British Journal of Neurosurgery, 2011; Early Online, 1–8

informa
healthcare

ORIGINAL ARTICLE

Re-evaluating the National Subarachnoid Haemorrhage study (2006) from a Patient-Related-Outcome-Measure perspective: comparing fiscal outcomes of Treatment-as-Usual with an enhanced service

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Abstract

Background. Subarachnoid haemorrhage (SAH) is neurological catastrophe, creating major disruption for patient and family, hence the importance of considering Patient-Related-Outcome-Measures (PROM). This study uses the National Study of SAH (2006) to explore any fiscal benefits to patients and NHS if they had an enhanced Neuro-Vascular-Specialist-Nurse (NVSN) service compared to Treatment-as-Usual (TAU).

Method. Ensuring total confidentiality, clinical data from the National Study ($n = 2397$) were matched with regional clinical data of a TAU ($n = 137$) and prospective NVSN service ($n = 184$) patients. The TAU and NVSN fiscal outcomes were projected onto the National Study patients to provide estimates of the potential benefits that could accrue nationally from a NVSN service based upon length of stay and earlier return to work of patients and carers.

Results. There were substantial benefits for NVSN cohort related to shorter time in hospital, reduced family disruption, earlier return to work and fiscal benefits to family and the NHS. NVSN patients and carers potential savings were estimated at £8.097 million and £2.492 million to the service, £10.497 million overall.

Practice implications. This PROM approach allows the 'patient's voice' to be heard, which facilitates speedier patient and family recovery, showing that an integrated treatment approach in 'high tech' neuro-surgery is cost-effective.

Key words: *Subarachnoid haemorrhage, neurorehabilitation, carers, specialist nurse.*

Background

There is a growing interest in patient's perception of outcomes,[1,2] which has begun to involve the views of neurosurgical patients.[3–7] These studies examined some quality of life measures in regards to the sequel of subarachnoid haemorrhage (SAH), but with some notable exceptions, few actively involved the patient's carers in the analysis.[7–14] The relatively narrow hospital/service focus on outcomes is no longer sufficient as in the proposed re-validation of consultants Patient-Related-Outcome-Measures (PROM) will be included in the assessment.[2] This is relevant for neurosurgery, exemplified by what happens to people following a SAH, as many patients experience severe cognitive disturbance, which has been recognised as a post-traumatic-stress-disorder (PTSD) reaction, with considerable levels of dysfunction lasting months and even years.[6,14–18] This occurs because of low basal corticosteriod secretion, enhanced negative feedback control of the hypothalamic-pituitary-adrenal (HPA) axis, increased autonomic responsiveness, as well as central nervous system (CNS) noradrenergic activity.[19] However, in a range of differing traumas, including SAH, with a cognitive dysfunctional sequel, it has been found that this can be reduced and better managed, irrespective of the method of aneurysm repair, by creating a positive feedback and speeding up the patients re-integration and return to normal life.[12,12,20–22] The extent of how much PTSD can be reduced following SAH is still an issue.[14,21] Although SAH patients may make a good physical recovery, they might be off work for 6, 9, 12 or more months after discharge, often with a considerable degree of distress to patients and family.[5,10,14,18] These outcomes cannot be ignored; the issues remain high on patients and carers agendas,[11,13] they give the patient a 'voice' and provide the epitome of PROM.

An early neurosurgical PROM orientated study analysed the cost to the service, patients and families in a 2-year regional cohort of SAH patients. Whilst the majority of patients and carers were generally

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Received for publication 15 June 2010. Accepted 16 February 2011.

ISSN 0268-8697 print/ISSN 1360-046X online © 2011 The Neurosurgical Foundation
DOI: 10.3109/02688697.2011.566379

very satisfied with the hospital service their biggest problems were after discharge, as their post-discharge reactions undermined their rehabilitation; badly affected their families, spouses and children, with considerable financial costs.[11] This initial PROM orientated study sought patient and carer recommendations to improve the problems and they recommended a form of Neuro-Vascular-Specialist-Nurse (NVSN) service to assist them deal with the impact of the cognitive disruption. The NVSN approach was tested in a 2-year prospective controlled study, using the Treatment-as-Usual (TAU) cohort as a control, to find that patients and carers in the NVSN cohort had significantly better outcomes compared to TAU patients with measurable benefits and financial savings to families and the NHS.[13,23]

These results led to a re-evaluation of the 2397 SAH patients included in the National SAH Study[24] to explore the potential benefits of a NVSN service if the psychosocial and fiscal outcomes occurred at national level. The psychosocial results are described elsewhere[12,13,23] but here the focus is upon the fiscal savings that would accrue if an enhanced NVSN service had been available in the 34 neurosurgical units.

