating children should engage in meaningful audit and participate in relevant continuing professional development' and that these requirements are likely to form the basis of revalidation.

10.17 The Paediatric Forum report also emphasises that children should receive care in an environment appropriate to their specific needs. We were reassured about the quality of the environment available for children requiring neurosurgical management or input in all 4 Scottish centres and by the level of commitment of paediatricians working in related disciplines to integrated care.

10.18 According to the recommendations of *Safe Paediatric Neurosurgery* only the units in Edinburgh and Glasgow provide care by recognised paediatric neurosurgeons, although neither unit has the recommended minimum of 2 WTE specialist consultants. We recognise that for the foreseeable future these paediatric neurosurgeons will be need to be supported by colleagues who work principally in adult neurosurgery and appreciate that the difficulties of sustaining emergency rotas would be resolved if Scotland had only one paediatric neurosurgical unit for its one million children. However, both Edinburgh and Glasgow do provide the critical mass of consultants experienced in paediatric neurosurgery and paediatric

anaesthesia with which to satisfy the demands of emergency rotas and undertake planned neurosurgical work.

10.19 Assuming that the ability to undertake emergency life-threatening neurosurgery is retained by all 4 centres, the options available for **elective** paediatric neurosurgical services in Scotland can be summarised as:

- No change to existing services
- A move to centralise services in one centre (Edinburgh or Glasgow)
- A move to concentrate services in both Edinburgh and Glasgow
- A move to a 3 centre model in which Aberdeen and Dundee function as a managed clinical network
- A distribution of services so that each centre becomes responsible for the management of a specific condition or range of conditions.

All of these options have various *pros* and *cons* and as in adult surgery there is a need to balance issues of workload, quality, equity, access and sustainability. However, the prevailing view of the Review group is that there can be little justification for the *status quo* given the increasing emphasis placed on provision of services by trained specialists and the need to maintain appropriate workloads and expertise. As discussed earlier, current moves to underpin the safe transfer of critically ill and injured children to Edinburgh and Glasgow will enable the neurosurgical management of children to be concentrated in the hands of trained specialists who have workloads that will sustain specialist skills. It also has great difficulty with any proposal to reallocate and distribute specialist services (the last option) given the lack of trained specialist paediatric neurosurgeons in some centres, the need to avoid reliance on services delivered by a single consultant, and the fact that Edinburgh and Glasgow are sited in the more populated Central Belt.

10.20 Much of the Group's debate centred on whether elective neurosurgical services for children should be concentrated in 1 or 2 centres in the Central Belt. From the outset it was recognised that neither paediatric neurosurgical unit is ideally located. The Glasgow unit does not share the same site as the city's children's hospital; the Edinburgh unit does look after children in the city's children's hospital but this is at some remove from the adult unit in the

Western General Hospital. The Group sees good arguments in favour of centralising Scotland's paediatric neurosurgical services on one site as a means of creating a centre of excellence that would comply with all of the recommendations of *Safe Paediatric Neurosurgery*. If a one site option was to be developed some members favoured Edinburgh, given that its neurosurgical services for children are already provided within a children's hospital. However, the Group recognised that plans are well developed in Glasgow to co-locate the Royal Hospital for Sick Children and the Neurosciences Institute (on the Southern General site) and could envisage considerable disruption if the larger existing paediatric neurosurgical unit in Glasgow were to close. On the other hand, closure of the Edinburgh unit would have an adverse influence on the Children's Hospital and its intensive care services (already affected by the loss of paediatric cardiac surgery) and militate against the commitment to retain that hospital as one of Scotland's two tertiary centres providing both level 2 and 3 intensive care facilities.

10.21 We recognise that some will attempt to draw parallels between our views on the disposition of children's neurosurgical services and the recent decision to centralise paediatric cardiac surgery on one site. To date, paediatric cardiac surgery in Scotland has only been performed in Edinburgh and Glasgow, but in both centres the surgeons concerned had a smaller commitment to adult services and there was little or no integration of paediatric and adult services. In the case of Edinburgh, the service depended totally on the commitment and expertise of one individual. While we consider that the best solution for paediatric neurosurgery is to retain elective services in both Edinburgh and Glasgow for the moment, we see that the future development and redistribution of hospital services in both cities will provide an opportunity to reconsider the case for a single site option.

