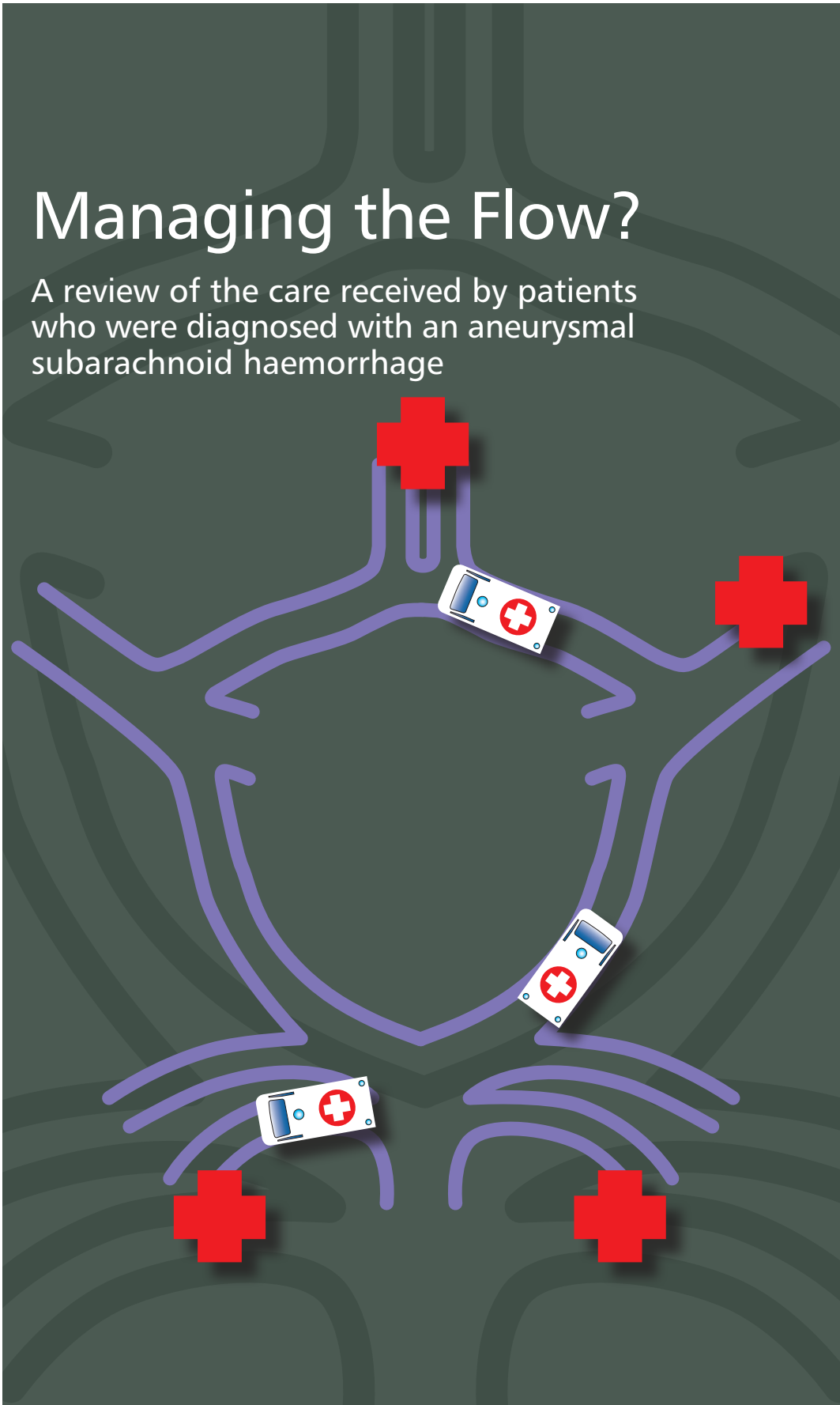
Managing the Flow?

A review of the care received by patients who were diagnosed with an aneurysmal subarachnoid haemorrhage



NCEPOD

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A review of the care received by patients who were diagnosed with an aneurysmal subarachnoid haemorrhage.

A report by the National Confidential Enquiry into Patient Outcome and Death (2013)

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Foreword

The changes in routine medicine are sometimes dazzling to the laity, especially if we take our eye off the ball. Here we learn that by 2011 over 80% of aneurysmal subarachnoid haemorrhages (aSAH) were treated with endovascular coiling by interventional radiologists, thus avoiding craniotomy. The immediate trauma associated with the procedure is so reduced that 85% of patients regain their pre-operative function within four hours. Of course complications still occur and this unfortunately does not mean that all such patients will have a good long term outcome, but the advantages of this treatment modality are remarkable and the extent to which it has been made available is a tribute to the NHS. 20 years ago the technique was not available; those lucky enough to get to neurosurgery all underwent open surgery. The morbidity and the mortality were so great that some surgeons believed it was safer to delay the operation for up to a week to avoid the risks of arterial spasm or re-bleed at surgery, even at the risk of a fatal second bleed whilst waiting.

Truly this is a wholly beneficial change that has been achieved as a result of advances in both the skill of the operators and the organisation of the service. And whilst we are welcoming a real achievement for the NHS, let us also acknowledge that 58% of cases were judged as having good care in all respects; that is with no room for improvement in the eyes of our Advisors. That is a good figure and as usual the Advisors are mainstream professionals managing these cases – they are neither the enthusiastic vanguard of the specialty nor the complacent minority making excuses for those who have fallen behind the curve. This is what mainstream professionals think of the care their specialty is delivering. At a time when it is so fashionable to knock the NHS, it is reassuring to hear that the majority of these very sick patients receive good care, even when they present with an immediately life-threatening disease that can be very challenging for the doctors involved at every stage in the process.

Good news indeed.

At the same time there are numerous ways in which we can make things even better with many recommendations being straightforward to implement. Why are only 12% of hospitals part of formal networks of care? This potentially fatal disease has to progress from the GP's surgery or A&E where it may present ostensibly as a simple headache, to the operative setting as fast as possible. An occurrence rate of about 5,000 cases a year makes aSAH common enough to be a priority for the Service, but rare enough to be unfamiliar to most of those who have to distinguish it from the common or garden headache.

Aneurysmal SAH can be barn-door obvious with the differential diagnosis being recognisable from an outline history, but in many other cases it is very subtle as these pages show. Wearing my non-NCEPOD hat, my medical negligence firm still regularly handles disastrous cases where the juniors saw no reason to investigate. An optimal outcome depends upon prompt recognition, appropriate investigation and immediate referral by people who are specialist in the vital task of recognition and filtering, but who may never have seen a case of aSAH. It is a sobering thought that the reader of these words should know that if they fall victim to this event, their life may depend upon their diagnosis being suspected at once by someone who has never seen it before. It may happen at any time of your life, but the incidence is highest between 40 and 70 years.

Despite the need for prompt recognition and referral, 32% of the hospitals where you are likely to present have no protocol or policy for the investigation of acute onset headache. It seems strange that the young doctor in A&E who has never seen a case of aSAH should be thrust back on his own stock of reason, even though the College of Emergency Medicine has issued widely acclaimed guidelines for the management of severe headache and the Royal College of Physicians *'National Clinical Guideline for Stroke'* should be the *vade mecum* of every A&E. Today we have so many guidelines, some of them as substantial as the textbooks they have replaced, that the task of deciding which to adopt is a vital role for relevant NHS Lead clinicians. Further dilemmas arise with the availability of expensive imaging techniques; CT scans where they are not indicated result in unnecessary expense and exposure to radiation, even if the consequences may be less disastrous than with the opposite error.

Once the suspicion of aSAH is raised, doctors have to know how to investigate it and where to refer, and here we come to another surprising change. 90% of hospitals can now provide CT scans 24/7. Senior professionals can remember when CT was introduced, and for a long time confined to the most advanced neurosurgery centres. In contrast and perhaps oddly, a much smaller number of hospitals, only 75% now say they are able to perform a lumbar puncture (LP) 24/7. In the 1970s, and I fancy much more recently, every hospital could tap the CSF and did so more often than was comfortable for their patients. How can the skill have disappeared? Given that all of these hospitals will have anaesthetists adept at providing spinal and epidural blocks, it sounds as if they cannot see the point of providing the service. 20 years ago most doctors could do a LP and it was not thought of as a specialist service at all. Young doctors today are seemingly less experienced at doing what used to be a routine first line investigation.

Only 29% of hospitals have formal transfer protocols. The registrar of 1990 had less need of such things than the modern StR. The result of longer hours and more years of experience meant that they knew who to call and how to make the system work, as well as having more experience of disease. And the pressure to move the patient rapidly through the system was less. Today simple, readily accessible transfer protocols are far more necessary than used to be the case; however, less than a third of hospitals claim to have them.

The organisation of the softer stuff is no better. Only a third of the hospitals where these patients went for rehabilitation could offer neuropsychiatric support. That really is not good enough: it may be that fewer of these patients need it now than used to be the case, but the need and benefits are more securely established where it is indicated. Furthermore, if the service is not available for these patients, presumably it is not available for other groups, such as those with head injuries.

It is alarming that only 19% of hospitals participate in regional audits for a disease that depends upon rapid recognition and referral and that of those that did not 26% did not did have local M&M audits either. Sir Bruce Keogh's proposition that if you do not know what your results are, then we must question your right to be doing it should not be confined to those who wield the scalpel or the catheter.

The clinical findings reveal a similar picture. That 32 patients were misdiagnosed is something that may continue to prove intractable in a disease that in some cases will always be elusive. But the finding that 18% of patients had no neurological examination at their presenting primary centre supports the suspicion triggered by the absence of facilities to sample the CSF: to many of these doctors the only neurological conclusion is that the patient does or does not need CT imaging and so they might as well cut to the chase. Indeed 22 patients who were either not comatose or whose GCS was not recorded did not apparently merit CNS examination by the secondary care facility. If only for training, one might expect the young doctor to seize any opportunity to examine such patients. Dr Christopher Earl, the revered neurologist at Queen Square who died

last year and was known as the best second opinion in London, used to say *"I've seen it before, you know"* to explain how he had made a diagnosis, like recognising an old friend in the street. Today the old friend is expected to wear a nametag, such as the report on a CT scan.

I expected to see the same problems raised by many other NCEPOD studies during this transition to a service delivered by consultants 24/7. The key to the endovascular coiling service is getting patients into the hands of interventional radiologists, which in turn demands that they have to be available every day. The longer intervals to CT scanning and definitive treatment that we seem to have found during weekends and out of hours point to the difficulties of developing the correct response. The problem has much in common with primary coronary angioplasty, although here the urgency is not always quite so acute: where our coronary vessels may have to be opened within the hour if disaster is to be averted, aSAH coiling is undertaken to prevent the next bleed, which is unpredictable but in most cases will not happen today.

One of the disadvantages of the cardiologists holding onto their fiefdom is that interventional radiology is delivered in a much more piecemeal fashion. But is it true that as a result we must endeavour to present our cerebral bleeds during working hours and avoiding the weekends? That does not really seem to be what this study has found: although there were delays, in only a few cases did our advisors say that earlier treatment would have avoided re-bleeding or other complications.

There is much food for thought in this paradigm of the problems of the modern NHS. Here we have a clinical problem that has challenged diagnosticians since the birth of modern neurosurgery, combined with a remarkable new treatment modality that offers a great improvement in clinical outcomes, but only if it is supported by a seamless service providing excellence in the organisation of clinical care across the country. The signs are that we are getting there. There are problems of transition and there is room for improvement, but there is no doubt that on this evidence the NHS has made sturdy progress.

You are here presented with the fruits of an enormous co-operative exercise in self-criticism by health care professionals who simply wish to improve the service that any of us may depend upon to save our lives.

As usual our thanks are due primarily to our Local Reporters and Ambassadors in hospitals up and down the countries who have identified the cases. Then to the treating doctors who have written their reports. At the centre we are grateful to the Expert Group who took the raw idea and designed the Study. Then to the Advisors who did the hard work of assessing each case and identifying the themes and vignettes that bring the numbers to life. Finally, to our authors who have taken the data and opinions and produced the narrative.

Outside the organisation we are grateful to the Royal Colleges and professional associations who continue to support our work, sending people to serve on our Steering Group and suggesting ideas for future studies. Lastly to our friends at HQIP who continue to provide the funding on which we depend.

Bertie Leigh
NCEPOD Chair

Principal recommendations

The clinical presentation of aneurysmal subarachnoid haemorrhage should be highlighted in primary and secondary care education programmes for all relevant health care professionals, including the guidelines for the management of acute severe headache published by the College of Emergency Medicine. *(Local Education and Training Boards/Deaneries, Medical, Surgical & Nursing Royal Colleges and Specialist Associations)*

Formal networks of care should be established, linking all secondary care hospitals receiving subarachnoid haemorrhage patients to a designated regional neurosurgical/neuroscience centre. *(Medical Directors)*

Standard protocols for the care of aneurysmal subarachnoid haemorrhage patients in secondary care should be developed and adopted across formal networks. These should cover, as a minimum, initial assessment and diagnosis, management, referral, transfer to a neurosurgical/neuroscience centre and subsequent repatriation to secondary care, including rehabilitation. These protocols should take into account existing guidelines where relevant. *(Medical Directors)*

Relevant professional bodies should develop a nationally-agreed and audited protocol for the management of aneurysmal subarachnoid haemorrhage in tertiary care that addresses initial assessment, multi-disciplinary management and documentation, informed consent, timing of interventions, peri-operative care, management of complications and rehabilitation. *(Royal Colleges and Specialist Associations)*

The nationally-agreed standard *('National Clinical Guideline for Stroke')* of securing ruptured aneurysms within 48 hours should be met consistently and comprehensively by the health care professionals who treat this group of patients. This will require providers to assess the service they deliver and move towards a seven-day service. *(Medical Directors)*

Appropriately funded rehabilitation for all patients following an aneurysmal subarachnoid haemorrhage should include, as a minimum, access to information for patients and relatives, specialist subarachnoid haemorrhage nurses and comprehensive in-patient and out-patient rehabilitation services including appropriate neuropsychological support. *(Specialist Associations, Medical Directors and Commissioners)*

Introduction

Subarachnoid haemorrhage, resulting from the rupture of a cerebral aneurysm (aSAH), accounts for about 5% of all cerebrovascular events in the UK.[1]

Subarachnoid haemorrhage may also be caused by head trauma, vascular malformations, hypertension or coagulation disorders, but aneurysms (aSAH) are the most common cause, accounting for approximately 85% of cases.[2,3]

Autopsy studies have reported that between 3.6% and 6% of the population have unruptured intracranial aneurysms. There is an increased rate of aSAH in first degree relatives of aSAH patients (relative risk 3.7–6.6). The risk of rupture increases with age and is greater in women (ratio 3:2). It is also more common in patients with connective tissue disorders or polycystic kidney disease. Hypertension and smoking are significant risk factors for aneurysmal rupture.[4]

The annual incidence of aSAH in the UK is in the order of 8-12/100,000 and at least 800-900 patients undergo either endovascular coiling or surgical clipping each year in England alone.[5]

In contrast to more common types of stroke, aSAH often occurs at a relatively young age: half the patients are younger than 60 years. The outcome of patients with aSAH is generally poor: half the patients die within one month of the haemorrhage, and of those who survive the first month, half remain dependent for help with activities of daily living (walking, dressing, bathing etc.). Thus only 25% of patients can expect to return to a relatively normal life.[6]

Aneurysms may be treated surgically by clipping the base of the aneurysm, or by endovascular coiling, placing a platinum coil in the aneurysm via an intra-arterial catheter to initiate a thrombosis of the aneurysm. The principal aim of either treatment is to prevent further bleeding.

Due to the profound effects of the haemorrhage and the risk of early re-bleeding and hydrocephalus, aSAH patients are routinely admitted to an intensive care unit and are cared for by a multi-disciplinary team including neurosurgeons, neurointensivists, neuroanaesthetists and interventional neuroradiologists. The intensive care stay of aSAH patients ranges from a few days to a few weeks and is frequently accompanied by multiple medical complications.[2-7]

In addition to the damage caused by the initial bleed or a re-bleed from the aneurysm, further complications include delayed cerebral ischaemia, which can occur 4 to 10 days after the haemorrhage and hydrocephalus. These complications require further intervention and can contribute to a poor outcome.

Although re-bleeding is a feared complication, there is some debate about the timing of treatment. Data from a recent international study indicates that time to treatment in the United Kingdom may be significantly longer than in other developed countries.[8,9] Although a 2001 meta-analysis of the limited randomised controlled evidence suggested that the timing of surgery is not a critical factor in determining outcome[10], this data was derived prior to the introduction of modern methods of therapy, particularly endovascular coiling. Currently, most UK neurovascular surgeons advise intervention within 48 hours in good grade patients to minimise the chances of a devastating re-bleed as defined by the RCP Stroke Guidelines.[6] However, the timing of treatment of patients with poorer grades of aSAH is less clear.[9]

Figure 1. WFNS SAH grading scale

Grade	GCS	Motor deficit
I	15	-
II	14-13	-
III	14-13	+
IV	12-7	+/-
V	6-3	+/-

The severity of a bleed is graded on a 5 point scale. The World Federation of Neurological Surgeons (WFNS) scale (Figure 1) is based on the Glasgow Coma Score (Figure 2) and the patient's motor deficit. Lower WFNS grade patients are associated with a better outcome.[11]

Definitive treatment for aSAH in England, Wales and Northern Ireland is performed in 27 regional specialist neurosurgical/neuroscience centres (NSC). Thus patients presenting with this diagnosis in primary and secondary care are subsequently transferred for treatment when this is appropriate. However, in patients with a poor WFNS grade/poor neurological function or with

Figure 2. Glasgow Coma Scale

Catagory		Best response
Eye opening		
Spontanious		4
To speech		3
To pain		2
None		1
Verbal	**(Modified for infants)**	
Oriented	Babbles	5
Confused	Irritable	4
Inappropriate words	Cries to pain	3
Moans	Moans	2
None	None	1
Motor		
Follows commands		6
Localises to pain		5
Withdraws to pain		4
Abnormal flexion		3
Abnormal extension		2
None		1
Glasgow Coma Score		
Best possible score		15
Worst possible score		3
If tracheally intubated then verbal designated with "T"		
Best possible score while intubated		10T
Worst possible score while intubated		2T

significant co-morbidities an unsatisfactory outcome associated with either treatment means that conservative management may be the most appropriate treatment option.

There is concern that some patients are not referred for treatment and that in others treatment may be delayed for non-clinical reasons. Nevertheless, a cohort of poor grade patients are managed conservatively in secondary hospitals and are not transferred to a NSC.

Patients suffering an aSAH may make an excellent neurological recovery but may not recover their premorbid state due to cognitive and psychosocial deficits leading to difficulties with reintegration into the social environment. The rehabilitation of patients should include both physical and psychological programmes. The cognitive and behavioural impairments caused by an aSAH are often more disabling than the physical symptoms. Neuropsychological assessment and treatment should play an important part in all phases of recovery, including the initial phase after aneurysm rupture and surgery. Early inpatient rehabilitation should be provided for all patients. Following discharge from hospital, the rehabilitation should not end. Community based specialist rehabilitation such as Early Supported Discharge can provide better outcomes for people with moderate disabilities.[12] It is also important to make arrangements for follow up assessments, which will allow the team to evaluate the patient's progress and social functioning as well as to gather valuable information to be used in planning further stages of rehabilitation for aSAH survivors.

Previous studies have largely assessed outcomes in patients who have been admitted to a specialist unit following a decision to treat. This provides relatively poor information on outcomes for patients in general and it does not allow an assessment of the decision making process that determines whether patients are referred for intervention, or provide information on any delays that might occur prior to referral, or on the exclusion criteria for referral that might be applied to patients with this condition. Any attempt to improve the quality of care for aSAH patients must be based on a sound understanding of the whole patient management pathway.

In an attempt to investigate remediable factors in the current service, this study examined the whole acute phase of the patient pathway from the time of arrival to secondary care hospitals until discharge from an NSC. This included data about the quality of the initial assessment, diagnosis and management of patients and the reasons for conservative management when this was selected and in those patients who were transferred to a specialist centre, to examine delays in this process and in the subsequent intervention. Finally, for patients that survived to discharge from a tertiary centre, the provision of rehabilitation services was also assessed.

1 – Method and Data returns

Expert group

A multi-disciplinary group of experts comprising consultants from neurosurgery, neurocritical care, neuroanaesthesia, neurovascular radiology, neurology, neuroscience nursing, acute medicine, and a lay representative contributed to the design of the study and reviewed the findings.

Aim

To explore remediable factors in the process of care of patients admitted with a confirmed diagnosis of aneurysmal subarachnoid haemorrhage (aSAH), including patients that underwent an interventional procedure and those managed conservatively.