A PROM outlook might be considered an unusual research approach but the need for a mixed-method research has been recognised to utilise quantitative and qualitative data to provide a more complete understanding of a service delivery.[25] Views of the community services are given elsewhere, sufficient to state that NVSN respondents were helped to utilise the services better,[23] which whilst varying greatly[26] most do not appear to adequately meet the needs of neurosurgical patients,[11,12] hence the need for a NVSN service.

The null hypothesis is that there will be no significant fiscal savings to families and service above the additional cost of a NVSN service in the 34 neurosurgical units.

Methodology

The regional TAU and prospective NVSN patient and carers psycho-socio-economic data were projected onto matched clinical cases of individual patients drawn from the National SAH study.[24] All individual and unit identification data were removed ensuring complete anonymity. Details of the psychosocial data collection methods are provided elsewhere.[11–13,23]

Clinical eligibility

There were common clinical data of the regional and national cohort's but to be included in this study, cases from the National cohort had to have essential matches for age, gender and confirmed aneurysm, plus, at least 5 other clinical variables from: (1) dates of haemorrhage and time to admission, (2) size of bleed as shown on CT scan, light, medium or heavy, (3) details of the aneurysm repair, (4) medical complications, (5) Glasgow Outcome Score (GOS), (6) location of aneurysm, (7) post-operative deterioration, (8) post-operative re-bleed, (9) clinical condition at hospital discharge and (10) all patient's GOS at 6 months, this latter item was however the most frequent 'non-response' in the National cohort.[24]

Additional demographic data

The additional socio-economic demographic data projected onto the National cases were (1) occupation of patient and carer, providing an estimate of socio-economic group and salary level assessment; (2) length of time off work of either patient or carer. '*Patients who survive in good clinical condition following treatment have a potentially long life expectancy*',[27] hence a PROM approach can consider costs to patients and families; (3) Numbers and ages of any children of school-age who will be affected by their parents serious illness as their reaction may well impact upon the patient and visa versa.

Sample

The National Study cohort involved all 34 neurosurgical units in the UK and Ireland.[23] There were 3174 possible SAH patients recruited, but only 2397 patients with a confirmed aneurysm and no co-existing pathology were analysed. Seventeen National cases were excluded from this study because they could not be adequately clinically matched with either TAU or NVSN cohorts, leaving 2380 cases to re-analyse.

Cost-analysis: patient and carers

The cost-analysis estimate for patients and families was based on time off work and levels of salaries linked to their occupation that provides indicators of annual income to various sections of the general population, from 2000 to 2007.[28] To match the National study we took data for 2004/05, in terms of average weekly incomes. Three groups were identified; the lowest at £226 per week, or £11,752 per annum, the median was £19,604 pa and the mean £24,076 pa. Based upon their type of employment, patients and carers were assigned to one of five socio-economic groups. The use of employment costs that examined UK average salaries by typical occupations provided more precise estimates of annual incomes.[28] In 2005 socio-economic group A averaged £61,944 pa; group B £34,923 pa; group C £25,752 pa, group D £16,824 pa and group E £13,668 pa. These rates should include national insurance and superannuation costs, but not all patients/carers would be on superannuation. To correct for the above average national incomes of patients/carers in the South East of England, no estimate will be made for superannuation. Since a majority of the patients

were 'middle-class' (groups A and B) costs to families are a deliberate under-estimation to err on the side of caution when estimating fiscal savings, especially when remembering that more men will be a carer as the majority of patients were females (66%). As many middle-class (A and B) occupations continue to pay full salary up to 6 months, costs may not fall directly upon patients, rather in terms of '*lost production*' to their employers and the wider economy.

National Insurance employees and employers contribution is 11% and 12.8%, respectively, on wages above £110 per week, though if employees are in some form of superannuation it is 9.4%.[29] As these rates have varied, to avoid under-estimating costs, an additional 10% was added to the estimates, which are an average of Office of National Statistics (ONS) and World Salaries rates[28,30] for 2004–2005 calculated from the proportions of patient's in the different socio-economic group.