10.22 While the Review Group sees attractions in closer functional linkages between Aberdeen and Dundee, not all of its members were convinced that the potential benefits would be attainable or sufficiently strong to justify the development of a 3-centre model. However, we recognise that whichever model is developed, much will depend on the involvement of paediatric neurologists (who are responsible for many of the referrals for elective paediatric neurosurgery) and the working arrangements between their departments and the paediatric neurosurgical units in Edinburgh and Glasgow.

10.23 If the two-centre model is adopted, Scotland lends itself to division into two parts with approximately equal populations; the West of Scotland continuing to link to Glasgow with the Eastern half of the country having stronger functional links with Edinburgh. In the event that a small-volume highly-specialised service (such as that required for the management of complex cranio-facial abnormalities) is available in Glasgow then it should continue to be used for all Scottish patients. Both services in an East-West split could be developed as a managed clinical network but we appreciate that this would require considerable developmental work on the part of those who would be involved in an Eastern network. An alternative arrangement would be to designate elective paediatric neurosurgery as a national service to be administered by the National Services Division (see section 11 for further discussion).

Conclusion

10.24 The Review Group can see persuasive arguments for the concentration of paediatric neurosurgical services on one site in Scotland. On balance we recommend retention and development of specialist elective services in both Edinburgh and Glasgow for the moment but emphasise the desirability of delivering these services from a site on which they are integrated with other specialist and general paediatric services. We encourage the development and sustenance of the strongest possible functional links between Aberdeen, Dundee and Edinburgh so that each of the two tertiary referral centres would deal with roughly half of Scotland's population. In circumstances where the transfer of children from Dundee and Aberdeen would jeopardise life, we accept that it may be safer to undertake emergency neurosurgery in these centres, even in the absence of a trained sub-specialty paediatric neurosurgeon.

11. COMMISSIONING, ORGANISATION OF SERVICES, SUSTAINABILITY

11.1 By comparison with other surgical specialities, neurosurgery is a small specialty which incorporates an increasingly well established spectrum of sub-specialised elements, most of which are highly dependent on multi-disciplinary working and access to high technology equipment. Services in Scotland are organised on a regional basis although the low volume, highly complex nature of several areas of subspecialist work has already resulted in some centralisation. Examples already cited include services for patients requiring craniofacial surgery and interventional radiology for cerebral aneurysm. While in some cases, the result is a consistent and rational arrangement across Scotland (eg the centralisation of complex craniofacial surgery in Glasgow), in others it is difficult to discern a logical argument for the current arrangements. Neither Aberdeen nor Dundee currently carry out interventional radiology for patients with cerebral aneurysm. However, cases from Dundee are referred for coiling to Newcastle while Aberdeen transfers cases to Edinburgh. There is a need for a more integrated rational approach to the distribution of services.

11.2 In seeking to formalise a rational structure for neurosurgical services the starting point is clearly the regional centre. Core functions of each of our 4 regional neurosurgical centres would include mainstream adult emergency and elective neurosurgery where specialist centralisation is not deemed necessary, together with emergency paediatric neurosurgery when life is threatened. However, there is no formal commissioning structure and Health Board consortium arrangements vary across the country. The style of commissioning, and the extent to which Boards commit to a regional approach, is a matter for local decision and individual neurosurgical units experience substantial difficulties when there is no coherent approach to service funding. Failure of effective regional commissioning is a particular problem when it comes to procuring expensive equipment, especially when the responsibility is left exclusively with the Trust hosting the neurosurgical unit and its parent Health Board. There is a pressing need for a funding structure that more effectively addresses the needs of a regionally-based service than the present arrangements.

11.3 It would not be appropriate for neurosurgery in its entirety to be designated as a national service because of its size, character, distribution and ill-defined boundaries. However, for those core elements of neurosurgery which are provided by the 4 neuroscience centres, each to a clearly defined regional catchment population, a centrally determined

funding flow (revenue and capital) could be negotiated in the context of a national strategic approach. Funding could be set against an agreed service specification and the approach would eliminate much of the uncertainty and frustration that characterises the present arrangements. It would be necessary to identify an appropriate commissioning body. One option would be to extend the remit of the National Services Division (NSD) to include the commissioning of core regional neurosurgical services. This would provide a national overview, ensure appropriate development of audit and quality assurance, and optimise the scarce use of resources, including capital and professional staff. Alternatively, Health Boards could retain autonomy but would be charged with developing an explicit structured and coherent approach to service commissioning and capital funding. In either case, funds would be managed by the Trust in which the unit is located but would be dedicated to the purposes for which they were allocated. We suggest that the Health Board option is pursued vigorously in the first instance with national commissioning of core services by NSD being seen as a reserve option.