Objectives

Based on the issues raised by the Expert Group, the objectives of the study were to collect information on the following aspects of care:

1. Organisational factors in the management of aSAH patients in secondary and tertiary care
2. Initial Assessment:
    a. Evidence that diagnosis was delayed/overlooked
        i. In primary care
        ii. In previous presentations to secondary care
    b. Presentation to secondary care
        i. Quality of initial assessment, delays
        ii. Delays in investigation
3. Description of referral pathway (where appropriate) including:
    a. The decision to transfer/ manage conservatively
    b. Delays in referral
    c. Delays in transfer
    d. Quality of care during transfer
4. Quality of care in the group of patients managed conservatively
5. Details of admission to a neurosurgical unit, assessment and quality of care during this period
6. Adequacy of any further investigations and detail of delays
7. Adequacy of decision making process: documented treatment plan, multi-disciplinary team (MDT) meetings, appropriateness of decision to operate
8. Assessment of the quality of pre-operative care including appropriate adjuvant therapy
9. Details of the intervention
    a. Appropriateness of intervention: endovascular or surgical approach
    b. Appropriateness of grade of surgeon/radiologist/ anaesthetist
    c. Delays
10. Detail of issues surrounding the consent process
11. Appropriate management of adverse events/ complications
12. Quality of post-operative care
    a. Appropriate level of care
    b. Recognition and management of complications; secondary ischaemia, re-bleeds, avoidable complications, delays in recognition and management
    c. Discharge destination, functional status at discharge, rehabilitation plan
    d. Appropriateness of end of life care
        i. Documented DNA-CPR/end of life care/death
        ii. Discussion with relatives
        iii. Discussion at Morbidity/Mortality meeting
        iv. Organ donation
13. Follow-up – quality of care post discharge
14. Overall quality of care

Study Population

Adult patients (aged 16 and older) presenting to secondary care after suffering an aSAH during the study period: 01/07/2011- 30/11/2011.

Hospital participation

Hospitals within Acute Trusts in England, Wales and Northern Ireland were expected to participate, as well as hospitals in the independent sector and public hospitals in the Isle of Man, Guernsey and Jersey. Within each hospital, a named contact, referred to as the NCEPOD Local Reporter, acted as a link between NCEPOD and the hospital staff, facilitating case identification, dissemination of questionnaires and data collation. A study contact and/or neurosurgical lead was appointed in each neurosurgical centre to promote the study and aid the Local Reporter to chase outstanding data.

Exclusions

Non-aneurysmal SAH and cases wrongly coded that were not SAH e.g. subdural bleed, admissions for rehabilitation only.

Case identification

NCEPOD Local Reporters retrospectively identified patients who had had a subarachnoid haemorrhage during the study period, based on ICD10 coding on admission (Figure 1.1). A spreadsheet was completed with basic data from the hospital electronic records. This included admission date and source, discharge date and destination, details of the admitting consultant and the date and details of any listed interventional radiology or neurosurgical procedures. These data were collected in the first instance during a one-year period (1/10/2010-30/9/2011) to ascertain an idea of the required study period to achieve the necessary sample size. It was found that a three-month study period gave a sample of approximately 1500 admissions which was a sufficiently large enough sample to allow for cases lost through exclusions of non-aneurysmal SAH (estimated as being 25% of cases), the linking of cases (where the same patient is admitted to more than one hospital –see below), admissions for rehabilitation only and limiting the number of cases to four per consultant. This gave a sample of approximately 700 cases.

I60.0	Subarachnoid haemorrhage from carotid siphon and bifurcation
I60.1	Subarachnoid haemorrhage from middle cerebral artery
I60.2	Subarachnoid haemorrhage from anterior communicating artery
I60.3	Subarachnoid haemorrhage from posterior communicating artery
I60.4	Subarachnoid haemorrhage from basilar artery
I60.5	Subarachnoid haemorrhage from vertebral artery
I60.6	Subarachnoid haemorrhage from other intracranial arteries
I60.7	Subarachnoid haemorrhage from intracranial artery, unspecified
I60.8	Other subarachnoid haemorrhage
I60.9	Subarachnoid haemorrhage, unspecified

Figure 1.1 ICD10 codes for SAH

Questionnaires

There were two clinician questionnaires associated with this study. A questionnaire was sent to the admitting consultants in secondary care hospitals. This followed the care of the patient from presentation in the emergency department (ED) to transfer to tertiary care or conservative management within the secondary care hospital (whichever was applicable). A tertiary care questionnaire was sent to the admitting neurosurgeon in tertiary care centres. Both questionnaires also gathered the clinician's opinion on the adequacy of care in the primary care setting prior to admission.

Because ICD10 coding does not distinguish between aneurysmal and non-aneurysmal SAH, consultants were asked to exclude non-aneurysmal cases through their clinical knowledge of the case and these were removed from the dataset.

An organisational questionnaire was sent to all hospitals that had cases in the study or that admitted patients as an emergency, to collect information on the facilities and resources available for the management of patients with aSAH. It was also divided into sections to be completed concerning the management of patients in secondary care and specialist neurosurgical tertiary care (where applicable). For the purposes of this study, 'organisation' was defined as a hospital rather than a Trust as a whole.

Case notes

For each admission, case note extracts were requested covering the whole admission. The following documents were requested:

- Inpatient and outpatient annotations
- Nursing notes
- Observation charts
- Operation notes
- Anaesthetic charts
- Radiology results
- Fluid balance charts
- Haematology (full blood count), and biochemistry (liver function tests & urea and electrolytes) results
- Resuscitation documentation (DNACPR forms)
- Discharge summary

Cases where a patient was transferred from secondary to tertiary care were linked by NHS number and date of birth. Questionnaires and case notes from the two different hospitals were combined and reviewed as one case by the Advisors.

Advisor groups

A multi-disciplinary group of Advisors was recruited to review the case notes and associated questionnaires.

The group of Advisors comprised clinicians from the following specialties: neurosurgery, neuroradiology, acute medicine, emergency medicine, neuroscience nursing, neurology, neuroanaesthesia/neurocritical care. All questionnaires and case notes were anonymised by the non-clinical staff at NCEPOD. All patient identifiers were removed. Neither Clinical Co-ordinators at NCEPOD, nor the Advisors had access to such identifiers.

After being anonymised each case was reviewed by one Advisor within a multi-disciplinary group. The Advisors assessed the cases by completing a structured Advisor assessment form, allowing both quantitative and qualitative data to be collected. At regular intervals throughout the meeting, the Chair allowed a period of discussion for each Advisor to summarise their cases and ask for opinions from other specialties or raise aspects of a case for discussion. Throughout the Advisor assessment questionnaire, where the Advisor felt that there was insufficient information available in the case note extracts present to make a judgment decision, there was the option to select 'insufficient data'.

The grading system shown in Figure 1.2 was used by the Advisors to evaluate the overall care that each patient received:

Good practice – a standard that you would accept for yourself, your trainees and your institution
Room for improvement – aspects of **clinical** care that could have been better
Room for improvement – aspects of **organisational** care that could have been better
Room for improvement – aspects of both **clinical** and **organisational** care that could have been better
Less than satisfactory – several aspects of **clinical and/or organisational** care that were well below that which you would accept from yourself, your trainees and your institution
Insufficient data – Insufficient information submitted to NCEPOD to assess the quality of care

Figure 1.2 NCEPOD Overall grading of quality of care

There were three types of cases reviewed by Advisors:
1) Cases where data had been collected from the secondary care hospital only (case notes plus a secondary care clinician questionnaire, when returned). These were patients who were managed conservatively in secondary care or who died before transfer
2) Cases where data were collected only from the tertiary neurosurgical centre (NSC) (case notes, including transferred clinical annotations from referring hospitals and a tertiary care clinician questionnaire). This group was comprised mainly of patients who were not formally admitted to a secondary care hospital ED before being transferred to a NSC
3) "Linked cases" were patients identified from the spreadsheet data as being formally admitted to a secondary care hospital then transferred and admitted to a NSC. Data were collected from both the secondary care (referring) hospital and the NSC (case notes plus secondary care and tertiary care clinician questionnaires).

Quality and confidentiality

Each case was given a unique NCEPOD number so that cases could not easily be linked to a hospital.

The data from all questionnaires were electronically scanned into a preset database. Prior to any analysis, the data were cleaned to ensure that there were no duplicate records and that erroneous data had not been entered during scanning. Any fields in an individual record that contained spurious data that could not be validated were removed.

Approval under S.251 of the NHS Act (2006) was obtained.

Data analysis

The qualitative data collected from the Advisors' opinions and free text answers in the clinician questionnaires were coded, where applicable, according to content to allow quantitative analysis. The data were reviewed by NCEPOD Clinical Co-ordinators and a Clinical Researcher to identify the nature and frequency of recurring themes. Case studies have been used to illustrate particular themes and were developed from multiple similar cases.

All data were analysed using Microsoft Access and Excel by the research staff at NCEPOD.

The findings of the report were reviewed by the Expert Group, Study Advisors and the NCEPOD Steering Group prior to publication.

Data returns

Over the three month period 1694 admissions for SAH (1457 patients) were reported to NCEPOD. In order to limit the burden on individual clinicians, the number of questionnaires sent out was limited to a maximum of four per clinician. This meant that 159 cases (145 separate patients) were not included as the named clinician had more than four cases assigned to them. There were 380 admissions (for 346 patients) for non-aneurysmal SAH excluded, and 307 admissions (from 279 patients) excluded for reasons other than non-aneurysmal SAH. These are presented in Table 1.1.

Table 1.1 Reasons for exclusions

Reason for exclusion of case	n
Non-aneurysmal SAH	380
Patient did not have a SAH	118
Patient was admitted outside study period	12
Patient was under 16 years of age	7
Duplicate record	16
Admission for rehabilitation only (non-"linked" case)	154

Figure 1.3 shows the data returns for the study.

In total 319/391 (82%) secondary care questionnaires and 344/438 (79%) tertiary care questionnaires were returned to NCEPOD. Copied extracts of the case notes alongside the completed questionnaires were returned in 490/687 (71%) cases.

In a number of cases questionnaires were returned blank or NCEPOD was informed of problems in terms of questionnaire completion; the most common reasons for this were case notes being lost or difficulty in retrieving case notes, and the consultant in charge of the patient at the time of admission no longer being at the hospital. Furthermore, in some cases, the case notes that were returned were too incomplete or were returned after the deadline so they could not be assessed by the Advisor group.

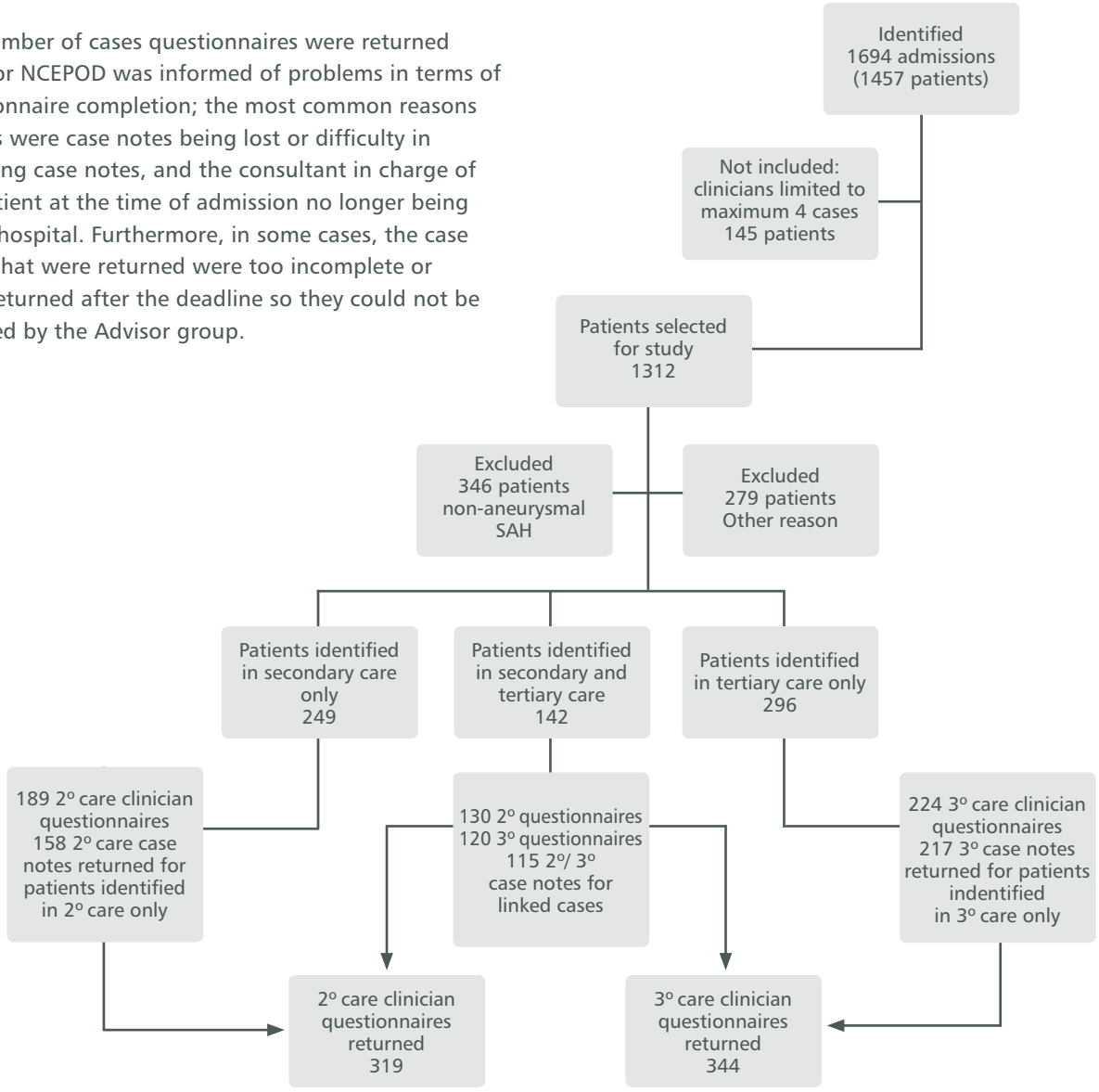


Figure 1.3 Data returns

Table 1.2: Denominators for subgroups of patients at different time points in the patient pathway

Subgroup	Advisor assessment form	Secondary care clinician questionnaire	Tertiary care clinician questionnaire
Total	**427**	**319**	**344**
Secondary care	427	319	-
Referred to NSC	404	-	344
Remained in secondary care	124	-	-
Conservative management	142	-	-
Tertiary care	303	-	344
Procedure	277	-	309
Complications of aSAH	199 (84 delayed cerebral ischaemia, 39 re-bleed, 108 hydrocephalus, 34 other)	-	76 delayed cerebral ischaemia, 24 re-bleed, 94 hydrocephalus
Survived to discharge	272	151 (8 conservatively managed)	299
Died in secondary care	116	146	-
Died in tertiary care	39	-	45
Total died	**155**	**-**	**-**

Study sample denominator data by chapter

Within this report the denominator used in the analysis may change for each chapter and occasionally within each chapter. This is because data have been taken from different sources depending on the analysis required. For example in most cases the data presented will be a total from a question taken from the Advisor assessment form. Where this is a question referring to the whole sample reviewed, the total is 427. However, where the question is looking at a subgroup of patients (e.g. those that underwent a procedure) it will vary as some data are presented as a total from the secondary or tertiary clinician questionnaires (or a subgroup thereof).
In total 427 cases were assessed by the Advisors. The number of tertiary care clinician questionnaires included in the study analysis is 344, the number of secondary care clinician questionnaires included is 319, and the number of organisational questionnaires included is 211. This includes 27/27 Hospitals with Neurosurgical centres (NSCs) and 184 hospitals without an NSC onsite. (Table 1.2)

2 – Organisational data

The aim of this chapter is to provide an overview of the organisational structures in place to identify, transfer and treat patients who suffer an aneuysmal subarachnoid haemorrhage (aSAH). This includes the availability of relevant facilities and staff as well as the presence of relevant policies and protocols.

Table 2.1 Hospital category from which a questionnaire was returned

Hospital type	n	%
District General Hospital <500	103	48.8
District General Hospital >500	50	23.7
Specialist Neurosurgical/ Neurosciences Centre	27	12.8
University Teaching Hospital	31	14.7
Total	**211**	

Table 2.1 shows the type of hospital from which a questionnaire was returned. All 27 hospitals that include a specialist neurosurgical/neurosciences centres (NSC) returned a questionnaire. The remainder of the hospitals from which a questionnaire was returned comprised small District General Hospitals (DGHs) (most commonly) followed by large DGHs and University Teaching Hospitals (UTHs).

Networks of care

Networks of care are an established system within the NHS, describing the regional organisation of a particular service provided by a specialist tertiary care centre and a series of secondary care hospitals that refer patients to it. This arrangement facilitates the referral process in order to move patients quickly and effectively from where they first present in the periphery to the tertiary specialist centre best equipped to treat them. In formal networks there are clear lines of accountability and formal arrangements for referral and transfer. Within informal networks the arrangements are less well defined. Only 11.9% (24/201) of hospitals in this study were part of a formal care network for aSAH patients (Table 2.2). Of those not part of a formal network, 86.5% (128/148) stated they were part of an informal network (Table 2.3). However, there remained 20 hospitals that were not part of any network.

Table 2.2 Part of a formal regional care network

Part of a formal regional network	n	%
Yes	24	11.9
No	177	88.1
Subtotal	**201**	
Not answered	10	
Total	**211**	

Table 2.3 Part of an informal regional care network, if not part of a formal regional care network

Informal regional care network	n	%
Yes	128	86.5
No	20	13.5
Subtotal	**148**	
Not applicable	21	
Not answered	6	
Total	**177**	

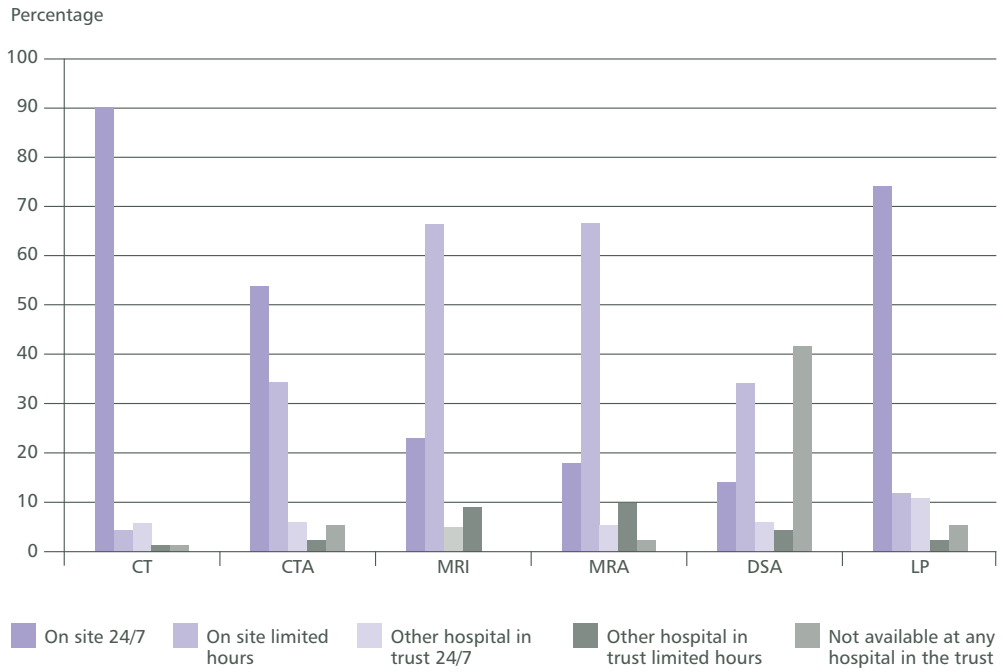


Figure 2.1 Availability of investigations
CT = computerised tomography (n=210); CTA = CT angiography (n=207);
MRI = magnetic resonance imaging (n=209); MRA = magnetic resonance angiography (n=209);
DSA = digital subtraction angiography (n=207); LP = lumbar puncture (n=204)

Facilities

The person completing the questionnaire was asked to document the availability of facilities at the hospital including equipment and workforce with the appropriate skills and experience to carry out procedures required for the accurate diagnosis and treatment of aSAH patients. They were also asked to state whether these were available twenty-four hours per day, seven days per week (24/7). Patients may present to hospital with aSAH at any time of the day or night and there is the need to diagnose aSAH within as short a time frame as possible.

CT scanning

Guidelines recommend that a CT scan be carried out within one hour of arrival in hospital in patients suspected of having a subarachnoid haemorrhage.[13] CT scanning without intravenous contrast enhancement is the preferred initial diagnostic study. However, CT scanning may fail to show small bleeds the later in time the investigation is performed after the time of onset of the of the SAH.[14,15]

In institutions with a high degree of expertise and experience, non-invasive imaging techniques such as CT angiography or magnetic resonance angiography (MRA) may be used in addition to or even replace catheter angiography to identify the underlying aneurysm.