These were 61% of patients in group A and B, 28% in group C and 11% in group D and E. Based upon the data below, the average income cost is calculated at £138 per working day for 2004–2005 as these are set against NHS costs in 2008, any subsequent 'savings' will be a deliberate under-estimate. However, no estimate is made for differentials between male and female salaries.[28] Table I shows two sets of estimated salary levels.

Apart from estimating 'savings' from reduced time off work, there was no fiscal value given to the work of the NVSN aiming at overall improvement of family functioning, e.g. dealing with the anxieties of children fearful for the life of their parents, etc. However, it might be said that 'returning to work' is a surrogate indicator of overall improved psychosocial functioning.

The wider economy

One feature of the debate on NHS costs that is often over-looked is the value to the wider economy of people returning to their normal responsibilities. In this sense, successful treatment is wealth producing and the fiscal gains can be calculated of what patients returning to work might contribute during the rest of their working lives. To estimate this the present retirement ages for men and women are taken as given, and the total numbers of people returning to work and the years they might work, are adjusted by subtracting the current UK mortality rates for the three age bands. That is, all causes of deaths in England & Wales that for 15–44 year old males is 1001per million pm females 517 pm; 45–54 year olds – 3585 pm and 2326 pm, respectively; 55–64 year olds – 883 pm and 5567 pm, respectively.[31] The equivalent numbers will be deducted from patients returning to work. The subsequent earnings can be seen as offsetting the costs to the NHS of treating the SAH.

Cost to service

A neurosurgical bed in 2008 costs approximately £544 per day but most patients spend at least one night in either an Intensive Therapy Unit (ITU) or a High Dependency Unit (HDU) bed, though often longer at a cost of £1,000 daily.

Based upon clinical experience, we estimated that patients in hospital less than 7 days, will occupy a ITU or HDU bed at least once, for those staying between 8 and 14 days, we estimate 3 days in ITU/HDU; for those staying between 15 and 21 days – 5 days ITU/HDU and for those staying longer – 7 days ITU/HDU. In addition, some patients will be discharged to the care of the referring hospital rather than directly home, but it is not known for how long. These costs are excluded from cost estimates further under-estimating any potential cost and savings. To account for NHS community charges for GP and nursing services a further 10% is added to estimates of the NHS costs to give an acknowledged cautious estimate of NHS costs for a patient surviving a SAH.

The NVSN service

Details of the NVSN service are given in the SBNS report,[23]briefly it consisted of a patient/family focused support and information liaison service, to individually facilitate the patient resume as normal a life as possible. The service is used equally by both coiled (endovascular) and clipped (craniotomy) treated patients. To improve the efficiency of the service it has been extended to include all neurosurgical patients with neuro-vascular disease. Further information is available from the authors on request.

Results

Samples

The regional TAU and NVSN cohort consisted of 137 and 184 patients, respectively, their clinical data were projected on to the 2380 matched National

TABLE I. Time off-work: estimated cost of Lost Production per day (p.d – based on 5 day week (plus 10% N.I. & superannuation)

Economic groups and % of sample	Social trend – p.d	World Salaries – p.d	Average & adjusted N.I & S.A. (+10%)
Groups A and B (61%)	£26,484pa–£102	£53,277–£205	£42,075–£168
Group C (28%)	£21,564–£83	£28,327–£109	£26,400–£106
Groups D and E (11%)	£12,927–£50	£12,660–£ 49	£13,475–£54

Based upon proportions of patients in employment groups = £138 per day.

TABLE II. Demographic data by age & sex in the national cohort

	<44, *n* = 242	45–54, *n* = 220	55–64, *n* = 199	65+, *n* = 155
Males				
Single	7	4	1	1
Married	70	48	88	82
Separated & Divorced	2	18	10	4
Partnership	20	29	4	11
Children				
0	30	15	8	6
1–2	60	78	82	25
3–4	10	7	10	68
Estimated No's children	340	325	435	457
social class				
A & B	57	49	22 (6)	10
C	25	35	47 (7)	52
D & E	11	15	21 (3)	34
Unemployed [unclassifiable]	7	1	12	4
	<44, *n* = 369	45–54, *n* = 454	55–64, *n* = 411	65+, *n* = 330
Females				
Single	4	3	1	0
Married	59	70	85	80
Separated & Divorced	7	13	4	8
Partnership	30	13	10	8
Children				
0	25	7	17	20
1–2	56	57	39	47
3–4	19	36	44	33
Estimated No's children	555	1126	873	614
Social Class				
A & B	45	41	8 (3)	10
C	37	32	39 (12)	10
D & E	17	26	29 (8)	34
Unemployed [unclassifiable]	2	1	24	44

*Excludes 3 widowed.

cases. Seventeen cases from the National study were excluded as they had missing essential or insufficient other clinical data preventing adequate matching. The demographic details of the final National sample are shown in Table 2.