11.4 Those neurosurgical services which are delivered by one centre (or, in the case of elective paediatric neurosurgery, two centres) and which meet the needs of Scotland as a whole are seen by the Review Group as strong candidates for designation as national services. Examples of services that could be so designated include elective paediatric neurosurgery, craniofacial surgery, functional neurosurgery, management of craniopharyngioma and stereotactic radiosurgery. This list is not exhaustive and would require detailed discussion. Where national service status is agreed, commissioning would be carried out by NSD as part of the Common Services Agency. When a service was to be commissioned (initially or indefinitely) from 2 sites, NSD would expect to negotiate individual agreements with the host Trust and recognise a Director of Service in each location. This would all be done in the context of an explicit common and integrated approach to the delivery of a national service.

11.5 In addition to national designation of some specialist parts of neurosurgery, we see much to commend the development of managed clinical networks as outlined in the Acute Services Review. As indicated earlier in this report, each regional neurosurgical unit is encouraged to formalise its network with referring hospitals, focusing principally on the early clinical management and transport of patients with intracranial emergencies. We also see much room for improved Scotland-wide collaboration between neurosurgeons and the use of

networks in the effective management of complex neurosurgical conditions. Even if paediatric neurosurgery is designated as a national service and administered by NSD, we can see great attraction in using this as an interim measure with ultimate movement to have the service delivered as a managed clinical network. As indicated earlier, further discussion will be needed to determine whether Scotland would be best served by having one or two managed clinical networks in this context.

Conclusion

11.6 Neurosurgical services in their entirety should not be commissioned as a national service as part of the remit of the National Services Division (NSD). However, the current arrangement whereby services are commissioned by Health Board consortia are less than satisfactory. Health Boards should be charged with developing a more explicit, structured and coherent approach to the core service provided by all 4 neurosurgical centres. The alternative option of employing NSD as the commissioner of core regional services has attractions but should be seen at this stage as a reserve option if Health Board consortia experience continuing difficulty in discharging this responsibility. Small-volume highly specialised services such as complex cranio-facial surgery would be best commissioned as national services administered by NSD. Paediatric neurosurgical services should in the first instance be commissioned by NSD with a view to establishing this service as a managed clinical network.

12. SUMMARY OF RECOMMENDATIONS

12.1 Scotland's neurosurgical units should continue to develop within integrated multidisciplinary Neuroscience departments.

12.2 Ready access to neurosurgical units is desirable but the need for local access must never be provided at the expense of quality. Scotland's geography and population dispersal means that absolute equity of access is impossible to achieve and a significant proportion of the Scottish population will continue to live in locations that are more than 2 hours away by *surface* travel.

12.3 More robust databases are needed to assure the quality of Scottish neurosurgical services. Early collaboration between all of Scotland's neurosurgical departments and ISD is needed to develop and maintain an agreed audit programme. Within the limits of existing databases there is no evidence to suggest that the service provided in any of Scotland's 4 neurosurgical units is sub-optimal and that closure is merited. Indeed there is evidence in some areas, notably the management of trauma, that Scotland performs well in comparison to the rest of the United Kingdom.

12.4 Maintaining 4 neurosurgical units will underpin the continued development of major trauma centres in Scotland's four University Medical Schools and sustain the integrated Neuroscience Departments needed for the optimal teaching (at both undergraduate and postgraduate level) of health professionals.

12.5 Maintaining 4 neurosurgical units does not mean that each should deliver a comprehensive range of neurosurgical services. The Glasgow and Edinburgh serve sufficiently large populations to sustain critical mass readily. The Aberdeen and Dundee units have smaller catchment populations and will struggle to sustain critical mass if they are to operate in functional isolation. Enhanced links between the Aberdeen, Dundee and Edinburgh units would create a functional entity that would serve approximately half of the population of Scotland and equate to the Glasgow unit in size.