CT scanning was available twenty-four hours per day, seven days per week in 190/210 (90.4%) hospitals included in the study. If other hospitals within the same Trust were included this figure rose to 202/210 (96.2%). Ten hospitals had limited or no ability to perform CT scans on patients with a potential diagnosis of aSAH. The ability to perform investigations other than CT scanning out of hours, is confirmed by the low percentage of hospitals (non-neurosurgical/neuroscience centres) in which magnetic resonance imaging (MRI) (22/180; 12.2%), magnetic resonance angiography (MRA) (14/182; 7.7%) and digital subtraction angiography (DSA) (17/180; 9.4%) were available in centres out of hours (Figure 2.1)

Case study 1

A patient presented with a sudden onset of headache and vomiting. It was known that their father had also suffered an aSAH. There was a 24 hour delay in arranging an MRA as a CT scan was contraindicated in this patient. Following coil embolisation they made a good recovery.

The Advisors considered that this demonstrated a delay due to lack of resources.

Lumbar puncture

Of interest to those involved in medical training is the finding that 11/204 (5.4%) hospitals were unable to perform lumbar punctures on site. Although 152/204 (74.5%) were able to provide this service twenty-four hours a day seven days a week (Figure 2.1). In only 24.6% (41/167) hospitals was there any guidance as to what grade of doctor should perform the lumbar puncture (Table 2.4).

In the 41 hospitals that had a policy for the performance of lumbar puncture, 18 specified that it could be performed by a basic grade doctor (Table 2.5). Lumbar puncture is a procedure that requires skill and experience. It is questionable as to whether this investigation should be delegated to the most junior of medical practitioners.

Table 2.4 Policy for who can perform lumbar punctures

Policy for who can perform lumbar punctures	n	%
Yes	41	24.6
No	126	75.4
Subtotal	**167**	
Not answered	33	
Total	**200**	

Table 2.5 Grade undertaking lumbar punctures

Minimum grade	n
Basic grade FY1/FY2	18
Specialist trainee (registrar)	9
Core Trainee	2
Clinical nurse specialist	2
None (competency based)	2
Not answered	8
Total	**41**

Case study 2

A patient was admitted to secondary care with a suspected aSAH. CT scan was negative. A junior clinician attempted a lumbar puncture but failed. As the patient's headache was subsiding no further attempts were made and no more experienced assistance requested. The patient was discharged on painkillers. The patient presented three days later with a re-bleed.

The Advisors commented that the opportunity to diagnose aSAH should not be missed. More experienced clinicians such as anaesthetists and radiologists should perhaps be approached to assist in cases such as this.

Some policies also specified the specialties that could perform lumbar punctures. These included medicine (17), anaesthesia/intensive care medicine (12), neurology and neurosurgery (3).

Secondary care

In the secondary care hospitals, questions were asked regarding the management of acute/severe headache and the diagnosis of aSAH. It was notable that 32.1% (52/162) of hospitals with an emergency department did not have guidelines or protocols for the management of acute severe headache (including 9 of the 27 hospitals with a NSC) (Table 2.6). Protocol driven investigation of headache can reduce misdiagnosis in this patient group.[16]

Table 2.6 Guidelines/protocols for management of acute/severe headache

Emergency department protocols	n	%
Yes	110	67.9
No	52	32.1
Subtotal	**162**	
Unknown	20	
No ED	29	
Total	**211**	

In hospitals that had guidelines, education highlighting the protocol was included in induction of new medical staff in 85.3% (93/109, 1 not answered) of hospitals and in new nursing staff in 39.8% (39/98, 12 not answered). It is vital that both new medical and nursing staff recognise the symptoms of aSAH and are familiar with the management protocols for these patients. Similarly 50/181 (27.6%) hospitals did not have a standard protocol for the management of patients that have been diagnosed with SAH (including 11/27 hospitals with a NSC). Without protocols in place, it is possible for the diagnosis of SAH to be missed and for delays in referral and treatment to occur. In those hospitals which had a protocol for management (131/181; Table 2.7), it included a head CT as soon as possible (121/131; 92.4%), immediate discussion with a NSC (127/131; 96.9%) and transfer if appropriate (126/131; 96.2%). However, 28/131 (21.4%) hospitals did not include the administration of nimodopine or active control of blood pressure 40/131 (30.5%; Table 2.8).

Table 2.7 Standard protocols for aSAH management

Standard protocol for aSAH management	n	%
Yes	131	72.4
No	50	27.6
Subtotal	**181**	
Not answered	30	
Total	**211**	

Table 2.8 Protocol includes:

Protocol that includes:	Yes (n/131)	No (n/131)	Unknown	%	n/16 NSCs
CT head as soon as diagnosis proposed	121	7	3	92.4	4
Lumbar puncture if CT scan is negative	116	9	6	88.5	13
Immediate discussion with NSC if CT scan/lumbar puncture positive	127	0	4	96.9	15
Arranging transfer to NSC if appropriate	126	0	5	96.2	15
Active control of blood pressure	88	40	3	67.2	6
Administration of nimodipine	98	28	5	74.8	13
Determination of severity using WFNS classification	38	88	5	29.0	11

Prioritisation of patients into treatment pathways is aided by determining the severity of the aSAH. Only 38/131 (29%) hospitals included the WFNS[17] scoring system in their protocol.

Care prior to transfer

In 93.9% (170/181) of hospitals the patients were routinely cared for in the ED or, ED/medical assessment unit complex prior to transfer to a NSC (Table 2.9). In nearly 80% (132/166) of these hospitals, Level 3 care was available in the ED should the patient require it prior to transfer (Table 2.10). In 93.1% of hospitals Level 3 care was available on site (Table 2.11).

Table 2.9 Patients routinely cared for in the emergency department until transfer

Routinely cared for in ED until transfer	n	%
Yes	170	93.9
No	11	6.1
Subtotal	**181**	
Not answered/no ED	30	
Total	**211**	

Table 2.10 Availability of Level 3 care in the emergency department

Level 3 in ED	n	%
Yes	132	79.5
No	34	20.5
Subtotal	**166**	
Not answered	4	
Total	**170**	

Table 2.11 Level of care available in the hospital pre-transfer *(answers may be multiple n/181, 30 not answered)*

Level of care available pre-transfer	n	%
Level 0	116	64.1
Level 1	132	72.9
Level 2	139	76.8
Level 3	170	93.9

Table 2.12 Policy for who looks after aSAH patients

Policy in place	n	%
Yes	109	59.6
No	74	40.4
Subtotal	**183**	
Not answered	28	
Total	**211**	

Table 2.13 Specialties who care for SAH patients *(answers may be multiple n/109)*

Specialties responsible	n	%
Acute medical physician	94	86.2
Medical staff in the ED	91	83.5
Care of the elderly physician	36	33.0
Stroke physician	35	32.1
Neurologist	15	13.8
Other	44	40.4

The questionnaire also asked if hospitals had a policy identifying who would be responsible for aSAH patients. 59.6% (109/183) of hospitals had such a policy (Table 2.12). Most commonly, aSAH patients were the responsibility of the acute physicians or the medical staff in the ED (Table 2.13).

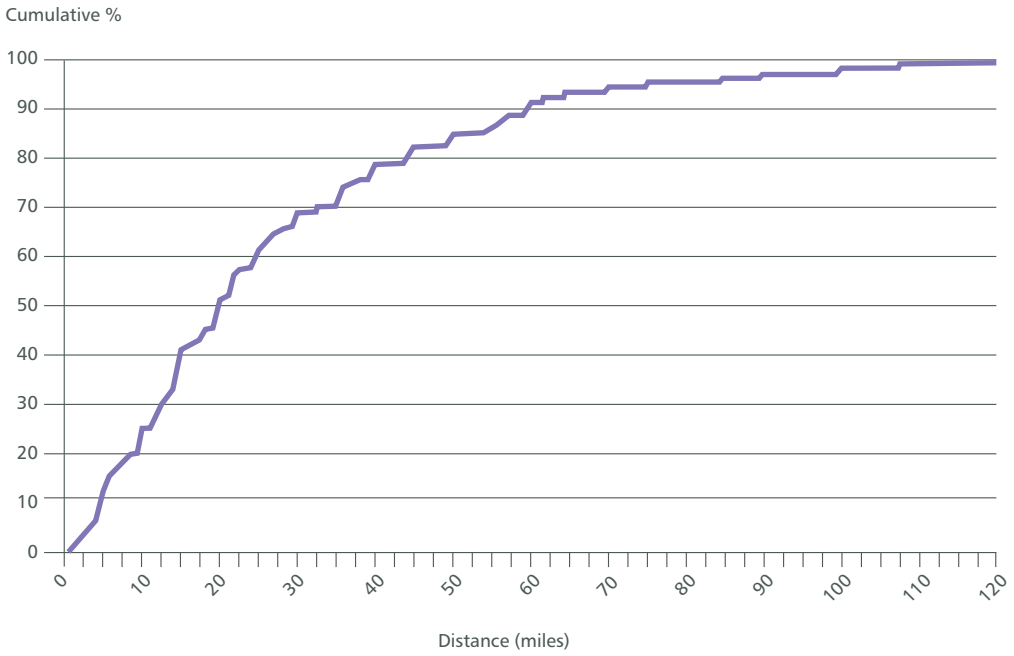


Figure 2.2 Distance to the nearest neurosurgical centre
(n=154, 30 not answered; hospitals without NSC on site)

It is important that once a diagnosis is made, suitable patients should be transferred as soon as possible to the nearest NSC for treatment of their aSAH. The role of networks of care in this process has already been discussed, but to obtain an overview of the distances that patients routinely need to travel to a NSC, the distance to the nearest NSC and the average journey time in the middle of the day was determined. The answers can be seen in Figures 2.2 and 2.3.

Half of the hospitals (78/154) in this study had a NSC within 22 miles and 84.4% (130/154) within 50 miles.

Eighty-six percent (134/156) of hospitals were within one hour travelling time of an NSC in the middle of the working day, whilst eight hospitals were more than an hour and a half by road in the middle of the day.

For almost all secondary care hospitals 157/160 (98.1%) it was policy to discuss aSAH patients with the nearest NSC (Table 2.14). However, from the case review data, it appeared that these policies were not always put into practice.

Table 2.14 Discussion of aSAH cases with NSC

All patients discussed with nearest NSC	n	%
Yes	157	98.1
No	3	1.9
Subtotal	**160**	
Not answered	24	
Total	**184**	

When asked if there were written guidelines for identifying patients for active treatment or those who would be managed conservatively, only 21/183 (1 not answered, 11.5%) responses indicated that this was the

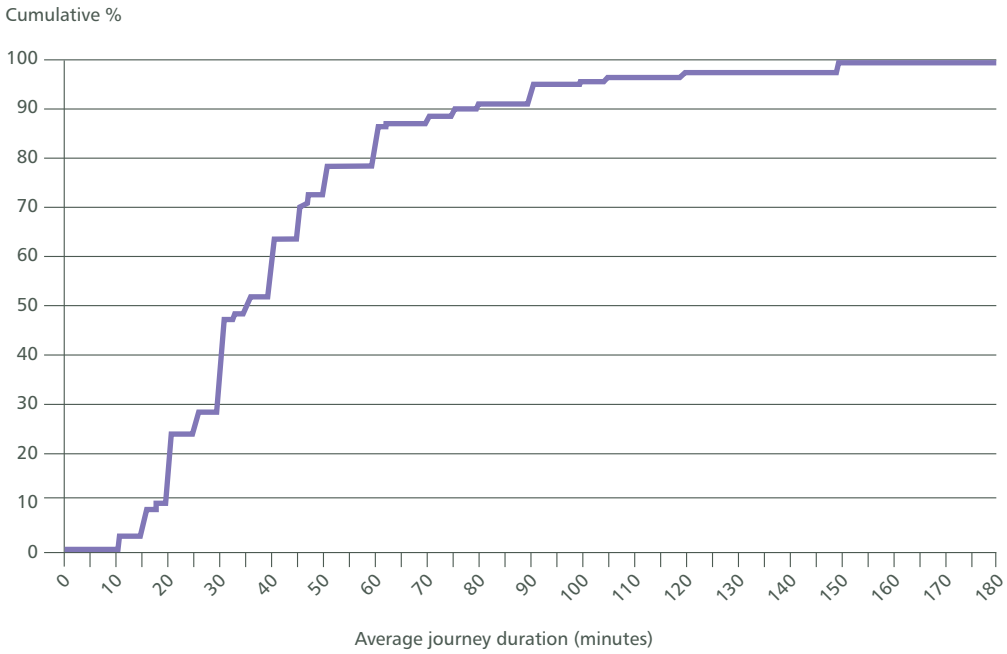


Figure 2.3 Average journey time in the middle of the day
(n=156, 28 not answered; hospitals without NSC on site)

case (Table 2.15). It is assumed that the lack of formal protocols for identifying patients for whom conservative management is appropriate is because individual cases are discussed with the local NSC and it is the NSC that informs the decision as to whether a patient is to be treated actively or conservatively. In those that did have written guidelines, (5 NSCs and 16 secondary care without NSC on-site) the commonest criteria that the decision was based on were the suitability of the cause for treatment, the presence of co-morbidities and the conscious level of the patient (Table 2.16).

Table 2.15 Written guidelines for identifying aSAH patients for transfer/conservative management

Written guidelines	n	%
Yes	21	11.5
No	162	88.5
Subtotal	**183**	
Not answered	28	
Total	**211**	

Table 2.16 Reasons for conservative management of patients *(answers may be multiple n/21)*

Reasons	n/21
Suitability of cause of aSAH for intervention	14
Co-morbidities	13
Conscious state	12
Age	8
Pre-morbid independence	10
Pre-morbid cognitive function	9
Severity of bleed	8
Other	5

Transfer

The development of endovascular treatment of aSAH has increased the number of transfers of patients with non-traumatic brain injury. Patients with aSAH receive their initial treatment at a local hospital, which may not have a NSC on site. As a result, many patients are transferred urgently between hospitals by ambulance, or occasionally by air. In some areas Critical Care Networks and transfer groups have been established according to national directives.[18]

Transfer of patients with brain injury is potentially hazardous if poorly executed and patients can come to harm as a result, with the eventual neurological outcome being adversely affected.[19] Most principles of safe transfer are common to all seriously ill patients but there are some specific features that apply to those with an acute brain injury. These principles apply equally to the transfer of patients both within and between hospitals. The Association of Anaesthetists of Great Britain and Ireland (AAGB&I) have published guidelines for the safe transfer of these patients (Figure 2.4).[20]

Despite this, only 29.3% (49/167) of hospitals had guidelines for the urgent transfer of these patients (Table 2.17). Of those that did have a policy, they were not always comprehensive. 38/49 included staffing arrangements, 34/49 included intubation and 30/49 mentioned the time to transfer. In 34/47 (2 not answered) transfer policies had been agreed with the nearest NSC.

Departure checklist

1. Do attendants have adequate competencies, experience, knowledge of case, clothing, insurance?
2. Appropriate equipment and drugs? Batteries checked? Sufficient oxygen? Trolley available?
3. Ambulance service aware or ready? Bed confirmed? Exact location?
4. Case notes, X ray films, results, blood collected?
5. Transfer chart prepared?
6. Portable phone charged?
7. Contact numbers known?
8. Money or cards for emergencies?
9. Estimated time of arrival notified?
10. Return arrangements checked?
11. Relatives informed?
12. Patient stable, fully investigated?
13. Monitoring attached and working?
14. Drugs, pumps, lines rationalised and secured?
15. Adequate sedation?
16. Still stable after transfer to mobile equipment?
17. Anything missed?

Figure 2.4 AAGB&I transfer checklist

Table 2.17 Guidelines for the transfer of urgent patients

Transfer of urgent patients	n	%
Yes	49	29.3
No	118	70.7
Subtotal	**167**	
Not applicable	13	
Not answered	31	
Total	**211**	

Repatriation following intervention at a NSC

The majority of secondary care hospitals referring aSAH patients to NSCs (161/181; 89.0%) would readmit patients for post-operative care and rehabilitation following the definitive treatment in a NSC (Table 2.18). In secondary care hospitals general physicians were most often responsible for their care (103/161; 63.9%). A specialist rehabilitation service for repatriated patients was available in only 51/161 hospitals (Table 2.19). When asked about the inpatient support available from relevant allied health care professionals and rehabilitation specialists, the majority of secondary care

hospitals could offer physiotherapy and occupational therapy (both 151/161; 93.8%). However, just under half (69/161; 42.9%) could provide some form of specialist neurorehabilitation care and only 63/161 (39.1%) could offer neuropsychological support (Table 2.20). The cognitive and behavioural impairments caused by aSAH are often more disabling than the physical effects. Neuropsychological assessment and treatment should play an important part in all phases of recovery.

Table 2.18 Patients return to a secondary care hospital following coiling/clipping

Return to secondary care	n	%
Yes	161	89.0
No	20	11.0
Subtotal	**181**	
Unknown	3	
Not answered	27	
Total	**211**	

Table 2.19 If the patient returns to secondary care who is responsible for them? *(answers may be multiple n/161)*

Who is responsible?	n/161	%
Specialist neurorehabilitation service	51	31.7
Specialist neurology service	25	15.5
Physicians on general ward	103	64.0
Other	44	27.3

Table 2.20 Support available *(answers may be multiple n/161)*

Support available	n/161	%
Specialist rehabilitation nurse	58	36.0
Physiotherapy	151	93.8
Occupational therapy	151	93.8
Specialist rehabilitation consultant	69	42.9
Neuropsychology	63	39.1
Other	24	14.9

After discharge from a secondary care hospital the rehabilitation picture was similar. Most hospitals could offer occupational therapy (128/161; 79.5%) and physiotherapy (138/161; 85.7%) as out patients but only a minority could provide specialist rehabilitation (61/161; 37.9%) or neuropsychological support (58/161; 36%). Only 28/161 (17.4%) stated that patients would have a specific case worker post discharge (Table 2.21).

Table 2.21 Post-discharge support *(answers may be multiple n/161)*

Post-discharge support	n/161	%
Physiotherapy	138	85.7
Occupational therapy	128	79.5
Physiotherapy (domiciliary)	102	63.4
Occupational therapy (domiciliary)	101	62.7
Specialist rehabilitation consultant	61	37.9
Neuropsychology	58	36.0
Hospital at home	32	19.9
Specific case worker	28	17.4
Specialist rehabilitation nurse	28	17.4
Other	20	12.4

Clinical governance

Good clinical governance requires that all hospitals should ensure that morbidity and mortality (M&M) audit meetings are held to review the quality of care received by patients with aSAH.

Tables 2.22 – 2.24 provide details on the clinical governance of aSAH patients in secondary care. It was found that only 25/130 (19.2%) hospitals were part of a formal network with regional audit or multi-disciplinary team (MDT) meetings for the discussion of patients with aSAH that had been cared for in both secondary care hospitals and a NSC. This was remarkable given the shared responsibility of secondary and tertiary care for these patients and the role of each hospital team in obtaining the best outcomes.

Table 2.22 Regional Audit/MDT

Regional audit	n	%
Yes	25	19.2
No	105	80.8
Subtotal	**130**	
Unknown	49	
Not answered	32	
Total	**211**	

In those hospitals that undertook some form of combined regional audit, this mostly took place more frequently than twice per year (18/25) most reviewing outcome following an intervention (15/25, Table 2.23).

Table 2.23 Topics that were audited regionally

Audit the following (n/25):	Yes	No	Unknown
Misdiagnosis	13	1	11
Transfer related problems	12	4	9
Outcomes for conservatively managed patients	8	4	13
Outcomes for patients undergoing intervention	15	0	10
Complications	14	1	10

Table 2.24 If not part of regional audit were aSAH patients included in audit/M&M meetings within the hospital

M&M meeting	n
Yes	60
No	21
Subtotal	**81**
Unknown	17
Not answered	7
Total	**105**

Where a regional audit/MDT meeting did not take place, 60/81 hospitals undertook their own audit and M&M meetings. There were 21/81 hospitals that did not include patients with aSAH as part of any audit/M&M meeting. In those that included aSAH patients as part of routine hospital audit/M&M, it was asked whether it was performed by the ED (it was in 18/58 (2 not answered)) and if not, then by which department. Most commonly this was by general medicine (16), general physicians (2) neurosurgery/neurology (10); patient safety (3); not answered (7)).

Tertiary care

The neurosurgical/neuroradiological care of patients with a diagnosis of aSAH is arranged regionally between 27 specialist neurosurgical/ neurosciences centres. An organisational questionnaire was received from all 27/27 of these centres.

Decision to admit

The standardisation of the decision making process relating to the acceptance of aSAH patients referred to a NSC is difficult. NSCs must balance the availability of resources for those that are amenable to treatment and likely to have a good outcome with the wish not to deny treatment to any patient that might benefit. Hence it may not be surprising that it is more common for NSCs to have no formal policy for accepting patients and for the on-call consultant neurosurgeon or neurosurgical registrar to make the decision on a case by case basis (Table 2.25).