General characteristics of the national TAU, NVSN cohorts

Demographics. The 2380 patients consisted of 1564 (66%) females and 816 (34%) males. Twenty-six percent of females were aged <44, 29% aged 45–54, 26% aged 55–64 and 21% aged 65+. There were 30% males aged <44 years, 27% aged 45–54, 24% aged 55–64 and 19% aged 65+ years.

Patients, who were unemployed or retired at the onset of their illness, are excluded from any employment related cost-analysis.

It is estimated that the <44 year patients had 895 school-aged children; the 45–54 years 1285, who would likely to be adversely affected by their parent's illness, which in turn would add to patient's burdens.

Length of stay (Table III)

The equivalent national TAU cohort would have stayed in the Neurosurgical Unit for 34,850 days compared to NVSN's 30,685 days shown in Table 3. No estimate is made of possible 'savings' to NVSN families of the earlier discharge.

TABLE III. Time off-work in-patient time

Group & cost	No. Males	No. females	No. days TAU	No. days NVSN
A&B p.day £168	461	620	18,609	16,252
C p. day £106	163	369	11,775	10,559
D&E p.day £54	72	133	4,466	3874
Total	696	1122	34,685	30,685 days

Estimate of wages & salaries of those in work by gender & socio-economic group per days off work cost to patients.

Patient and carer time off-work costs

Table IV shows the estimated post-discharge costs to patients and family showing the potential 'savings' of people returning to work earlier in the NVSN group compared to TAU patients. Patient's 'Savings' are estimated at £6.014 million and carers £2.083 million, in all £8.097 million a year.

It should be noted that the major 'savings' to patients came from substantially fewer in the NVSN group being off work >6 months, (37,814 compared

to 111,080 days) and fewer carers work in the NVSN group being disrupted for 18 weeks or more.

Time-off work by age and sex (unemployed and non-responders excluded)

Table V examines time-off work in the three age-bands by sex. In regard to younger < 44 male patients significantly fewer in the NVSN group permanently lost their employment or were still off work than TAU men ($p < 0.0001$). This also applied significantly but less markedly for the younger women ($p < 0.001$). All the other NVSN age bands, 45–64 had significantly less time off work than the TAU peers for both sexes.

Returning to work is a surrogate indicator that the problems associated with post-treatment cognitive disruption had been reduced, but nonetheless 19% of NVSN <44 year old males and 44% of TUA were still off work after 24 weeks.

In respect to females <44 years, 28% of NVSN and 44% TAU were still off work at 24weeks, so it is not suggested that the NVSN eradicates PTSD reactions but rather enables patients cope better with a speedier return to work.

Cost and potential service savings

In-patients. Table VI provides the differential costs of in-patient care related to the length of stay of patients. Based upon the estimated numbers of bed-occupancy days, the TAU length of stay translates into a cost of £30.238 million compared to £27.746 million for the NVSN patients, a potential savings of £2.492 million.

It should be noted that no data was available for those patients who were transferred back to their referring hospitals, rather than direct into community, so it is not possible to calculate for any post-neurosurgical unit other hospital admissions. Hence these costs are likely to be an under-estimate of total real NHS cost and of course, potential savings.

The service is being used and valued by both coiled and clipped treated SAH patients as well as

Table IV. Post-discharge estimated numbers of days lost by patients & carers £'s (averaging £138p.d.) between NVSN and TAU cohorts.