12.6 Elective paediatric neurosurgery should only be undertaken in units with sub-specialty trained paediatric neurosurgeons able to maintain their skills and deliver a full 24-hour

service with appropriate supporting staff and facilities. Glasgow and Edinburgh largely fulfil these requirements but Dundee and Aberdeen do not have a sufficiently large population base to justify development of an elective paediatric neurosurgical service. We anticipate that strengthened retrieval services for critically ill and injured children will ensure the safe transfer of children to specialist care in Edinburgh and Glasgow. The exception to the rule that neurosurgical operations in children should only be undertaken by trained paediatric neurosurgeons is a life-threatening emergency situation, a situation that is most likely to arise following trauma or shunt blockage.

12.7 While we recommend the continuation of elective paediatric neurosurgery in Glasgow and Edinburgh, we can see the desirability of having one centre of excellence for a population as large as that of Scotland. Continuing delivery of paediatric neurosurgical services on two sites does not mean that either unit should attempt to deliver a full range of services. For example, complex syndromic cranio-facial abnormalities should continue to be managed in one unit. We appreciate that neither the Glasgow nor the Edinburgh unit is ideally placed in that neither is located in a children's hospital on the same campus as the adult neurosciences complex. Reconfiguration and rebuilding of hospitals in both cities will provide an opportunity to ensure full service integration and reconsider the case to concentrate paediatric neurosurgery in one centre of excellence.

12.8 Further development of networking is essential to strengthen the equitable development of high quality sustainable neuroscience services throughout Scotland. This does not just apply to neurosurgical services; it applies to services such as interventional neuroradiology, neuropathology and neurophysiology. Scotland must take full advantage of its available resources, recognising that functional linkages, collaboration, staff mobility and optimal communication (including telecommunication) will be the key to sustaining robust services on 4 sites.

12.9 While all 4 neurosurgical units will continue to deliver core services, they will not all be able to deliver a full range of specialist and sub-specialist services. The functional linkages described above could also underpin the continued development of interventional neuroradiology on fewer than 4 sites. Similarly in adult neurosurgery, there may be preferential development of services such as functional neurosurgery, surgery for mental

disorder and surgery for epilepsy on fewer than 4 sites. It does not necessarily follow that all specialist adult services have to be developed in the larger units of the Central Belt.

12.10 The continued evolution of neurosurgical services will entail careful development of important interfaces between neurosurgery and allied specialties/services. The BASICS approach can continue to improve pre-hospital care and we endorse the recommendations of the RCS England report on the management of head injured patients. Time and resources will be needed to develop observation facilities in A&E departments for those patients who do not require immediate transfer to a neurosurgical unit. In addition to work to ensure appropriate patients flow *into* neurosurgical departments, work will be needed to ensure appropriate patient flows *out* of such departments once their need for specialist inpatient care has passed.

12.11 Neuro-rehabilitation services in Scotland need to be developed further and strengthened. Wherever possible, such services should be provided as close to the patient's home as possible and they should be seen as an integral multidisciplinary part of the core function of neurosurgical/neuroscience departments. Particular concerns surround the rehabilitation of children after neurosurgery. While a Scottish paediatric neuro-rehabilitation centre could not be sustained (given the small number of children concerned), much can still be done to develop high quality outreach services which integrate care in community settings and ensure optimal physical and intellectual recovery and development.

12.12 Scotland should take full advantage of its 4 neurosurgical units and their parent neuroscience departments in the training of neurosurgeons. The suggestion that Edinburgh strengthens its links with Dundee and Aberdeen in no way precludes a Scottish training programme where trainees based in both Central Belt units continue to rotate through the more northern centres. While there are smaller overall levels of neurosurgical activity in Dundee and Aberdeen, they provide valuable training opportunities and offer an experience that is different to that on offer in the larger units of the Central Belt.

12.13 Scotland has a strong track record in research and development and should continue to build on its national and international reputation. Increasing emphasis on large multicentre studies by major national grant giving bodies such as the Medical Research Council means that greater coherence and collaboration between the four Scottish neurosurgical units would be beneficial. Such coherence would allow the development and

implementation of agreed guidelines and protocols, underpin national audit, and facilitate the peer review of service attainment and quality. It would also access of Scottish neurosurgery to funding streams such as that operated by the Clinical Resource and Audit Group.

12.14 Arrangements for the commissioning of neurosurgical services need to be improved. We recommend that core regional neurosurgical services continue to be commissioned by Health Board consortia using a more explicit, structured and coherent approach. NSD is available to take over this function if arrangements remain suboptimal. There is a strong argument for designating some highly specialised services and elective paediatric surgical services as national services to be administered by NSD, recognising that in time, these services could be administered as managed clinical networks.

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