Table 2.25 Formal policy for discussing/accepting patients

Formal policy for accepting patients	n
Yes	9
No	17
Unknown	1
Total	**27**

Factors that might determine the decision are listed in Table 2.26, the most common being the neurological grade (24/27). However, co-morbidities (23/27), availability of beds (23/27) and age (22/27) were also considered. In 21/27 NSCs a record was kept of the patients who were referred from secondary care but not accepted.

NSCs were asked if they had a written protocol defining the pre-operative management of aSAH patients. In only seven hospitals was this the case. However, in four of these hospitals the protocol determined the level of care and in five hospitals it determined the investigations performed, the adjuvant therapy given and the monitoring techniques employed.

Table 2.26 Factors that determine the decision to accept patients *(answers may be multiple)*

Reasons	n/27
Age	22
Neurological grade	24
Co-morbidities	23
Conscious state	21
Suitability of cause of aSAH	19
Pre-morbid independence	23
Pre-morbid cognitive function	20
Availability of beds	23
Availability of staff	17
Unknown	7
Other	2

In only three NSCs were there any written guidance on the appropriate intervention: surgical clipping or interventional neuroradiology. Again, decisions appear to be made on a case by case basis by the admitting neurosurgeon or neuroradiologist. Neurovascular anatomy was the most common defining criterion. One NSC stated that the time of admission was a factor, given that there was no neuroradiology coiling service available at weekends.

Whilst the ideal timing of coiling or clipping after aSAH is not certain, there is evidence to support the practice of early aneurysm treatment in aSAH and the Royal College of Physicians guidelines on stroke state that this should be done within 48 hours .[6,21,22]

Only five NSCs had a policy document stating the ideal timing of treatment for aSAH patients. In those without a policy, there was variation in the answers given for when the NSC would intervene in good grade and poor grade aSAH patients. Most would intervene within 48 hours in good grade patients (Table 2.28), and in mid/poor grade the patient's clinical status played more of a role in the decision making process, with treatment taking place once the patient's condition had stabilised (Tables 2.29, 2.30). However for one hospital it was stated that they did not treat WFNS grade 5 patients (Table 2.30).

Table 2.27 If no written guidance, what criteria determined the method of definitive aSAH treatment *(answers may be multiple n/22)*

Criteria	n/22
Neurovascular anatomy	21
Vascular access	15
Age	12
Availability of neuroradiologist	9
Availability of nursing staff	4
Availability of neurosurgeon	3
Availability of equipment	0
Other	4

Table 2.28 When would NSC intervene in good grade (WFNS grade I-II) patient?

Usually intervene in good grade patients:	n/19
<24 Hours	2
<48 Hours	7
<72 Hours	2
<120 hours	1
As soon as possible	3
Next working day if stable	2
Other	1
Not answered	2

Table 2.29 When would NSC intervene in poorer grade (WFNS grade III-IV) patient?

Usually intervene in poorer grade patients:	n/19
<24 Hours	4
<48 hours	3
Coiling as soon as possible, clipping delay-up to 10 days	2
Depend on clinical status	6
Next working day if stable	2
Other	1
Not answered	2

Table 2.30 When would NSC intervene in poor grade (WFNS grade V) patient

Usually intervene in poor grade patients:	n/19
<24 Hours	1
Depend on clinical status	8
Next working day if stable	1
Wait until improve/flex to pain/localise	4
Sometimes treated	2
Do not treat WFNS grade 5 patients	1
Not answered	7

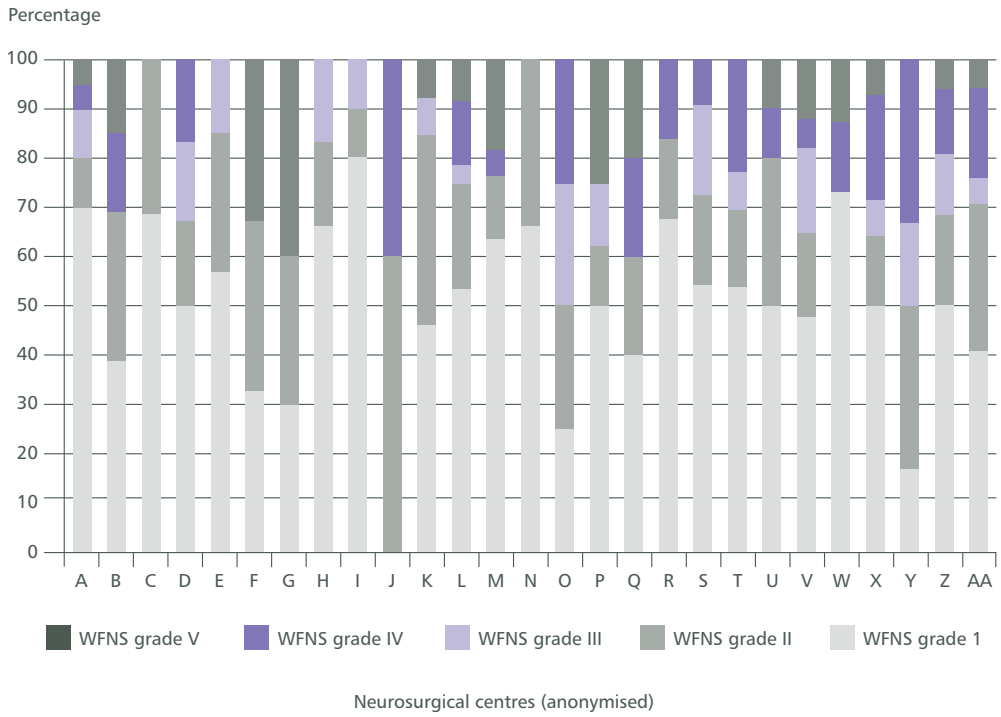


Figure 2.5 Proportion of cases in the study of each WFNS grade treated at each regional NSC (n=303)

Figure 2.5 shows the proportion of each WFNS grade of cases submitted for review by each NSC. It can be seen that there was variation in the proportion of good and poor grade patients that were treated between NSCs, with 12/27 having no grade 5 patients in the case mix submitted. Whether this is co-incidence (grade V patients only comprised about 5% of the datasets from those centres who did treat them during the study) or represents a true management decision is not clear.

Multi-disciplinary team meetings

Multi-disciplinary team (MDT) meetings are established in many care pathways and are of benefit to patient care. MDT meetings can ensure a smooth transition between services avoiding duplication of effort. Other advantages are provision of education, understanding the roles of others and widening skills. All NSCs held MDT meetings and they were most commonly held on a weekly basis (21/24; 3 not answered). In all NSCs that answered the question (26/27), one or more consultant interventional radiologist and/or consultant neurosurgeon would attend the MDT.

In 19/27 NSCs it was stated that the proposed management of patients with aSAH was normally discussed at an MDT meeting (when clinical urgency permitted) (Table 2.31). Within local networks the formal documentation of MDT discussions, with regular local review, would aid planning and the enhancement of care.

Table 2.31 The management of aSAH patients was normally discussed at an MDT

Management discussed at MDT	n
Yes	19
No	4
Subtotal	**23**
Not answered	4
Total	**27**

Availability of staff and facilities

NSCs were asked to document the availability of senior clinicians from different specialties involved in the care of aSAH patients: whether it was twenty four hours per day, seven days per week, twenty four hours per day/ Monday-Friday or more limited hours (Figure 2.6). In all but one NSC consultant neurosurgeons, and intensivists were available twenty four hours per day, seven days per week. However in only 10/27 units were interventional neuroradiologists available on the same basis.

This increased to 17/27 (63%) when twenty four hour weekday availability was included and 27/27 for daytime hours Monday to Friday. As the majority of aSAH patients are treated by interventional radiologists, it is clear that there is a gap in the service provision.

NSCs were asked about the level of care post intervention regardless of the method of treatment. In 18/27 of hospitals patients were usually cared for in Level 2 (HDU) beds (Table 2.32).

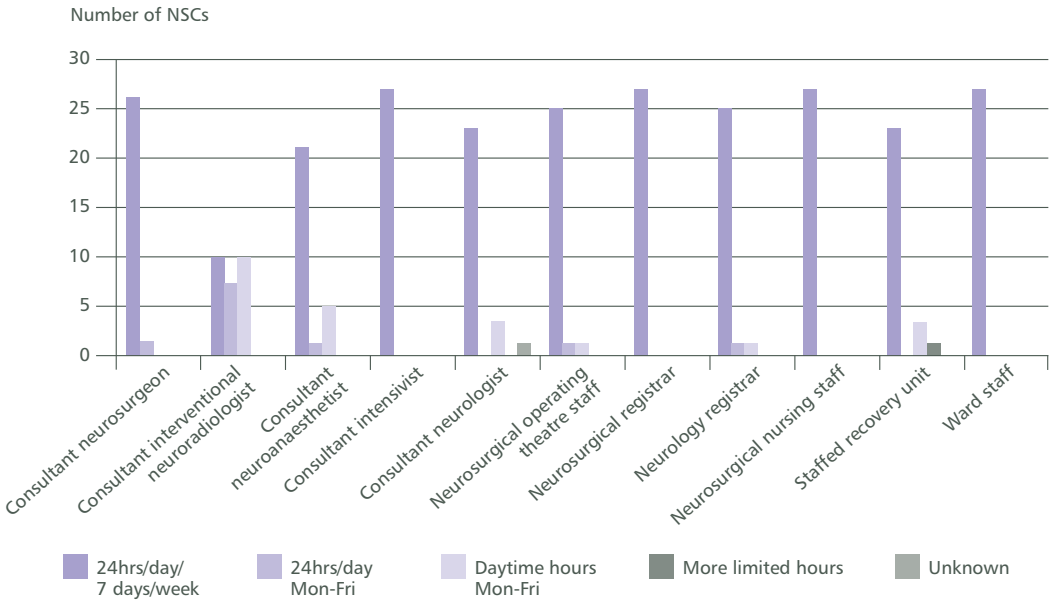


Figure 2.6 Availability of clinicians in NSCs (n=27)

Table 2.32 Usual level of care post-intervention

Following intervention (n/27)	Level 3	Level 2	Level 1	Level 0
After surgical clipping	5	18	4	0
After endovascular treatment	5	18	3	1

It was also asked whether there were written protocols that covered the post-operative management of patients with aSAH (Table 2.33). In half of the NSCs (12/24) no such protocols existed and 16/27 NSCs did not have protocols to aid the identification of complications of aSAH (Table 2.34). The benefits of evidence based-protocols on the delivery of high quality healthcare are well established and it is logical to suggest that there would be some benefit if NSCs shared best practice protocols.

Table 2.33 Written protocols covering post-operative management

Written Protocols	n
Yes	12
No	12
Subtotal	**24**
Unknown	3
Total	**27**

Table 2.34 Protocols to identify patients with complications of aSAH

Protocols for patient with: (n/27)	Yes	No	Unknown
Delayed cerebral ischaemia	8	16	3
Re-bleeding	7	17	3
Hydrocephalus	7	16	4

Investigations

NSCs were asked which investigations and which methods of monitoring were routinely employed post-operatively (Tables 2.35 and 2.36). More than half of the NSCs routinely employed CT scanning (15/27) or MRI (11/27) and 8/27 routinely performed CTA.

Patients in all the NSCs benefitted from pulse oximetry post-operatively and in the majority of NSCs intra-arterial (24/27) or non-invasive (20/27) blood pressure measurement. However, only 7/27 NSCs routinely used transcranial Doppler (TCD) in post-operative patients; this may be due to the limited sensitivity and predictive value of TCD for identifying patients at high risk for delayed cerebral ischaemia (DCI) after aSAH.

Table 2.35 Investigations performed post-operatively
(answers may be multiple n/27)

Post-operative investigations	n/27
CT scan	15
Digital subtraction angiography	8
CT angiography	8
MRI	11
None	5
Unknown	1

Table 2.36 Method of post-operative monitoring *(answers may be multiple n/27)*

Post-operative monitoring	n/27
Pulse oximetry	27
Central venous pressure measurement	16
Intra cranial pressure measurement	8
Transcranial Doppler	7
Cardiac output	4
CFM/EEG	2
Intra Arterial blood pressure	24
Non-invasive blood pressure	20

Rehabilitation

Although inpatient rehabilitation services were available in 21/27 NSCs, 17 of these centres normally repatriated patients back to the referring secondary hospital for rehabilitation. The detail of these services in NSCs is shown in Table 2.37. In all sites this included physiotherapy and the majority include a specialist rehabilitation consultant and nurse led care. In 20/21 NSCs neuropsychology support was available.

Table 2.37 Detail of in-patient rehabilitation in NSCs *(answers may be multiple)*

Inpatient rehabilitation	n/21
Inpatient physiotherapy	21
Inpatient occupational therapy	21
Rehabilitation nurse specialist	15
Rehabilitation consultant	18
Neuropsychology	20
Other	2

Table 2.38 Services post discharge

Services post discharge	n/27
Hospital at home	5
Specific case worker	4
Neuropsychology	12
Specialist nurse	10
Physiotherapy	24
Physiotherapy (domiciliary)	10
Occupational therapy	24
Occupational therapy (domiciliary)	11
Other	3

NSCs were also asked what services were available to aSAH patients following discharge. The full range of supportive services was not available in most NSCs: specific case worker 4/27; specialist nurse 10/27; neuropsychology 12/27 (Table 2.38).

End of life care in secondary and tertiary care

Protocol based care enables NHS staff to put evidence into practice by addressing the key questions of what should be done, when, where and by whom at a local level. It provides a framework for working in multi-disciplinary teams and across established hospital boundaries. This standardisation of practice reduces variation in the treatment of patients and improves the quality of care.[23]

Patients in whom a decision is made to withhold treatment because their condition is unsurvivable may be managed in a formal end of life care pathway. However, Table 2.39 shows that one in five hospitals had no formal policy or protocol to manage patients near the end of their lives. These protocols can help improve the care of dying hospitalised patients when used appropriately. Ensuring comfort and dignity for patients at the end of their lives has to be a priority for clinicians.

Table 2.39 Written policy or protocol for End of Life Care

Written policy for EoLC	n	%
Yes	149	80.5
No	36	19.5
Subtotal	**185**	
Not answered	26	
Total	**211**	

Organ donation in secondary and tertiary care

Between April 2011 and March 2012, 3960 organ donations occurred in the UK thanks to the generosity of 2,143 donors and their relatives.[24] However, there are always substantially more people waiting for organ transplant than there are suitable donors. Such is the catastrophic nature of aSAH that this condition may result in a significant number of potential donors. The Department of Health in England has urged all parts of the NHS to embrace organ donation as a usual, not an unusual event and stated that local policies, constructed around national guidelines, should be put in place. Discussions about donation should be part of all end of life care when appropriate. Each Trust should have an identified clinical donation champion and a Trust donation committee to help achieve this.[25]

Table 2.40 Intensive care unit policy suggesting organ donation where appropriate

Organ donation policy	n	%
Yes	178	97.8
No	4	2.2
Subtotal	**182**	
Not answered	29	
Total	**211**	

Nearly all hospitals had a policy covering organ donation (178/182; Table 2.40) and a designated member of the intensive care team to facilitate it was declared in nearly all hospitals (171/178; 96.1%). Although this is encouraging, data presented later in this report provides an insight on the performance of UK hospitals in respect of patients dying from aSAH.

Table 2.41 Organ donation policy covers: *(answers may be multiple n/166, 12 not answered)*

Written policy covers	n	%
Suitable donors	145	87.3
Method of contacting transplant co-ordinator	150	90.4
Grade and specialty of doctor that discusses option with the patient's family	87	52.4
Other	38	22.9

Key findings

Secondary care only

32.1% (52/162) of secondary care hospitals had no protocol or policy for the investigation and treatment of acute onset headache.

29% (38/131) of secondary care hospitals used the WFNS subarachnoid haemorrhage grading to assess patients.

84.4% (130/154) of secondary care hospitals are within 50 miles of a neurosurgical/neuroscience centre.

85.3% (133/156) of secondary care hospitals are within one hour of the nearest neurosurgical/neuroscience centre by road.

70.7% (118/167) of secondary care hospitals did not have formal transfer protocols.

Tertiary care only

22/27 of neurosurgical/neuroscience centres did not have a policy defining the optimal timing of treatment of aneurysmal subarachnoid haemorrhage patients.

20/27 of neurosurgical/neuroscience centres did not have a policy for pre-operative care of aneurysmal subarachnoid haemorrhage patients.

17/27 of neurosurgical/neuroscience centres did not have interventional radiologists available seven days a week.

Both secondary and tertiary care

88.1% (177/201) of hospitals were not part of formal networks of care.

90.5% (190/210) of hospitals could perform CT scans twenty-four hours/day, seven days/week.

25.5% (52/204) of hospitals were not able to perform lumbar punctures twenty-four hours/day, seven days/week.

75.4% (126/167) of hospitals undertaking lumbar punctures did not have a policy defining who should perform them.

97.5% (178/182) of hospitals had a policy for organ donation and 96.1% (171/178) of hospitals had an intensive care team member to facilitate it. (see key finding on page 93 of the full report with regard to how this policy was actually used)

80.8% (105/130) of hospitals did not participate in regional audit or multi-disciplinary team meetings.

39.1% (63/161) of secondary care hospitals offered neuropsychological support to in-patients, repatriated post procedure and 36% (58/161) could offer neuropsychological support post-discharge.

20/27 of neurosurgical/neuroscience centres could offer neuropsychological support for in-patients and 12/27 could offer neuropsychological support post-discharge.

Recommendations

1. Formal networks of care should be established, linking all secondary care hospitals receiving subarachnoid haemorrhage patients to a designated regional neurosurgical/neuroscience centre. *(Medical Directors)*

2. All hospitals should undertake regional audit or multi-disciplinary team meetings, in order to share learning that could improve the care provided to aneurysmal subarachnoid haemorrhage patients. *(Medical Directors and Clinical Directors)*

3. The availability of interventional neuroradiology services should be such that hospitals can comply with the *'National Clinical Guideline for Stroke'* stating that patients should be treated within 48 hours of their aneurysmal subarachnoid haemorrhage. *(Medical Directors and Clinical Directors)*

3 – Secondary care

This chapter describes the demographics of patients sampled in the study, and the care provided to those patients who presented to secondary care hospitals with an aneurysmal subarachnoid haemorrhage (aSAH).

Patient population

Patients were distributed normally for age and the group was made up of 70% females and 30% males. This is in line with published international data where the prevalence of aSAH in women peaks in the sixth decade of life (Figure 3.1).[26]

Table 3.1 Age (years)/ gender of patients in the study population n=427

	All	Female	Male
Mean	58.7	60	55.9
Median	57	60	55
Range	24-97	24-97	27-89

The mean age was 58.7 years (60 in females, 55.9 in males) and the median age was 57 (60 in females, 55 in males; Table 3.1). The age range was 24-97 with females spanning the entire range. It has been reported that in the age group 25–45 years, the incidence of aSAH is significantly higher in men than in women, but in the age group 55–85 years; the incidence is significantly higher in women than in men.[26]

Presentation to general practice

The management of headache in primary care is challenging. It is common and 90% of the population in the United Kingdom will suffer a headache at some point in their lives. It accounts for 4.4% of consultations in general practice and 30% of neurology outpatient consultations. A full-time general practitioner (GP) with 2000 patients will see, on average, one patient with a headache every week but only one aSAH every 7-8 years. Thus the diagnosis and management of headache is difficult and rare, or serious causes, might be missed.[27]

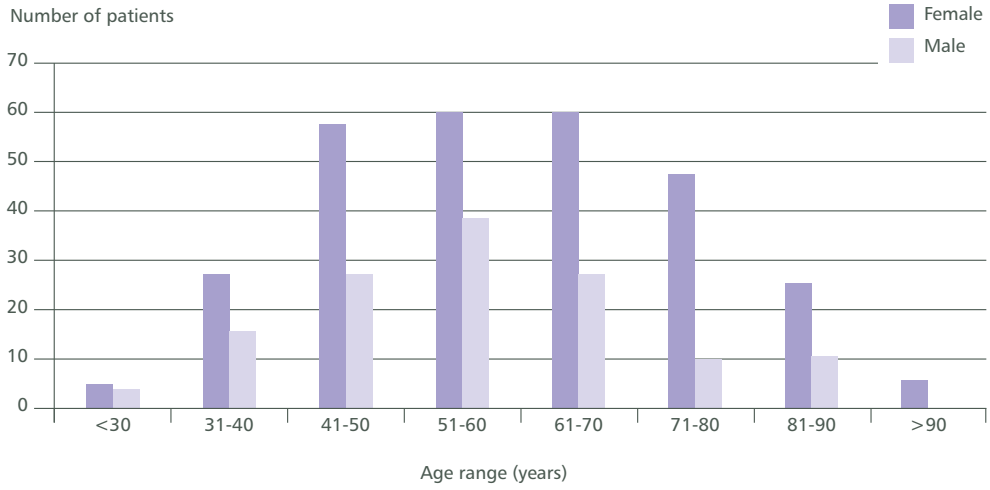


Figure 3.1 Age/gender of patients in the study population

Of the cases included in this study, 17.6% (75/427) of patients saw their GP in relation to the symptoms of the current episode of aSAH. The Advisors considered that the diagnosis of aSAH was delayed or overlooked by the GP in 32/75 of these patients. Furthermore the Advisors considered that the outcome was potentially affected by the resulting delay in diagnosis in 23/32 patients.