Time Off before Returning to work	NVSN (Days)	TAU (Days)	Costs £ million		Potential 'Savings' £m (£m)
Patients (×130)					
SAH led Job loss	24 pnts	260 pnts	0.431	4.664	4.233
<12 weeks (×40 days)	29,815	20,362	4.114	2.809	−1.305
13–26weeks (×100)	76,356	25,452	10.537	3.512	−7.025
Continues 26+ weeks (×130)	37,814	111,080	5.218	15.329	10.111
Total Patients	143,985	156,894	20.300	26.314	6.014
Carers					
<4 weeks (×10)	13,453	8,545	1.856	1.179	−0.677
5–18 (×50)	27,270	47,268	3.763	6.523	2.760
Total for carers	40,723	55,813	5.619	7.702	2.083
Grand Total	184,708	212,707	25.919	34.016	+£8.097m

TABLE V. Patient time-off work by age & gender %

	<44, $n=252$		45–54, $n=220$		55–64, $n=155$	
	TAU	NVSN (%)	TAU (%)	NVSN (%)	TAU (%)	NVSN (%)
Males						
Employment status *						
Time off work – permanent	14	2	2	4	12	16
>Less than 12 weeks	2	24	10	18	8	12
>12–23 weeks	24	32	46	52	22	42
Still off Work	54	30	36	18	42	24
Chi Square 2*d/f*	72.52 < 0.0001		23.43 < 0.001		31.79 < 0.001	
	<44, $n=369$		45–54, $n=455$		55–64, $n=411$	
	TAU	NVSN	TAU	NVSN	TAU	NVSN
Females						
Employment status*						
Off work – permanent	4	6	6	8	3	6
>Less than 12 weeks	19	24	14	20	9	17
>12–23 weeks	14	28	46	52	19	4
Still off Work	44	28	34	16	18	14
Chi Square 2 *d/f*	31.983 < 0.001		35.11 < 0.01		24.12 < 0.001	

*Not 100% as not employed & no responses excluded.

TABLE VI. Cost of neuro-surgical in-patient care + 10% for subsequent NHS treatment

Length of Stay (+ITC & HDC) No. patients	No. of days NVSN–TAU	Cost £m NVSN	Cost £m TAU	Potential 'Savings' £k
<7 (+1 day) 237	1644–1834	1.103	1.216	£113k
8–14 (+3 days) 1091	9274–9630	8.497	8.710	£213k
15–21 (+5 days) 524	6778–9633	6.624	8.333	£1709k
22+ (+7 days)) 528	12,989–13753	11.522	11.979	£.457k
Totals	30,685–34,850	27.746	30.238	£2.492m

those with other neuro-vascular disease, further improving the efficiency of the service.

Other potential NVSN savings

Other potential annual NVSN savings accrued from the NVSN's undertaking 10% of consultant's out-patient clinics, yielding £1,800, a further £1,900 from reducing post-discharge unnecessary GP calls and approximately 12 patients a year whom the NVSN identified as needing treatment, avoiding unplanned re-admission, estimated at saving 2 days hospitalisation, £13,056. In total, this amounts to £16,756 and by extrapolating to the National cohort would yield a further £1.139 million.

Summary of costs and savings

Table VII lists the summary of cost and savings, minus the cost to the NHS, if there had been a NVSN in every neurosurgical unit. An experienced NVSN would cost approximately £36,300, including on-costs, estimated at £1.23 million a year.

It is noteworthy that the major gainers are patients and carers, but after deducting the cost of a NVSN service nationally, the potential savings, would be £10.498 million.

Benefits of neurosurgical treatment to wider economy?

In parenthesis, when discussing NHS costs, it is seldom acknowledge that there are often economic benefits following successful treatment that off-sets future NHS costs, a situation this study wishes to correct. Table VIII shows the likely economic benefits from the 1365 patients who returned to work, i.e. 72% of work-aged (24–64) people, who through the rest of their working lives will contribute to the general economy.

Based upon the age and gender of the returned-to-work patients, over the years the younger group would contribute £304.37 million until aged 65; £260.78 million for the 45–54 years and £88.83 million by the 55–64year olds, in all £688 million at 2005 income levels. This goes someway to offset the cost to the NHS treatment for people who had recovered from a SAH and other neuro-vascular disorders.

TABLE VII. Summary of costs & savings of NVSN *vs* TAU treated SAH in 2 year cohorts (millions)

Groups – costs	TAU	NVSN	'Potential Savings'
Cost to patients – post-discharge	£26.314m	£20.300m	£6.014m
Cost to carers – post-discharge	£7.702m	£5.619m	£2.083m
Cost to NHS in-patient time	£30.238m	£27.746m	£2.492m
NVSN new tasks (out- patient etc)	£0.569m	00.0	£0.569m
Cost NHS for NVSN nationally	00	£1.23	(−£1.23)
Totals	£64,823	£54.895	£9.928

TABLE VIII. Gains to wider economy of those returning to work by age & gender* averaging £138 p.d. = estimated average £34.5k pa

Age and gender*	Numbers	Years of work at £34.4k	Economic gain £'s million
<44 years			
Males	214	24	177.192
Females	256	16	141.312
45–54			
Males	222	20	153.180
Females	312	10	107.640
55–64			
Males	154	10	53.130
Females	207	5	35.708
Totals	1365	85	£668.162

*Assume women stop work at 60years minus annual England & Wales death rate for the age-band.