Case study 3 provides an example of delayed diagnosis in primary care.

Case study 3

An elderly patient complained to their GP that they had had a severe headache for 24 hours that had not responded to analgesia. Severe spasm and pain in the neck muscles were noted by the GP. The patient also complained that light was upsetting but this was not considered to be "true" photophobia. Co-codamol and diazepam were prescribed. The next day the patient telephoned the surgery as they were no better and was asked to attend surgery that evening. Subsequently the patient was referred to the local hospital where their management was exemplary and the aneurysm successfully treated.

The Advisors noted that despite classical symptoms and signs the patient was not admitted to hospital for 36 hours and stated that guidelines on the management of severe headache need to be circulated to clinicians in primary care.

Presentation to secondary care

All the patients in the study population presented to secondary care.

For cases that were reviewed by Advisors and where a secondary care questionnaire was included, Table 3.2 shows the type of hospitals to which they first presented. 352 patients (82.4%) attended a secondary/acute (non-specialist) hospital and 75 presented to a hospital with a neurosurgical/neurosciences centre (NSC) on site. Advisors identified 137/371 (56 not answered) cases where the patient remained in an emergency department (ED) in a secondary care facility without being formally admitted to the hospital prior to being transferred to tertiary care (either in the same hospital or at a different hospital) or dying in the ED.

Table 3.2 Hospital type for first recorded admission
(Secondary care clinician questionnaire/Advisor assessment form)

Hospital category	n	%
Secondary/acute (non-neurosurgical/neurosciences specialist hospital)	352	**82.4**
Hospital with onsite NSC	75	17.6
Total	**427**	

There has been some concern about the availability of resources to care for aSAH patients in secondary care both during normal working hours and outside this time. Review of the admission data shows that patients presented to secondary care consistently throughout the week (Table 3.3).

Table 3.3 Day of the week of first arrival to secondary care *(Advisor assessment form)*

Day of the week	n	%
Monday	72	16.9
Tuesday	60	14.1
Wednesday	73	17.1
Thursday	58	13.6
Friday	58	13.6
Saturday	46	10.8
Sunday	60	14.1
Total	**427**	

When the time of arrival was established, 60.6% (229/378) of patients arrived during normal working hours (08:00-18:00) (Table 3.4). However when weekends were excluded from this time frame, the overall percentage seen in normal working hours fell to 45.8% (173/378).

Table 3.4 Time of first arrival in secondary care *(Advisor assessment form)*

Time of arrival to secondary care	n	%
00:00-07:59	48	12.7
08:00-17:59	229	60.6
18:00-23:59	101	26.7
Subtotal	**378**	
Insufficient data	49	
Total	**427**	

Initial assessment

When looking at the grade of clinician who performed the initial assessment, this information was only available in 245 cases (mainly because the grade was not documented in the case notes) (Table 3.5). Where this information was available, only 51.4% (126/245) of patients were initially assessed by a senior doctor (consultant or senior trainee).

Table 3.5 Grade of clinician conducting the initial assessment *(Advisor assessment form)*

Grade of clinician	n	%
Consultant	35	14.5
Staff Grade/Associate Specialist	19	7.9
Trainee with CCT	3	1.2
Senior Specialist Trainee	69	28.6
Junior Specialist Trainee	32	13.3
Basic Grade	75	31.1
Nurse	8	3.3
Other	4	1.7
Subtotal	**245**	
Insufficient data	182	
Total	**427**	

The specialty of the clinician conducting the initial assessment was recorded in 291/427 cases. The majority of initial assessments were undertaken by emergency medicine (200/291; 68.7%), acute medicine (15/291; 5.2%), general medicine (48/291; 16.5%) or intensive care specialists (15/291; 5.2%), with stroke/neurology specialists performing only 3.1% of these (9/291) (Figure 3.2). The variety of specialties conducting the initial assessment reflects the wide range of clinical presentations of aSAH requiring the attention of intensivists when comatosed, and other acute specialties when presenting with headache and other neurological symptoms.

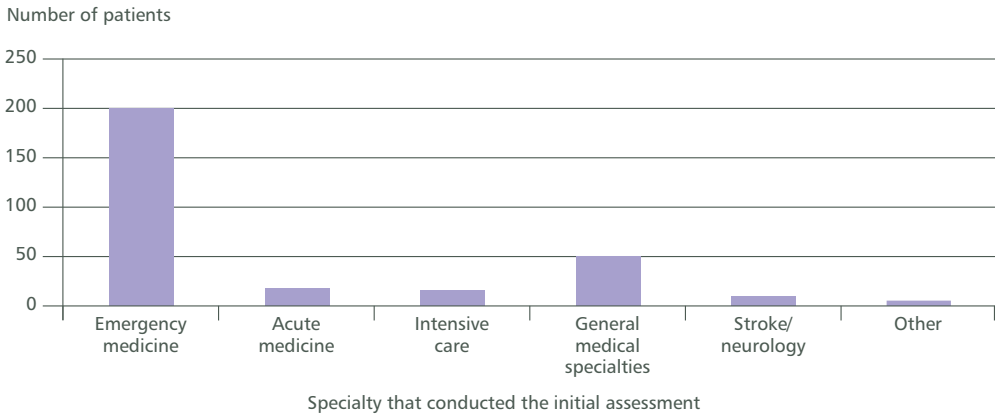


Figure 3.2 Specialty of clinician conducting the initial assessment (n=291, insufficient data in 136)
(Advisor assessment form)

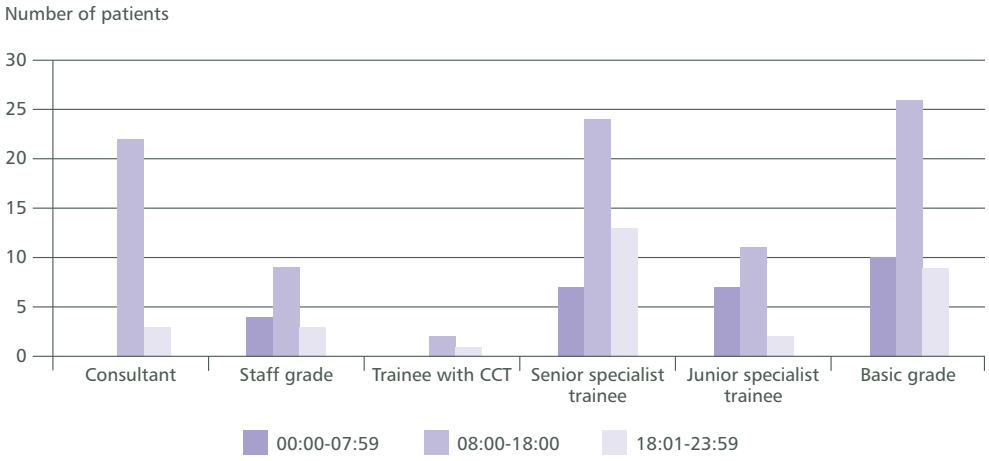


Figure 3.3 Grade of clinician conducting the initial assessment: different timeframes (n=153)
(Advisor assessment form)

The grade of clinician performing the initial assessment at different timeframes is shown in Figure 3.3. Patients were not assessed as often by senior clinicians out of the normal working hours, with consultants performing 22/94 initial assessments from 08:00 to 18:00, 3/31 between 18:01 and 23:59 and 0/28 between 00:00 and 07:59.

Case study 4 gives an example of where symptoms can be misleading and experience in recognising aSAH is required.

Case study 4

A middle aged patient called an ambulance because of the sudden onset of nausea, vomiting, palpitations, heavy legs, pounding head and headache. The patient had consumed a number of glasses of wine. On admission an FY2 and cardiology registrar reviewed the patient. The initial diagnosis was alcohol intoxication leading to atrial fibrillation with vomiting and headache. The patient was cardioverted with intravenous amiodarone and was observed. Three days following admission the patient was seen by a consultant physician for the first time. The consultant reviewed the history and noted some minor neurological symptoms. A CT scan was performed and the diagnosis of aSAH made. The patient was then transferred to a local neurosurgical centre.

The Advisors remarked that this case demonstrated the cardiovascular complications that may occur with aSAH and how the atrial fibrillation was in fact a "red herring" being the effect rather than cause.

Having established who performed the initial assessment, the Advisors were asked to assess the quality of the initial assessment in respect of history taking, neurological examination, investigation planning, differential diagnosis and treatment planning.

Past medical history

An accurate description of the patient's past medical history is important to provide a contextual understanding of the presenting condition and may affect subsequent treatment planning and management.

It was considered by the Advisors that a satisfactory history had been taken in the majority of cases 325/341 (95.3%) (Table 3.6).

Table 3.6 Adequate past medical history *(Advisor assessment form)*

History taking was adequate	n	%
Yes	325	95.3
No	16	4.7
Subtotal	**341**	
Insufficient data	86	
Total	**427**	

Certain co-morbidities are more common in patients presenting with aSAH. Modifiable risk factors are hypertension, smoking and excessive alcohol intake, all of which have been reported to double the risk of aSAH.[28] In this study the most common co-morbidities were hypertension, ischaemic heart disease and diabetes (Table 3.7) although 34.6% (104/301) of patients had no co-morbidities.

Table 3.7 Co-morbidities in the patient population
(Answers may be multiple n/301, 18 not answered; secondary care clinician questionnaire)

Co-morbidities	n	%
Hypertension	121	40.2
None	104	34.6
Unknown	33	11.0
Angina, myocardial infarction, arrhythmia	32	10.6
Other	25	8.3
Diabetes	21	7.0
COPD	21	7.0
Ischaemic stroke	19	6.3
Cancer	17	5.6
Dementia/mental health problems	11	3.7
Renal impairment	8	2.7
Migraine/tension headache	8	2.7
Arthritis	8	2.7
Smoker	7	2.3
Hyperthyroidism	4	1.3
Hypercholesterolaemia	4	1.3
Irritable bowel syndrome	4	1.3
Abdominal aortic aneurysm	3	1.0

According to the Advisors, 37 patients had previously presented to secondary care with symptoms relating to their current aSAH. Of these patients, the Advisors stated that the diagnosis had been overlooked in 24 cases, and that the outcome could have potentially been affected in 17/24 of these. In 4/24 of these cases the outcome was death. From the secondary care clinician questionnaire, 11 patients (3.4%) had a history of a previous aSAH.

Of these, six patients had undergone surgical clipping, one had undergone endovascular coiling and in two cases the treatment received was not known.

The secondary care clinician questionnaire/Advisor assessment form indicated that prior to this hospital admission with aSAH, 70% (269/385) of the patients had no symptoms or no disability (Table 3.8). Furthermore, only 9.6% (37/385) of patients in this study had moderate or severe disability prior to presenting to secondary care. This reflects the relatively young age at which aSAH most often occurs, and is important when considering the outcome of treatment.

Table 3.8 Functional status prior to this aSAH *(Secondary care clinician questionnaire/Advisor assessment form)*

Functional status prior to aSAH	n	%
No symptoms	269	69.9
No significant disability despite symptoms	43	11.2
Slight disability	36	9.4
Moderate disability	22	5.7
Moderate to severe disability	11	2.9
Severe disability	4	1.0
Subtotal	**385**	
Unknown	42	
Total	**427**	

Neurological examination and neurological status on arrival

From the review of the case notes, the Advisors found that 18% (62/344, insufficient data in 83) of patients had no neurological examination performed or documented on admission to secondary care.

Asking the same question of the admitting clinician on the secondary care clinician questionnaire revealed a similar lack of neurological examination in 32/312 cases (Table 3.9). Of these cases 10 had a GCS of 3-5, which could explain why a detailed neurological examination could not be performed. However, this was not the case in seven cases, where the GCS was 7-15 (in 15 cases the GCS was unknown).

Table 3.9 Neurological examination performed *(Secondary care clinician questionnaire)*

Examination performed	n	%
Yes	280	89.7
No	32	10.3
Subtotal	**312**	
Unknown	7	
Total	**319**	

In those patients that did undergo a neurological examination, the pupil responses and presence of a motor deficit are shown in Tables 3.10 and 3.11. 20.7% (58/280) of patients had pupillary abnormalities and 36.2% (89/246) had a motor deficit.

Table 3.10 Pupil responses *(Secondary care clinician questionnaire)*

Pupil responses	n	%
Bilaterally reacting	191	68.2
Unilateral reaction only	15	5.4
Bilaterally unreacting	21	7.5
Both fixed and dilated	22	7.9
Not examined	31	11.1
Total	**280**	

Table 3.11 Motor deficit *(Secondary care clinician questionnaire)*

Motor deficit	n	%
Yes	89	36.2
No	154	62.6
Not examined	3	1.2
Subtotal	**246**	
Unknown	26	
Not answered	8	
Total	**280**	

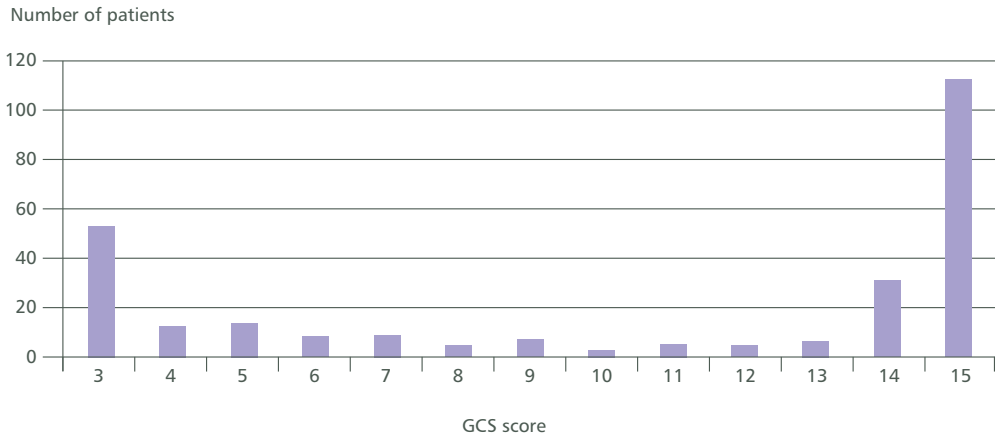


Figure 3.4 Glasgow Coma Score when first assessed in secondary care
(Secondary care clinician questionnaire)

Of the patients for whom a GCS score was documented on the secondary care clinician questionnaire, 176/288 (61%) displayed a depressed conscious level and 110/288 (38%) patients were in coma (GCS 3- 8) (Figure 3.4). These proportions are in line with previously reported GCS score of aSAH patients admitted to secondary care.[29] Accurate assessment of GCS is important as it impacts on subsequent management decisions.

Investigations

In 315/345 (91.3%) of cases the Advisors felt that the investigation plan was adequate (Table 3.12). However, in 30 cases there was room for improvement.

Table 3.12 Satisfactory plan of investigation *(Advisor assessment form)*

Investigation plan	n	%
Yes	315	91.3
No	30	8.7
Subtotal	**345**	
Insufficient data	82	
Total	**427**	

Radiological investigation

CT scanning is the first investigation if aSAH is suspected. In this study the majority (390/427; 91.3%) of patients had a CT scan in secondary care. Detection rates for SAH are dependent upon the amount of subarachnoid blood, the time since symptom onset and the experience of the radiologist reporting the scan. The time from arrival to CT scan will dictate the speed with which any patient proceeds down the correct patient pathway. The National Clinical Guideline for stroke published by the Royal College of Physicians in 2012 has suggested that all stroke patients should have a CT scan within one hour of admission to hospital if they fall within certain acute categories. One of these categories is acute onset of headache in association with a neurological deficit. An immediate CT scan is required to exclude the possible diagnosis of aSAH.[6] In this study only one third of patients (32.1%, 96/299) had a CT scan within one hour of admission (Table 3.13). In addition to its direct effects on the central nervous system aSAH can cause cardiovascular instability and other organ dysfunction (such as renal/respiratory failure). This means that early diagnosis (to initiate appropriate management pathways to respond to this) should be a priority.[30]

Table 3.13 Time difference from arrival to CT *(Advisor assessment form)*

Time from arrival in secondary care to CT	n	%
0-1 hr	96	32.1
>1-3 hr	100	33.4
>3-6 hr	41	13.7
>6-12 hr	22	7.4
>12-24 hr	15	5.0
>24-48 hr	11	3.7
>48 hr	14	4.7
Subtotal	**299**	
Insufficient data	91	
Total	**390**	

Delays of more than 1 hour and less than 12 hours were more commonly seen in patients arriving out of hours. However, delays of greater than 12 hours were more common in patients who arrived in normal working hours (Figure 3.5).

Table 3.14 Time interval between the onset of the aSAH and CT scan *(Advisor assessment form)*

Time difference from the onset of the aSAH to CT	n	%
0-3 hr	103	41.5
>3-6 hr	52	21.0
>6-12 hr	24	9.7
>12-24 hr	23	9.3
>24-48 hr	13	5.2
>48 hr	33	13.3
Subtotal	**248**	
Insufficient data	142	
Total	**390**	

The time between the onset of the aSAH and CT, where recorded, is shown in Table 3.14.

Case study 5 gives an example of a delay in performing CT.

Case study 5

A middle aged patient presented to a district general hospital with a worsening headache, vomiting and visual disturbance. Following a discussion with a consultant physician the patient was admitted to the medical assessment unit for observation. The following day a consultant reviewed the patient and decided to perform a non-urgent CT scan, despite the fact that their symptoms had not resolved. The CT scan was performed the following day when a "significant" aSAH was diagnosed. The patient was transferred to a neurosurgical centre, where they underwent coiling within 24 hours of admission.

The Advisors considered that there was an unnecessary delay in performing a CT scan which delayed diagnosis in secondary care.

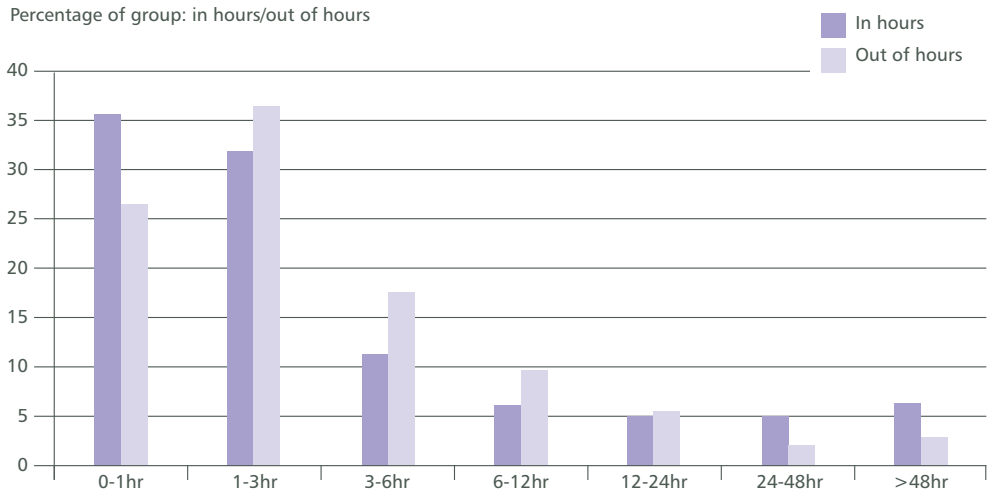


Figure 3.5 Time from arrival to CT scan when patients arrival was during working hours (8am-6pm) and outside of these hours *(in hours n=186 out of hours n=113) (Advisor assessment form)*

When reviewing the case notes 25.1% (89/354) had the results of the scan documented in the notes by a radiologist, 265 did not (insufficient data in 73). Of those where the results were not documented by a radiologist, a non-radiologist had recorded the findings in 87.5% (232/265) of patients. Formal CT scan results were present in only 54.2% (201/371) of case notes. The exclusion of electronic reports from the case notes may account for the low frequency with which reports were included in the patients' notes. Where the grade of radiologist was recorded (in the notes or on a formal report) the scan was reported by a consultant radiologist in 73.3% (88/120) and by a senior specialist trainee in 17.5% (21/120) of patients.

The Advisors considered that there had been a delay in requesting a CT scan in 10% (30/299) of patients. Five of these patients deteriorated during this delay and it was thought that two suffered a poorer outcome as a result.

When delays in requesting CT scans were reviewed, these were more common out of hours (18:01-07:59) than during the normal working day (Table 3.15).

In 32 cases (10.7%) there was a delay in performing the CT during which four patients deteriorated (and the outcome was thought to be affected in one). There were also delays in interpreting the results of the CT scan in 10 patients (3.4%). Looking at all three aspects of the CT (requesting, performing and interpreting), 51 separate patients suffered some form of delay, during which seven patients deteriorated and four suffered a worse outcome as a result (three of these patients did not survive to discharge).

Lumbar puncture

Lumbar puncture is a useful diagnostic tool in patients with a good history for aSAH and a negative radiological investigation. In the face of a negative CT scan, lumbar puncture should be performed between 12 hours and 14 days following the onset of aSAH. Cerebrospinal fluid (CSF) should be sent for spectrophotometry to identify xanthochromia, as this has 100% sensitivity for the diagnosis of aSAH.[31] Only 14 patients, (3.6%) of this cohort underwent lumbar puncture. Four patients experienced delays or problems during the performance of the procedure, mainly due to technical difficulties. From the secondary care clinician questionnaire, 12 patients were identified that did not have the diagnosis confirmed radiologically. Ten of those patients had a lumbar puncture that confirmed the diagnosis of aSAH. Two patients did not have a lumbar puncture.

The Advisors considered that the majority of patients received adequate investigation in secondary care. In the 16/364 (4.4%) that did not, most often (9/16) they considered that the patient should have undergone CT angiography.

Table 3.15 Delay in requesting a CT scan in hours (Monday to Friday/08:00-17:59) versus out of hours (weekend and 18:00-07:59) *(Advisor assessment form)*

Delay occuring to the request of CT scan during normal working hours and out of hours	Delay	No delay	Total	% delayed
In hours	9	117	126	7.1
Out of hours	19	140	159	11.9
Subtotal	**28**	**257**	**285**	
Insufficient data	2	12	14	
Total	**30**	**269**	**299**	

Diagnosis and treatment plan

The study Advisors considered that a differential diagnosis was not documented in 20.2% cases (66/326) (Table 3.16) and there was no satisfactory treatment plan in 17.1% (56/327) (Table 3.17).

Table 3.16 Differential diagnosis included *(Advisor assessment form)*

Differential diagnosis	n	%
Yes	260	79.8
No	66	20.2
Subtotal	**326**	
Insufficient data	101	
Total	**427**	

Table 3.17 Treatment plan included *(Advisor assessment form)*

Treatment plan	n	%
Yes	271	82.9
No	56	17.1
Subtotal	**327**	
Insufficient data	100	
Total	**427**	

Further, the Advisors considered that the diagnosis was not made within an appropriate timeframe in 49/383 (12.8%) of patients (Table 3.18).

In 10 of the 49 patients where the diagnosis was not made within an appropriate timeframe the Advisors considered that the delay affected outcome. There were five deaths amongst these 10 patients (Table 3.19).

Table 3.18 The diagnosis was made within an appropriate time frame *(Advisor assessment form)*

Diagnosis made within an appropriate time frame	n	%
Yes	334	87.2
No	49	12.8
Subtotal	**383**	
Insufficient data	44	
Total	**427**	

Table 3.19 Outcome affected by a delayed diagnosis *(Advisor assessment form)*

Outcome affected	n
Yes	10
No	34
Subtotal	**44**
Insufficient data	5
Total	**49**

Examples of how the Advisors considered that delays in diagnosis had affected the care provided;

"Delay in diagnosis of haematoma and hence reversing the effects of warfarin"

"Diagnosis should have been made earlier both in primary and secondary care"

"aSAH and early hydrocephalus on MRI, still proceeded with lumbar puncture"

"Timely diagnosis and treatment might have improved outcome"

Case study 6

An elderly patient attended their local emergency department with severe headache (nothing similar previously) and nausea. The patient was drowsy but rousable. ECG showed some T-wave inversion. The patient had marginally elevated troponin, but no chest pain and was prescribed aspirin and low molecular weight heparin. The patient was admitted to a cardiac ward and reviewed by consultant 18 hours later who asked for cerebral CT scan. This was performed 3 days later followed by a CT Angiogram which confirmed an aneurysm. The patient was transferred to a neurosurgical centre for coiling.

The Advisors commented that initial symptoms and signs were ignored. It was not appreciated that ECG changes and rises in troponin occur in aSAH patients.

In secondary care, as in primary care, a proportion of cases where the diagnosis was delayed/overlooked reflected an atypical presentation together with the difficulty of identifying patients with aSAH from the large numbers of patients presenting with benign headaches. However, the early management of some patients was concerning. Case studies 6,7 and 8 describe three such patients.

A potential factor in avoiding delayed diagnosis is to increase levels of suspicion about aSAH and to improve the quality of the initial clinical assessment when the patient first presents. Patients with a severe headache account for 1–2% of attendances in EDs, of whom a variable proportion (1-10%) have a serious cause. Although aSAH is uncommon failure to identify such patients is likely to result in fatality.

The College of Emergency Medicine has therefore produced *Guidelines for the Management of Lone Acute Severe Headache*.[32] These state that:

"a) Sudden or abrupt onset of a severe headache warrants further investigation to exclude serious underlying pathology.

b) Despite a high sensitivity (which decreases with time) a normal CT does not rule out aSAH and patients with a negative scan require a lumbar puncture. It is important to note that this may provide a false negative result within the first 12 hours."

It would seem logical that physicians in primary care should also adopt the first recommendation and refer all such patients to the local ED. Similar guidelines have also been developed by the Scottish Intercollegiate Guidelines Network (SIGN).[33]

Case study 7

A middle aged patient presented to an emergency department with a sudden onset of headache. The patient had a GCS of 15 with no focal neurology. The patient was discharged home but self referred three days later as the headache had not abated. CT scan demonstrated a large aSAH. The patient underwent coiling within 24 hours and had an uncomplicated recovery period. However at follow-up they were noted to have a slight disability.

The Advisors stated that this case demonstrated the difficult nature of diagnosing the cause of headaches.

Case study 8

An elderly patient presented to an emergency department (ED) with a history of loss of consciousness whilst exercising. The patient had had some mild pre-syncopal symptoms and was observed in the ED for a few hours and investigated for a cardiac problem. A CT scan was not performed. Two days later the patient presented to their GP with a persistent headache, photophobia and neck stiffness. The GP immediately referred the patient back to the ED and in the referral letter stated "I am increasingly concerned that the cardiac side is a red herring and this patient may have had an intracranial bleed as the cause of the original and ongoing symptoms". A CT scan was undertaken and an aSAH was diagnosed. Referral was made to a neurosurgical centre (NSC), nimodpine and fluids commenced and within 6 hours of presenting on this occasion the patient was transferred to the local NSC.

Following coiling this patient had mild weakness in both lower limbs. However at follow up it was noted that they had no significant disability.

The Advisors thought this case demonstrated that aSAH can be equally difficult to diagnose in secondary care settings as in primary care.

Considering all the aspects of the initial assessment (neurological examination, history taking, investigation plan, differential diagnosis and treatment plan), the Advisors were asked if deficiencies in any of these aspects could have affected the outcome. They were of the opinion that in the 132 patients, in whom one or more deficiencies occurred, the outcome could have been affected in 23.4% (26/111; insufficient data in 21) and in nine patients the outcome was death (Table 3.20).

Table 3.20 Outcome affected by the deficiency in care *(Advisor assessment form)*

Deficiency affected the outcome	n	%
Yes	26	23.4
No	85	76.6
Subtotal	**111**	
Insufficient data	21	
Total	**132**	

Table 3.21 Delay to initial assessment *(Advisor assessment form)*

Delay to initial assessment	n	%
Yes	25	7.4
No	311	92.6
Subtotal	**336**	
Insufficient data	91	
Total	**427**	

Table 3.22 Outcome affected by the delay *(Advisor assessment form)*

Delay could have affected the outcome	n
Yes	7
No	16
Subtotal	**23**
Insufficient data	2
Total	**25**

The commonest reason given by the Advisors for this opinion was a delay in diagnosis and hence delayed treatment.

The Advisors also considered that there had been a delay in the initial assessment in 25 (7.4%) patients (Table 3.21), which could have affected the outcome in 7 patients (Table 3.22).

Half of the patients in secondary care had no consultant review documented (170/334, 50.9%) (Table 3.23). However, in those patients where a consultant review was recorded, the Advisors considered this review had largely occurred within an appropriate time frame in 154/161 (95.7%) patients (Table 3.24).

Table 3.23 Documented consultant review *(Advisor assessment form)*

Consultant review	n	%
Yes	164	49.1
No	170	50.9
Subtotal	**334**	
Insufficient data	93	
Total	**427**	

Table 3.24 Consultant review within an appropriate timeframe *(Advisor assessment form)*

Appropriate timeframe	n	%
Yes	154	95.7
No	7	4.3
Subtotal	**161**	
Insufficient data	3	
Total	**164**	

Table 3.25 Management of patients in an appropriate location *(Advisor assessment form)*

Appropriate location	n	%
Yes	251	95.4
No	12	4.6
Subtotal	**263**	
Insufficient data	164	
Total	**427**	

The Advisors also assessed the level of care (Level 0/1, Level 2, Level 3) in which patients were managed, and considered that this was appropriate in 95.4% (251/263) of the cohort (Table 3.25).

Management of aSAH in secondary care

In patients who survive the initial hours after aSAH, three main neurological complications can affect outcome, re-bleeding, delayed cerebral ischaemia and hydrocephalus. Treatment options established in secondary care might reduce the risk of these complications.

Re-bleeding following aSAH is not uncommon. It occurs in 5 -10% of cases in the first 72 hours.[34] Thus early repair of the aneurysm reduces the risk of re-bleeding. However, patients admitted to secondary care need to be transported to a NSC for repair, which injects an inevitable delay into the treatment pathway, hence the control of blood pressure, prior to transfer, remains paramount. No evidence exists regarding optimal blood pressure in the presence of an unsecured aneurysm, but systolic blood pressures between 110mmHg and 160 mmHg are not considered to increase the risk of re-bleeding.

A further complication of aSAH is delayed cerebral ischaemia (DCI). Whilst this should not occur in patients in secondary care that have been accepted for transfer to a NSC (the onset is usually 4-10 days post-onset of aSAH), administration of nimodipine, a calcium channel agonist is the only treatment proven to improve outcome.[35-38] This drug will also help to control hypertension and its administration is a good surrogate marker of the standard of care following diagnosis of aSAH.

The Royal College of Physicians' publication on stroke management recommends that *"every patient diagnosed with SAH should be started on nimodipine 60mg 4 hourly unless there are specific contraindications."*[6] Only 46.9% (126/269) of patients in this study received nimodipine in secondary care (Table 3.26). Whilst the

priority is to get suitable patients to a NSC as soon as possible, the proven effect of nimodipine on outcome and the relative ease of its administration, either orally or via a nasogastric tube, is an aspect of aSAH care that could be improved.

Table 3.26 Patients received nimodipine during the first 24 hours of admission *(Secondary care clinician questionnaire)*

Nimodipine given	n	%
Yes	126	46.8
No	143	53.2
Subtotal	**269**	
Not applicable	27	
Unknown	12	
Not answered	11	
Total	**319**	

Aside from the administration of nimodipine, retrospective studies have identified a relationship between hypovolaemia and a worsening outcome.[39,40] Nevertheless, 16.5% (47/284) of patients in this study received no intravenous fluids in secondary care (Table 3.27).

Table 3.27 Administration of fluids *(Secondary care clinician questionnaire)*

Received fluids	n	%
Yes	237	83.5
No	47	16.5
Subtotal	**284**	
Not applicable	6	
Unknown	18	
Not answered	11	
Total	**319**	

Sixty-two separate patients had some form of haemodynamic instability during their stay in secondary care. Of these, 55 received IV fluids and 7 did not (3 unknown). Of the 10 patients that did not receive fluids (or unknown whether they received fluids), all were managed conservatively.

Raised intracranial pressure

There was a clinical suspicion of raised intracranial pressure in 72/142 (50.7%) of patients, for whom it could be assessed according to the clinician completing the secondary care clinical questionnaire (Table 3.28). Only 15 of these patients received either mannitol or hypertonic saline (Table 3.29). Twenty-nine of the 43 patients that received neither treatment were managed conservatively (according to the Advisor assessment form), seven were for active management and there was no Advisor assessment form data in a further seven cases.

Table 3.28 Clinical suspicion of raised intracranial pressure *(Secondary care clinician questionnaire)*

Raised intracranial pressure	n	%
Yes	72	50.7
No	70	49.3
Subtotal	**142**	
Not applicable	9	
Unknown	154	
Not answered	14	
Total	**319**	

Table 3.29 Treatment given for raised intracranial pressure *(Secondary care clinician questionnaire; answers may be multiple, n/59, 7 not answered)*

Treatment given	n
Mannitol	13
Hypertonic saline	2
Other	1
Neither	43
Subtotal	**59**
Unknown	6
Not answered	7
Total	**72**

Referral to neurosurgical centres

The vast majority of patients in the study (404/427) were referred to a NSC in line with good practice (Table 3.30). In 11 cases Advisors noted that the referral was delayed in secondary care, in 15 cases there was a delay due to the non-availability of a contact in the NSC, and in 36 cases there was a delay in the NSC accepting the patient (Table 3.30). In all, 56 separate patients experienced some form of delay. In nine patients the Advisors considered that deterioration occurred during the delay and in four patients they believed that the outcome could have been affected (three of these patients did not survive to discharge). The reasons the Advisors gave for delayed acceptance by the NSC are shown in Tables 3.31 to 3.34.

Table 3.30 The patient was referred to a NSC *(Advisor assessment form)*

Neurosurgical care referral	n	%
Yes	404	94.6
No	23	5.4
Total	**427**	

Table 3.31 Delay in referral *(Advisor assessment form)*

Delayed referral	n	%
Yes	11	3.5
No	299	96.4
Subtotal	**310**	
Insufficient data	94	
Total	**404**	

Table 3.32 Delay due to the non-availability of a contact at the NSC *(Advisor assessment form)*

Delay due to NSC contact	n	%
Yes	15	4.9
No	292	95.1
Subtotal	**307**	
Insufficient data	97	
Total	**404**	

Table 3.33 Delay in accepting the patient by the NSC *(Advisor assessment form)*

Delay in accepting the patient at a NSC	n	%
Yes	36	13.2
No	236	86.8
Subtotal	**272**	
Insufficient data	31	
NA- not accepted by NSC	101	
Total	**404**	

Table 3.34 Reasons for delayed acceptance by NSC *(Advisor assessment form)*

Reasons for delay	n
Lack of beds in NSC	13
Staffing issue	6
Other reason	17
Total	**36**

Time of admission

Mirroring the delays that occurred in CT scanning, the time of admission also influenced delays in the referral process (Table 3.35).

These results suggest that out of normal working hours the referral process is delayed, both in referral from the secondary centre and in the secondary centre's ability to contact the NSC. However, once the process was underway, there was no difference in normal hours or out of hours in the NSCs ability to agree to the transfer of patients.

Table 3.35 Delays in referral, finding a contact in NSC and acceptance by NSC during normal working hours and out of hours *(Advisor assessment form)*

		Referral	Contact in NSC	Acceptance
In hours	Delay	1	2	14
	No Delay	126	127	97
	% delay	<1	1.6	12.6
	Subtotal	**127**	**129**	**111**
Out of hours	Delay	9	12	22
	No Delay	156	150	139
	% delay	5.5	7.4	13.6
	Subtotal	**165**	**162**	**161**
Overall	**Subtotal**	**292**	**291**	**272**
	Insufficient data	18	16	0
	Total	**310**	**307**	**272**

Transfer process

A delay in transfer was experienced by 17.9% (47/263) of patients (Table 3.36). Ten patients deteriorated during this delay and the Advisors considered that the outcome could have been subsequently affected in five cases; all of whom died (Table 3.37). The most common reason for delay was lack of beds in the NSC (21/47). Case studies 9 and 10 provide examples of this.

Table 3.36 Delay in transfer process *(Advisor assessment form)*

Delay in transfer	n	%
Yes	47	17.9
No	216	82.1
Subtotal	**263**	
Insufficient data	40	
NA	101	
Total	**404**	

Case study 9

An elderly patient collapsed and presented to a district general hospital. A CT scan showed an aSAH and the patient was referred to the local neurosurgical centre (NCS) with a GCS of 14 (WFNS grade II). There was a delay in transfer due to the time taken to accept the patient, during which they deteriorated to a GCS of 8. The patient was finally transferred unintubated and breathing spontaneously. On arrival at the NSC they were immediately intubated and went to theatre for an emergency decompression. Sadly this patient did not survive.

The Advisors considered that both the delay in transfer and the sub standard medical treatment during transfer were contributors to the outcome.

Table 3.37 Deterioration during transfer *(Advisor assessment form)*

Deterioration during transfer	n
Yes	10
No	32
Insufficient data	5
Total	**47**

Case study 10

A middle aged patient presented with vomiting, paraesthesia in the right hand and leg and headache. The emergency department team referred the patient for a CT scan at 17:15. The radiology registrar initially declined to do an emergency CT scan unless the patient developed abnormal neurology or their GCS fell. However the CT scan was carried out at 18:47 and an aSAH diagnosed. A medical registrar saw the patient at 22:30 who then referred the patient to the local neurosurgical centre (NSC). The patient was immediately accepted by the neurosurgical registrar. Nimodipine was started. The transfer was delayed due to "bed problems" in the NSC. At 14:30 the following day an ambulance was booked but failed to arrive. At 16:00 an enterprising staff nurse rang 999 to ensure an ambulance arrived to transfer the patient. The patient underwent coiling two days later and had an uneventful recovery when reviewed at follow-up.

The Advisors thought this case demonstrated delays caused by a lack of resources.

Conservative management

Overall 142/427 (33.3%) of the patients in this study were managed conservatively (Table 3.38).

Table 3.38 Conservative management *(Advisor assessment form)*

Managed conservatively	n	%
Yes	142	33.3
No	285	66.7
Total	**427**	

Of the patients managed conservatively, 119/142 were referred to a NSC and 23 were not; despite the Royal College of Physicians' guidelines that all patients should be discussed.[6] However, the Advisors were of the opinion that the decision to adopt a conservative pathway in the 23 patients not referred to an NSC was appropriate.

The reasons for the decision to manage patients conservatively were documented in 129/131 (98.4% insufficient data in 11) patient notes. These are summarised in Table 3.39.

Table 3.39 Reason for conservative management *(Advisor assessment form; answers may be multiple)*

Reasons for conservative management	n/131	%
Unsurvivable haemorrhage	102	77.9
Neurological state	59	45.0
Co-morbidities	27	20.6
Inoperable aneurysm	6	4.6
Other	5	3.8
No rationale documented	2	1.5
Patient decision	1	0.8

Table 3.40 Appropriate decision to manage conservatively *(Advisor assessment form)*

Decision to manage conservatively was appropriate	n	%
Yes	127	94.1
No	8	5.9
Subtotal	**135**	
Insufficient data	7	
Total	**142**	

The Advisors considered that the decision to opt for conservative management was inappropriate in eight patients in which it was claimed that the haemorrhage was unsurvivable or the neurological deficit was severe (Table 3.40).

The ability to discuss treatment options in patients with aSAH may be difficult in the face of an altered conscious level or neurological status. However, five patients who were managed conservatively were able to participate in the decision making process (Table 3.41). More appropriately, discussions were held with the next of kin, regarding a decision to treat conservatively, in all patients.

Table 3.41 The decision was discussed with the patient *(Advisor assessment form)*

Conservative management was discussed with the patient	n	%
Yes	5	3.9
No	124	96.1
Subtotal	**129**	
Insufficient data	13	
Total	**142**	

Table 3.42 Deficiencies in conservative management

Deficiencies in conservative management	n	%
Yes	7	5.3
No	124	94.7
Subtotal	**131**	
Insufficient data	11	
Total	**142**	

The Advisors were asked to assess the quality of the care of patients managed conservatively, and found that in the vast majority there were no deficiencies (Table 3.42). In seven cases where deficiencies were noted they related most commonly to the management of complications of aSAH (four patients) and to a lack of consideration for organ donation in patients that died (three patients).

Quality of care in secondary care

Advisors were asked to grade the overall quality of care in secondary care, and this is displayed in Figure 3.6.

The care of patients with aSAH in secondary care was considered good in 68.9% (247/359) of patients (insufficient data in 68). Only 7.5% (27/359) of patients had a poor or unacceptable rating for their care (Table 3.43).

At every step of the patient pathway delays have been identified in secondary care. There were 123 separate patients identified who experienced some form of delay in secondary care. There were 49 separate patients identified who may have suffered an altered outcome due to deficiencies in care outlined in this chapter.