Discussion

Main finding

This study has shown that major fiscal benefits accrue to patients and their families with the appointment of a NVSN as well as potential savings to the service and the null hypothesis can be rejected.

Invariably a key issue for policy makers is cost to the NHS, with it's major focus upon saving lives, preventing or reducing illness, although some recognise that the reduction of psychosocial distress, irrespective of age of patients, is of itself of worth while.[1,11,13,14,32–34] The study could be criticised for apparently over-focusing on returning people to work, seeming to ignore the value of those outside

the labour market. This is not intended but shows that by taking a PROM approach, it can include an important patient/carer outcome agenda item that is often over-looked in more traditional studies.

It is appreciated in straightened economic circumstances, some budget holders might feel that as the greater benefits are for families and the wider economy, therefore a NVSN service might have a lower priority. But such a narrow view ignores the recent example of BAA whose lack of investment in snow-clearing equipment during the winter disruption led to an estimated daily loss to their customers and to the national economy of £1.2 billion.[35,36]

Limits to the study

The main limitation is that all fiscal results are estimates, although based upon matched samples. Furthermore, the original regional studies were not randomised trials as the retrospective study served as a control for the prospective 2 year NVSN project. Patients estimated socio-economic group was based upon their occupation though there were some non-responders to this question and seeking estimates of costs to patients/family necessitated combining the two sources of incomes for 2004–2005,[28,30] to adjust for higher salaries in England's South East.

Another limitation was that as the regional study took place before the impact of the ISAT studies,[37] nonetheless, there had been no significant differences between the clinical and psychosocial outcomes between clipped and coiled TAU and NVSN patients. Over 74% of the current regional SAH patients are now coiled. However, this paper does not compare the National and ISAT studies[27,37] but rather the need to reduce the cognitive and social deficits that so often follow a SAH, whether patients are treated by clipping or coil embolisation.

Finally, the NVSN type service does not eradicate all disrupting PTSD reaction following SAH[14] but appears to considerably reduce the longer-term effects typically found amongst unsupported patients. We recognise that over the past 5 years or more a number of neurosurgical units have introduced some form of post-discharge psychosocial support for patients with cerebrovascular disease including Belfast, Bristol, Cambridge, Coventry, Glasgow, Kings College, Liverpool, Manchester, The National, Nottingham, Salford and Royal Free hospitals and more patients are coiled than clipped. However, currently, both coiled and clipped patients potentially benefit from the service. The level of psychosocial disruption appears to relate more to the severity of the bleed rather than to the modality of treatment, i.e. clipping or coiling.[38–40]

Practice implications

A psychosocial approach that facilitates a speedier recovery for patients but does not mean that the consultant neurosurgeon has to take on the 'counsellor role, but as Giddings and Williamson highlight, the consultant as the leader of the surgical team,[41] should ensure that the 'total care of their patient' is available, thus facilitating a fuller and more speedy recovery.

Thus, the investment in a comprehensive neurosurgical service for SAH produces a net surplus and continues to yield an ample return from those returning to work. Thus it would be reasonable to assert that in respect to an integrated holistic treatment of SAH patients, neurosurgery not only saves lives, but taking a wider view, also produces wealth.

Acknowledgements

It is recognised that the study could not have proceeded without the active work and collaboration of a number of colleagues including Neurosurgical Consultants Jonathan Duffil, Dorothy Lang, Glen Neil-Dwyer, Owen Sparrow, and Sister Beryl Pritchard all of the Wessex Regional Neurological Unit; to Professor John Pickard, University of Cambridge and Dr. Langham of the Health Improvement Unit at the RCS but most of all to the patients and carers who gave of their time in contributing to the original questionnaires and to all former patients and their carers who completed them. Finally authors are deeply indebted to the Southern General Hospital Neurovascular Fund for contributing to the financial costs of this project.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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