Table 3.43 Reasons given for poor/unacceptable rating
(Advisors' assessment form)

Reasons for poor/unacceptable rating	n
Delay in performing CT head	12
Delayed/missed diagnosis	10
Deficiencies in the initial assessment	4
Lack of senior review	1
Total	**27**

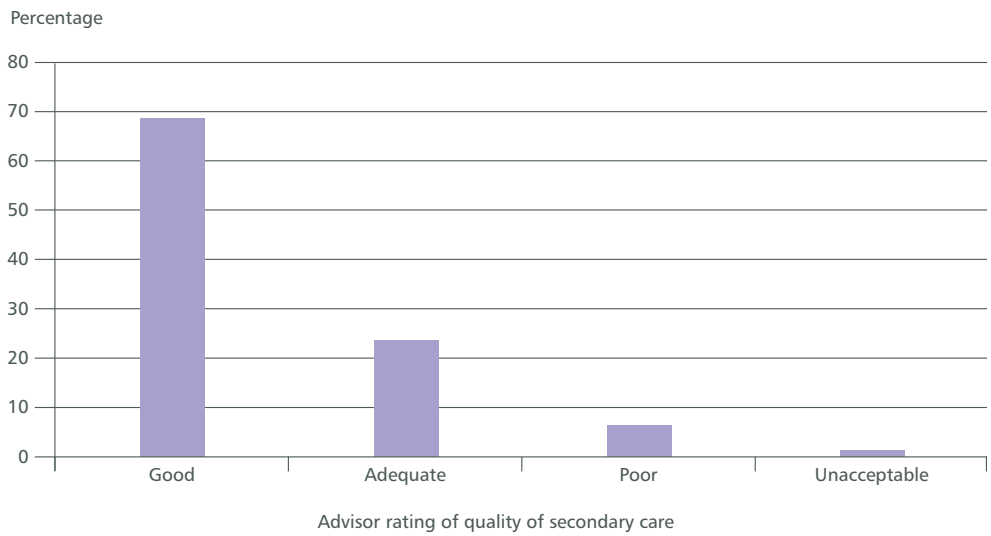


Figure 3.6 Quality of secondary care
(Advisor assessment form)

Key Findings

32/75 patients in primary care had their diagnosis of aneurysmal subarachnoid haemorrhage overlooked in the view of the Advisors; they considered that this could have affected the outcome in 23 of these patients.

18% (62/344) of patients did not have a neurological examination performed, or documented, in secondary care at the time of their initial assessment.

Initial assessment was delayed in 7.4% (25/336) of patients in secondary care; the Advisors considered that 7 of these patients could have had an altered outcome as a result.

12.8% (49/383) of patients in secondary care did not have a timely diagnosis of aneurysmal subarachnoid haemorrhage, in the view of the Advisors. It was further stated by the Advisors, that in 10 of these patients their outcome was adversely affected.

51 patients in secondary care, experienced a delay related to their CT scan in the view of the Advisors. Most commonly this was in requesting and performing of the CT scan. As a result of these delays, it was also the Advisors' view that 7 patients deteriorated and in 4 the outcome was affected (3 of these patients did not survive to discharge).

67.9% (203/299) of patients in secondary care did not have a CT scan within one hour of admission.

46.4% (143/308) of patients did not receive nimodipine in secondary care following the diagnosis of an aneurysmal subarachnoid haemorrhage, despite the *'National Clinical Guideline for Stroke'* stating that this should be prescribed for all patients.

16.5% (47/284) of patients did not receive intravenous fluids in secondary care despite 7 of these patients being haemodynamically unstable.

Advisors felt that the decision to manage patients conservatively in secondary care was appropriate in 94.1% (127/135); this included 23 patients who were not discussed with a neurosurgical/neuroscience centre (not meeting the 'National Clinical Guideline for Stroke').

Delays in the referral of patients from secondary care occurred more frequently out of hours, 5.5% (9/165), than during normal working hours, <1% (1/127), as did finding a contact in a neurosurgical/neuroscience centre, 7.4% (12/162) and 1.6% (2/129) respectively, in the view of the Advisors.

The care of patients with aneurysmal subarachnoid haemorrhage in secondary care was considered good by the Advisors in 68.8% (247/359) of patients.

Recommendations

4. The clinical presentation of aneurysmal subarachnoid haemorrhage should be highlighted in primary and secondary care education programmes for all relevant health care professionals, including the guidelines for the management of acute severe headache published by the College of Emergency Medicine. *(Local Education and Training Boards/Deaneries, Medical, Surgical & Nursing Royal Colleges and Specialist Associations)*

5. All patients presenting with acute severe headache in a secondary care hospital should have a thorough neurological examination performed and documented. A CT scan should be performed immediately in this group of patients as defined by the *'National Clinical Guideline for Stroke'*. *(All doctors)*

6. Standard protocols for the care of aneurysmal subarachnoid haemorrhage patients in secondary care should be developed and adopted across formal networks. These should cover, as a minimum, initial assessment and diagnosis, management, referral, transfer to a neurosurgical/neuroscience centre and subsequent repatriation to secondary care, including rehabilitation. These protocols should take into account existing guidelines where relevant. *(Medical Directors)*

7. All patients diagnosed with a subarachnoid haemorrhage should be commenced on nimodipine immediately as recommended in the *'National Clinical Guideline for Stroke'*, unless there are contraindications to its use. *(All doctors)*

4 - Tertiary care

Data for patient care in neurosurgical centres (NSC) were obtained from two sources: a clinical questionnaire completed by the admitting neurosurgeon in the NSC, which was returned for 344 patients, and the Advisor assessment form. The Advisors noted that in 303/427 cases reviewed the patient was admitted to tertiary care. The reported source of admission is shown in Table 4.1 whilst the level of care to which patients were admitted is summarised in Table 4.2.

Table 4.1 Source of admission *(Advisor assessment form)*

Source of admission	n	%
Transfer from different secondary care hospital	228	75.2
From emergency department in the hospital with the NSC	61	20.1
From another department in hospital with the NSC	14	4.6
Total	**303**	

Table 4.2 Level of care provided following admission *(Advisor assessment form)*

Level of care	n	%
Level 1	157	55.3
Level 2	62	21.8
Level 3	60	21.1
Other	5	1.8
Subtotal	**284**	
Unknown	16	
Not answered	3	
Total	**303**	

In the majority of cases the Advisors considered the initial level of care to be appropriate (Table 4.3). Where this was not the case it was mostly believed that patients admitted to a Level 1 bed should have received Level 2 care (9/14).

Table 4.3 Appropriateness of the initial level of care *(Advisor assessment form)*

Appropriate level of care	n	%
Yes	270	95.1
No	14	4.9
Subtotal	**284**	
Not answered	19	
Total	**303**	

Following admission and further assessment the majority of patients in tertiary care underwent definitive treatment for their aSAH. Following publication of the initial one and five-year results of the International Subarachnoid Aneurysm Trial (ISAT), endovascular treatment has generally been selected over surgical clipping, when technically feasible. The basis for this approach is a highly significant reduction in the proportion of patients who were dependent or dead at two months (244/959; 25.4% versus 345/947; 36.4%, relative risk reduction of 22.6%; 8.9-34.2) with no difference in late mortality between the groups.[10,41,42]

Table 4.4 indicates the frequency with which each treatment modality was used in the current study. Twenty-six patients were managed conservatively, or were only treated for complications.

Table 4.4 Management of aSAH *(Advisor assessment form)*

Treatment for aneurysm	n	%
Interventional radiology only	233	76.9
Surgical clipping only	38	12.5
Both interventional radiology and surgery	6	2.0
No procedure: conservative management/treatment of complications only/died before procedure	26	8.6
Total	**303**	

There were 123 patients that required multiple interventions to deal with both the underlying aneurysm and complications of the haemorrhage.

It is evident from these data that patients with aSAH confer a substantial workload upon neurosurgical units in addition to the primary treatment of the underlying aneurysm, with almost a third undergoing some type of further emergency intervention (most frequently for the relief of hydrocephalus) within 24 hours of admission (Table 4.5).

As indicated in Table 4.4, 26 patients were managed conservatively following admission to a NSC. The reasons for this decision was most commonly unsurvivable haemorrhage (8/18 cases; insufficient data in 8).

That relatively few patients did not undergo definitive treatment in the tertiary centres is to be expected given that patients in whom active treatment was inappropriate were rarely transferred from the secondary care hospital to which they were first admitted. In the group of patients managed conservatively 15/26 patients presented directly to a secondary care hospital with a NSC on-site, following onset of their symptoms.

Table 4.5 Emergency surgery performed in 105 patients *(answers may be multiple, not answered for 18 patients) requiring multiple procedures (Tertiary care clinician questionnaire)*

Emergency procedures performed within 24 hours of admission	n	%
External ventricular drainage	59	56.2
Lumbar drainage	6	5.7
Evacuation of intra-cerebral haematoma	5	4.8
Evacuation of intra-cerebral haematoma and aneurysm clipping	4	3.8
Emergency coiling and evacuation of intra-cerebral haematoma	12	11.4
Other	21	20.0

In patients in whom no procedure was performed the Advisors felt that it should have been in 2/12 patients where they could make a decision (insufficient data in 14). However, they only considered that the outcome might have been affected in one.

The majority (20/26) of these patients died prior to discharge from the NSC, one was transferred to another NSC and 5/26 were transferred for palliative care.

Initial assessment in the neurosurgical centre

In secondary care it was evident, based on the opinion of the Advisors, that clinical assessment was not always performed with an appropriate level of skill. Review of the case note in tertiary care revealed similar deficiencies. Two thirds of patients were initially assessed by specialist trainee surgeons (165/245; 67.3%), and a quarter were basic grade (63/245; 25.7% Table 4.6). Although an adequate history was taken in most cases (277/292, 94.9%) deficiencies were noted in the neurological examination (35/289; 12.1%) and in the planning of investigations (24/289, 8.3%).

Table 4.6 Grade of doctor performing the initial assessment in specialist neurosurgical centres *(Advisor assessment form)*

Grade of clinician	n	%
Consultant	5	2.0
Associate Specialist/Staff Grade	1	<1
Trainee with CCT	7	2.9
Senior Specialist Trainee	125	51.0
Junior Specialist Trainee	40	16.3
Basic Grade	63	25.7
Other	4	1.6
Subtotal	**245**	
Insufficient data to assess	58	
Total	**303**	

Nevertheless senior specialist trainees performed the initial assessment most often and this was true both during daytime working hours (08:00-18:00) and out of hours (Table 4.7).

These shortcomings were potentially compounded by the time from admission to patient review by a consultant neurosurgeon (self reported in tertiary clinician questionnaire, Table 4.8) with only 64.6% (159/246) of patients (where an answer was given) being seen within 12 hours of admission. The timing of the consultant review was unknown in 93 cases. Furthermore, the Advisors considered that there were clinically important delays in consultant review in 14% (21/150) of patients, where a consultant review was documented. They also pointed out that a consultant review was not documented in 45.3% (135/298) of cases (not answered in 18 cases).

Table 4.8 Time from admission to review by a consultant neurosurgeon *(Tertiary care clinician questionnaire)*

Time from admission to NSC to consultant review	n	%
Less than 6 hours	79	32.1
6-12 hours	80	32.5
12-24 hours	69	28.0
24- 48 hours	18	7.3
Subtotal	**246**	
Unknown	93	
Not answered	5	
Total	**344**	

Table 4.7 Grade of clinician performing the initial review by time of admission *(Advisor assessment form)*

Grade of clinician	08:00-17:59	%	18:00-07:59	%	Not known	Total
Consultant	2	2.6	2	1.4	1	5
Associate Specialist/Staff Grade	0	0	0	0	1	1
Trainee with CCT	1	1.3	5	3.5	1	7
Specialist trainee	48	63.2	99	68.8	18	165
Basic Grade	24	31.6	36	25.0	3	63
Other	1	1.3	2	1.4	1	4
Subtotal	**76**		**144**		**25**	**245**
Insufficient data	20		30		8	58
Total	**96**		**174**		**33**	**303**

Advisors were also asked to take a global view as to whether there were deficiencies in the admission process and considered that this was the case in 13.1% (36/275) of patients. Details of these are shown in Table 4.9.

Table 4.9 Deficiencies in the initial management *(Advisor assessment form)*

Deficiencies	n
Delayed acceptance by NSC	14
Delay in consultant review	8
Poor documentation	5
Delay in CTA/investigations	4
Delay/deficiency in initial assessment	4
Level of care	1
Total	**36**

When a consultant performed the initial assessment (only five cases) no deficiencies were identified. In the remaining patients the frequency of these deficiencies (13%) was the same regardless of the level of seniority of the trainee who saw the patient. It was considered that patient outcome could have been affected in only two instances and these were related to a delay in accepting patients for transfer to the NSC. One of these patients died and the other was transferred back to the referring hospital for conservative therapy.

Investigations following admission

Although the diagnosis of aSAH was confirmed prior to transfer to the NSC, in most patients (337/344; 98%) information from the CT scan performed in the referring hospital was often insufficient to confirm that an aneurysm was responsible for the aSAH, or to allow the development of a definite management plan. Thus the majority of patients (245/335 (not answered in 9), 73.1%) underwent a CT angiogram (CTA) following admission to the NSC. The development of high quality CTA that provides sufficient information for treatment planning has allowed less reliance on conventional digital subtraction angiography (DSA) with its small but inherent risks (allergy, nephrotoxicity, vessel injury, embolism and stroke). In 51 patients a satisfactory CTA had already been performed in the referring hospital prior to transfer to the NSC. Although collaborations between the NSC and those in secondary care could result in the development of appropriate protocols to increase the proportion of patients who have a suitable CTA prior to referral (reducing the need for a second CTA following transfer) this should not be allowed to delay transfer to an NSC. Further, suitable measures must be in place to allow effective transmission of the CTA data to the receiving hospital. In view of these potential difficulties, there are mixed opinions on the benefit of providing CTA in secondary centres prior to transfer.

The reasons why CTA was not performed are summarised in Table 4.10.

Table 4.10 Reasons why a CTA was not performed in the NSC *(Tertiary care clinician questionnaire)*

Reasons why CTA was not performed	n
Suitable study done in referring hospital	51
Patient underwent DSA	16
Patient died before investigation possible	6
Other	13
Subtotal	**86**
Not answered	4
Total	**90**

The size and location of the aneurysm in patients admitted to an NSC are shown in Figure 4.1.

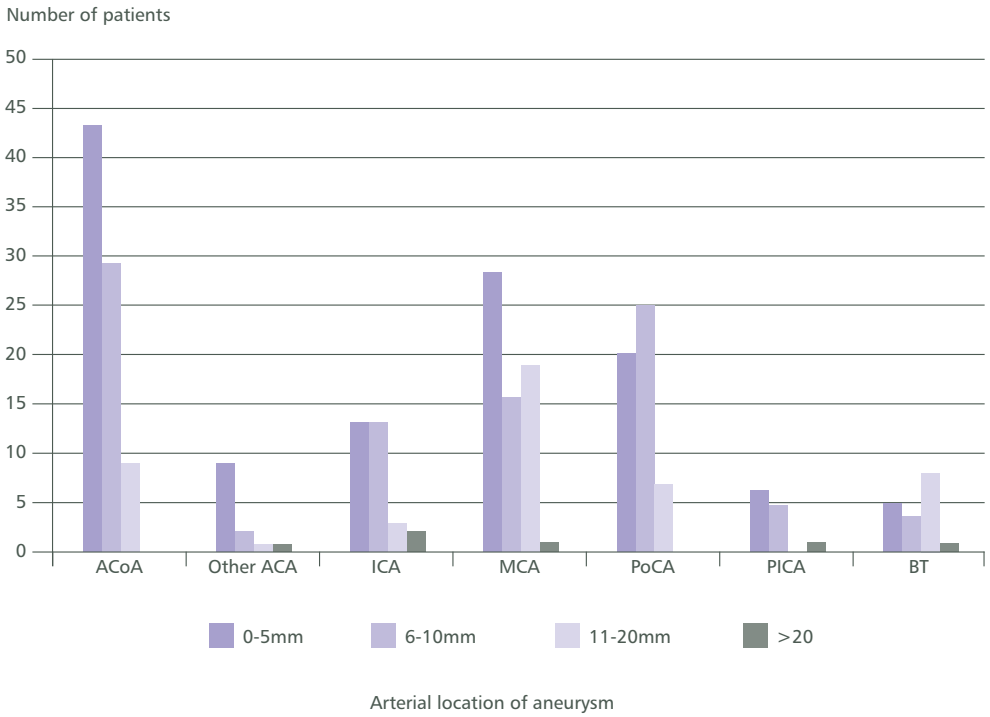


Figure 4.1 Location and size of aneurysms responsible for aSAH
((Tertiary care clinician questionnaire; Arteries: ACoA & PCoA: anterior and posterior communicating (n=88 & 60); ACA: anterior cerebral (n=16); ICA: internal carotid (n=34); MCA: middle cerebral (n=72); PICA: posterior inferior cerebellar (n=12); BT: Basilar terminus (n=19))

Decision on treatment options for aSAH

Clinicians were asked whether the choice of treatment for patients was made at a multi-disciplinary team meeting. This was not the case in more than half of the 309 patients who underwent surgical or radiological intervention (Table 4.11), although the acute presentation and need for urgent intervention are satisfactory explanations for this. Whilst it would be assumed that the responsible neurosurgeon and an interventional radiologist discussed the optimum treatment for an individual patient, the decision on how to treat the aneurysm was not recorded in the case notes in 67/289 (23.2%) patients where the answer was available (not answered for 20 patients).

Table 4.11 Decision on treatment method was made at an MDT *(Tertiary care clinician questionnaire)*

Decision made at MDT meeting	n	%
Yes	140	47.3
No	156	52.7
Subtotal	296	
Unknown	13	
Total	**309**	

Delays in formulating a treatment plan

The Advisors were asked if there was a delay in forming an appropriate treatment plan for patients admitted to an NSC and concluded that this was the case in 24/250 (9.6%) patients where a decision could be made (Table 4.12). The reasons for this were often multi-factorial but the commonest reason was delay in performing a CTA or DSA (11/24 cases).

Table 4.12 There was a delay in formulating a treatment plan *(Advisor assessment form)*

Delayed treatment plan	n	%
Yes	24	9.6
No	226	90.4
Subtotal	**250**	
Insufficient data	53	
Total	**303**	

Consent

Data from the NSC clinician's questionnaire (Table 4.13) indicated that consent for definitive treatment was obtained by a consultant in 219/295 (74.2%) cases or a senior trainee in 64/295 (21.7%) cases. This reflects a good standard of practice. Despite this, the Advisors considered that the consent process was deficient in 34/244 (13.9%; insufficient data in 33) patients that underwent a procedure. The reasons for this are summarised in Table 4.14. It was also noted that discussions with the next of kin were documented for only half of the patients (118/241; 48.9%).

Table 4.13 Grade of doctor obtaining consent for definitive treatment *(Tertiary care clinician questionnaire)*

Grade of clinician obtaining consent	n	%
Consultant	219	74.2
Associate Specialist/Staff Grade	2	<1
Trainee with CCT	7	2.4
Senior Specialist Trainee	64	21.7
Junior Specialist Trainee	1	<1
Basic Grade	1	<1
Other	1	<1
Subtotal	**295**	
Not answered	14	
Total	**309**	

Table 4.14 Deficiencies in consent process *(Advisor assessment form, answers may be multiple n/34)*

Deficiencies in consent process	n/34
Person from whom consent obtained	6
Lack of discussion with next-of-kin	15
Grade of doctor taking consent	4
Inadequate description of risk on consent form	16
Failure to document risk of death	10
Other	7

Table 4.15 indicates the source from which consent was obtained. This led to a further concern that was raised by the Advisors since they considered that some patients who signed a consent form might not have had

sufficient mental capacity to do so. This assertion was based on the fact that only 160/205 patients who gave consent were World Federation of Neurosurgical Societies (WFNS) grade I. Of the remainder, 33 were WFNS grade II, 7 grade III and 2 grade IV (WFNS grade was unknown in 3 cases).[16]

Table 4.16 provides a further analysis about the adequacy of the consent process based on the method that was used. This suggests that the processes for consent using Form 4 appear to be slightly better than that for the conventional methods.

Table 4.15 Source of consent *(Tertiary care clinician questionnaire)*

Source of consent	n	%
Patient	205	68.8
Form 4: patient unable to give consent	93	31.2
Subtotal	**298**	
Unknown	6	
Not answered	5	
Total	**309**	

Table 4.16 Was the consent process satisfactory *(Tertiary care clinician questionnaire/Advisor assessment form)*

	Advisor opinion on adequacy of consent process				
Source of Consent	**Consent process was adequate**	**Deficiencies**	**Subtotal**	Insufficient data/ no assessment form	**Total**
Patient	131	24 (15.5%)	155	50	**205**
Form 4	52	6 (10.3%)	58	35	**93**
Subtotal	**183**	**30**	**213**	**85**	**298**
Unknown	4	0	4	2	**6**
Not answered	1	1	2	3	**5**
Total	**188**	**31**	**219**	**90**	**309**

Table 4.17 Treatment method employed for aSAH *(Tertiary care clinician questionnaire)*

Definitive treatment for aneurysmal SAH	n	%
Aneurysm coiling	258	84.9
Aneurysm clipping	40	13.2
Aneurysm clipping after attempted coiling	6	2.0
Subtotal	**304**	
Unknown	5	
Total	**309**	

Definitive treatment

Most patients who underwent primary treatment for their aneurysm were managed with an endovascular procedure (Table 4.17). Only a minority underwent open surgery either as a primary procedure or after endovascular coiling had failed to occlude the aneurysm.

Table 4.18 Neurosurgeons' opinion on reasons for delay in definitive treatment *(Tertiary care clinician questionnaire)*

Reason for delayed treatment	n
Non availability of neurosurgical/ neuroradiological staff	8
Non-availability of theatre equipment or similar	11
Non-availability of Level 2/3 bed	1
Patient required additional treatment/ resuscitation	6
Other clinical reasons	5
Problems with CTA/DSA	3
Other lack of resources	2
Change in treatment plan	2
Awaiting specialist consultant review	2
Not answered	8
Total	**48**

Delays

Both the responding neurosurgeons and the Advisors were asked about delays in undertaking definitive treatment for patients with aSAH. In the opinion of the neurosurgeons a delay occurred in 15.6% (48/307, not answered in 2) of patients and the reasons for this are summarised in Table 4.18.

The Advisors were also of the opinion that there was an unnecessary delay in controlling aneurysmal haemorrhage in 21.6% (53/245, 32 insufficient data) of the patients that they reviewed and in five of these patients they considered that the delay might have influenced the ultimate outcome. The most commonly cited reason for a delay was a lack of appropriate service over the weekend (23/39).

These data highlight a deficiency in the ability of neurosurgical units to provide treatment for aSAH at weekends. This is further suggested by an analysis of the time from admission to intervention according to the day of the week, which shows that patients waited longer for treatment if they were admitted on Friday, Saturday or Sunday (Figure 4.2).

The frequency of the common complications of aSAH was reviewed to see if they were more likely when the interval from admission to intervention was longer. These data are shown in Figure 4.3. In this small cohort the frequency of re-bleeding was greater when treatment was undertaken more than 48 hours after admission but as is evident from Figure 4.3 the number of patients was small (n=43) making it difficult to draw any firm conclusions.

Similarly the frequency of 'other' complications also seemed to increase when the time from admission to intervention exceeded 48 hours (Table 4.19).

Table 4.19 The relationship between time to intervention and the frequency of 'other' disease-specific complications *(Advisor assessment form)*

Time delay	'Other' complications of aSAH	n	%
<24 h	14	150	9.3
>24-48 h	6	53	11.3
>48 h	15	43	34.9
Insufficient data		31	
Total		**277**	

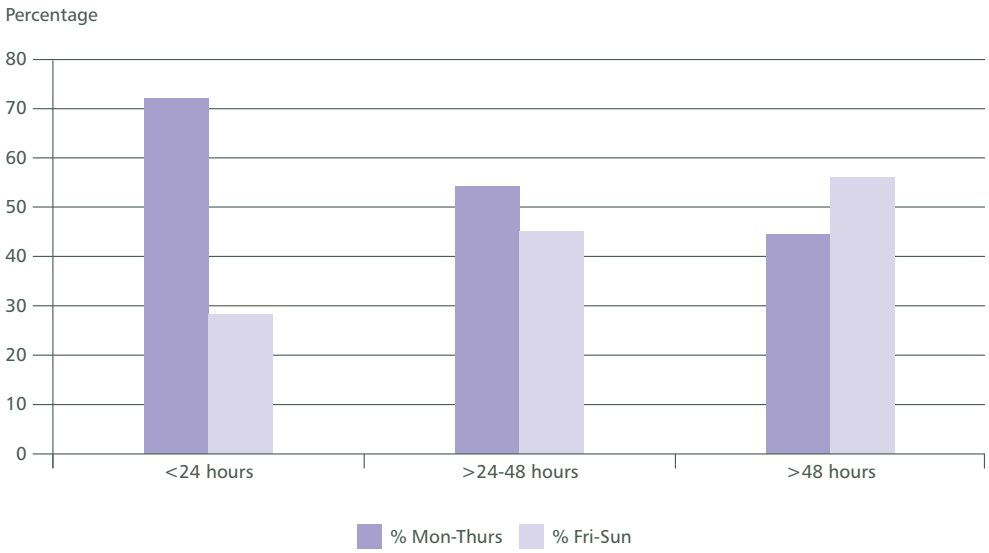


Figure 4.2 Comparison of time from admission to intervention by day of admission
(Advisor assessment form) n=246 (Insufficient data in 31; 24 hours n=150; >24-48 hours n=53; >48 hours n=43)

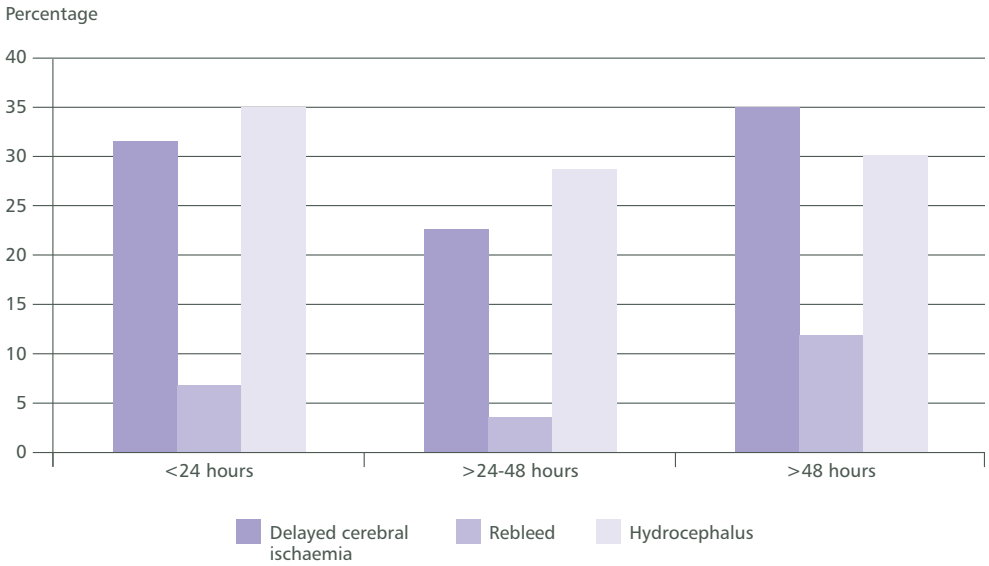


Figure 4.3 The relationship between time to intervention and the frequency of delayed cerebral ischaemia, re-bleeding and hydrocephalus
(Advisor assessment form) n=246 (Insufficient data in 31; 24 hours n=150; 24-48 hours n=53; >48 hours n=43)

The type of complications included in the "other" category are shown in Table 4.20. Certainly, for the largest group (and others) it is reasonable to suppose that there might be a link between these and a delay in treatment based on a neurogenic pathogenesis.

Finally the possible impact of delayed intervention upon functional capacity at discharge was examined. These data are presented in Figure 4.4. The proportion of patients with no symptoms or symptoms but no disability are greater in patients undergoing intervention within 48 hours of admission whilst the percentage with some form of disability is increased when intervention was performed after this time.

Discussions with the Advisors, who included neuroradiologists, suggested that delays in treatment were often related to a lack of specific neuroradiology on-call rota and an insufficient number of neuroradiologists in each NSC to staff a seven-day on-call service.

Table 4.20 Complications classified as "other" by the Advisors *(Advisor assessment form)*

'Other' complications of aSAH	n
Cardio-respiratory (Myocardial infarction, myocardial stunning, arrhythmia, pulmonary oedema/infection	8
Cerebral infarction/stroke	6
Cerebral oedema	3
Cognitive impairment/memory loss	3
Cranial nerve palsy	4
Hyponatraemia +/- cerebral salt wasting syndrome	5
Intraoperative rupture/intra-ventricular haematoma	1
Seizures	2
Sepsis/ventriculitis	3
Total	**35**

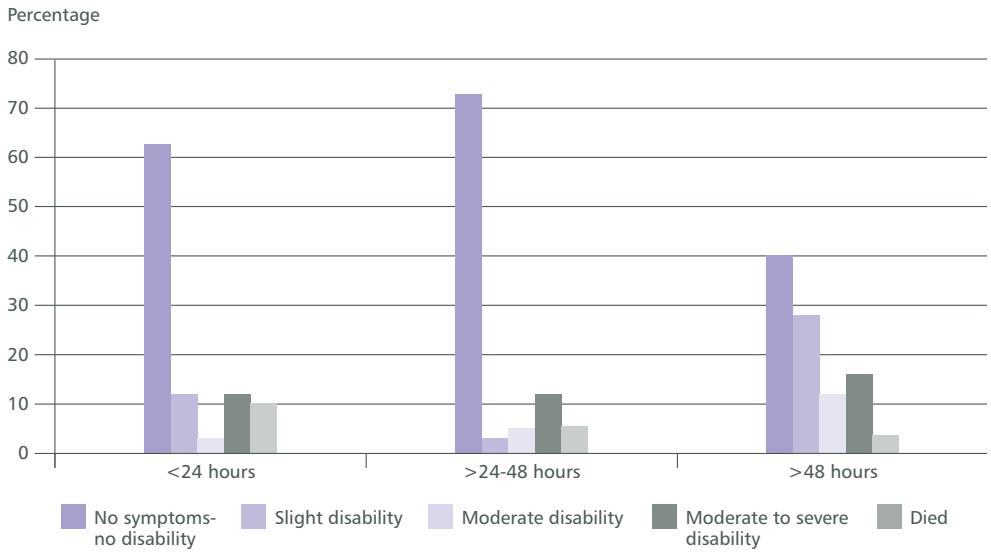


Figure 4.4 The relationship between time to intervention and functional status at discharge from the NSC
(Advisor assessment form) n=246 (Insufficient data in 31; 24 hours n=150; 24-48 hours n=53; >48 hours n=43))

Case study 11

A middle-aged patient presented to a DGH with a history of headache and seizure. A large aSAH with intraventricular haemorrhage was found on CT scan. Within 4 hours they were transferred to the local neurosurgical centre (NSC). Despite arriving at the NSC on a Saturday morning, endovascular intervention was delayed until Tuesday. There was no entry in the notes for Monday (a bank holiday). The patient was discharged sixteen days later having undergone coiling of an aneurysm.

The Advisors considered this case to be an example of delay in treatment caused by a lack of 7 day service in neuroradiology.

A potential solution to this problem, given the NHS Seven-Day Hospital initiative,[43] is the development of networks providing continuous radiological cover between geographically close neurosurgical centres. Another, less feasible, alternative could be a joint rota with vascular interventional radiologists within each centre. There are a number of obstacles to this that include the existing out of hours workload for vascular interventional radiology and training issues.

Although it would be attractive to deliver 24/7 "in-house" cover, the provision of suitable training could be difficult. Whilst the separation of neuroradiology from vascular interventional radiology is not universal (radiologists in Australia and New Zealand often combine both areas of work) training programmes deliver experience in both disciplines from the outset.

Further, it should not be forgotten that provision of continuous neuroradiology cover would also require availability of the appropriate support staff.

A recent publication by Lamb et al[44] has considered the problem associated with delayed treatment in the context of both European and North American guidelines which recommend that surgical clipping or endovascular coiling of a ruptured aneurysm should be performed as early as possible and certainly within 48 hours of onset in most patients to reduce the risk of re-bleeding.[45,46]

A 2-year retrospective audit (2007-2009) showed that only a quarter of patients underwent treatment within this time frame and that patients undergoing endovascular treatment waited much longer than those undergoing open surgery. They also found the same relationship between delayed treatment and the day of admission described above. As a result they recommended that a collaborative network should be established across the seven neurosurgical centres in Greater London,[44] although this did not happen.

The Advisors also considered whether there were any staffing issues during the peri-operative period that led to a delay in treatment. Their opinion is summarised in Table 4.21 and again highlights the issue of provision of service over the weekend.

Table 4.21 Peri-operative staffing problems
(Advisor assessment form; answers may be multiple n/215; insufficient data in 62)

Peri-operative staffing problems	n	%
No concerns	203	94.4
Poor communication between theatre and clinicians	5	2.3
Lack of staff members	6	2.8
Lack of weekend service	9	4.2

Grade of clinician performing the intervention

Information was collected on the grade of clinician who performed the definitive procedure for patients with aSAH. The data are summarised in Table 4.22, and show that a consultant neurosurgeon or neuroradiologist was present for all procedures and personally performed the majority of them (281/307; 91.5%). Whilst this represents a very high standard of care there must be concern that trainee neurosurgeons and radiologists may not be given enough experience to develop the required competencies to deliver a safe service in the future. That this is the case that has been highlighted in a previous publication.[47]

Table 4.22 Grade of surgeon or radiologist performing the definitive procedure *(Tertiary care clinician questionnaire)*

Grade of operating surgeon/neuroradiologist	n	%
Consultant	281	91.5
Senior trainee - supervised by scrubbed consultant	24	7.8
Senior trainee - supervised by un-scrubbed consultant	2	0.7
Subtotal	**307**	
Unknown	2	
Total	**309**	

Table 4.23 Grade of anaesthetist for the definitive procedure *(Tertiary care clinician questionnaire)*

Grade of anaesthetist	n	%
Consultant	275	91.7
Supervised trainee	11	3.7
Unsupervised trainee	14	4.7
Subtotal	**300**	
Unknown	9	
Total	**309**	

Similarly, anaesthetic support for these interventions was largely provided by a consultant or supervised trainee reflecting an equally high quality service (Table 4.23).

Procedural complications

The Advisors considered that procedural complications related to intervention occurred in 48/262 (18.3%) patients (Table 4.24). Tables 4.25 and 4.26 indicate the frequency for surgery and interventional radiology.

Table 4.24 Frequency of procedure-related complications following treatment for aSAH *(Advisor assessment form)*

Procedural complications	n	%
Yes	48	18.3
No	214	81.7
Subtotal	**262**	
Insufficient data	15	
Total	**277**	

Table 4.25 Procedural complications – surgery *(Advisor assessment form)*

Procedural complications: surgery	n	%
Yes	8	19.5
No	33	80.5
Subtotal	**41**	
Insufficient data	3	
Total	**44**	

Table 4.26 Procedural complications – interventional radiology *(Advisor assessment form)*

Procedural complications: Interventional Radiology	n	%
Yes	40	18.0
No	181	81.9
Subtotal	**221**	
Insufficient data	18	
Total	**239**	

Given the small number of patients undergoing open surgery it was difficult to draw any firm conclusions.

In general the number of procedural complications following endovascular coiling is in line with previously published data, although it would appear that failure to occlude the aneurysm might have occurred more often in the current review than in the ISAT trial[9] (4/239 ; 1.7% versus 5/489; 0.5%).

In this study 8/221 (3.6%) patients suffered a thromboembolic complication. Whilst none were treated with thrombolysis (which caused devastating re-bleeding in the ISAT trial) four suffered a debilitating stroke.

It was also apparent that 7/239 (2.9%) aneurysms ruptured during endovascular therapy and 2/44 (4.5%) in patients during surgical clipping. The frequency of this complication in the patients treated with coils is consistent with previous reports.[10, 48]

One other procedural complication also justifies further consideration. Vessel occlusion by the percutaneous device used to close the arterial puncture site occurred in 5/239 (2.1%) patients. In a recent meta-analysis of both randomized and non-randomised studies comparing the outcomes for a closure device or manual compression[49] the frequency of this adverse event was 11/1595 (0.69%). These data suggest that there may be a training issue in relation to the use of these devices.

Neurosurgeons completing the questionnaire identified 44/309 (14%) patients who failed to regain their pre-intervention neurological status 4 hours post-operatively. (not recorded in 12 patients) (Table 4.27).

This initial assessment aims to identify neurological events related to the intervention: possible re-bleeding, cerebral oedema, or increasing intra-cranial pressure. Continued assessment is vital to optimise outcomes in this population and changes in neurologic examination may require further investigation and intervention to reduce the risk of long-term brain damage.[50]

Table 4.27 Details of neurological deficits present 4 hour post-intervention *(n=44, answers may be multiple) (Tertiary care clinicians' questionnaire)*

Neurological deficit	n
Drop in GCS	11
Hemiparesis	6
Aphasia	3
Dysphasia	5
Confused	3
Upper limb weakness	6
Drowsy	2
Sedated/ventilated (could not assess)	8

Table 4.28 Functional status at discharge in patients with neurological signs 4 hours post-intervention *(Advisor assessment form/Tertiary care clinician questionnaire)*

Functional status at discharge	n
No symptoms	1
No disability despite symptoms	9
Slight disability	7
Moderate disability	4
Moderate-severe disability	13
Severe disability	0
Died	10
Total	**44**

For the 44 patients with neurological signs 4 hours post-intervention the functional status at discharge is shown in Table 4.28.

It is apparent that the majority (61%) had a moderate disability or worse and thus only 13/44 patients were initially discharged to their own home (Table 4.29).

Table 4.29 Discharge destination of patients with neurological signs 4 hours post-operatively *(Advisor assessment form/ tertiary care clinician questionnaire)*

Discharge destination	n
Place of residence	13
Rehabilitation unit	11
Neurosurgical centre for further treatment	3
Non-hospital care	7
Died	10
Total	44

Mortality

For patients in this study who underwent definitive treatment of their aneurysm mortality rates are shown in Table 4.30.

Given the small number of patients who underwent surgical clipping no detailed comments can be made about the mortality for this group, particularly in comparison to the endovascular group. For the latter the mortality is almost identical to the 60-day mortality in the ISAT Trial.[51] Other series have reported mortality rates ranging from 0-17.4%.[52-54] It would seem reasonable to conclude that the risk of mortality reported in the current study is in line with that which would be expected.

Complications of aSAH

All patients (conservative and active management)
As part of the review performed by the Advisors they determined the frequency of disease-specific complications in patients receiving both conservative and active management. The data are shown in Table 4.31 where it can be seen that 199/427 (46.6%) of patients had documented evidence of a complication.

More detailed information about the nature of these complications is recorded in Table 4.32, which also demonstrates that some patients experienced more than one adverse event.

Table 4.30 Mortality following treatment of aneurysmal SAH *(Advisor assessment form)*

Primary Procedure	n	Died	Discharged alive	Mortality (%)
Open surgery	38	1	37	2.6
Endovascular intervention	233	18	215	7.7
Both: Endovascular intervention followed by surgery	6	0	6	0.0

Table 4.31 Frequency of disease-specific complications of aSAH *(Advisor assessment form)*

Documented complications of aSAH	n	%
Yes	199	46.6
No	228	53.4
Total	427	

When these complications arose the Advisors considered that an appropriate management plan was instituted in the majority of patients (Table 4.33).

Table 4.32 Type of complication in 199 patients in whom they occurred (answers may be multiple) *(Advisor assessment form)*

Detail of aSAH complications	n	%
Delayed cerebral ischaemia	84	42.2
Re-bleed	39	19.6
Hydrocephalus	108	54.3
Other	34	17.1

Nevertheless they also suggested that the complication was avoidable in 19/146 (13%) patients where this could be determined. The most common reason for avoidable complications was delays in various stages of the patient pathway (data not shown).

Table 4.33 Advisors opinion on the adequacy of the management of complications *(Advisor assessment form)*

Complications managed appropriately	n	%
Yes	104	95.4
No	5	4.6
Subtotal	**109**	
Insufficient data	90	
Total	**199**	

An example of one of these avoidable complications is described in Case study 12.

Case study 12

Following coiling of their aneurysm a middle-aged patient developed a headache requiring opiate analgesia. Five days later, an MRI scan was satisfactory and they were discharged home (66 miles away) with no documented disability. The patient subsequently re-presented to the local district general hospital with symptoms and signs of delayed cerebral ischaemia. Despite appropriate management the patient had a poor outcome with significant disability and poor cognitive function.

The Advisors stated that if discharge from the neurosurgical centre had been delayed until it was clear that the symptoms were not settling, earlier management of delayed cerebral ischaemia would have been possible. This might have resulted in a better clinical outcome.

Complications in patients admitted to a neurosurgical/neurosciences centre

Although the introduction of endovascular techniques for the control of aSAH has reduced the associated mortality[10,55,56] post-intervention adverse events still occur. These include re-bleeding, hydrocephalus, and delayed cerebral ischaemia. There is reasonably strong evidence to suggest that re-bleeding occurs more frequently both in the acute setting and longer term after endovascular treatment[56-58] whilst there are varying reports on the incidence of delayed cerebral ischemia (similar[57-59] or possibly lower frequency[60]) compared to surgical clipping.

The clinical questionnaire identified both the frequency and outcome for these complications in patients admitted to a tertiary neurosurgical centre.

Aneurysm re-bleeding

The frequency with which re-bleeding occurred (clinician questionnaire) is shown in Table 4.34. This is somewhat higher than that (4.2%; pre-treatment to one year) in the Cochrane Review comparing endovascular coiling and neurosurgical clipping.[57]

Table 4.34 Frequency of re-bleeding following definitive treatment *(Tertiary care clinician questionnaire)*

Re-bleed	n	%
Yes	24	7.1
No	313	92.9
Subtotal	**337**	
Not answered	7	
Total	**344**	

This may reflect that the diagnosis was only made on clinical grounds in some patients (Table 4.35) which was clearly unreliable. And that there were 8 patients that did not undergo a proceedure.

Table 4.35 Basis for the diagnosis of re-bleeding *(Tertiary care clinician questionnaire)*

Diagnosis made	n
Clinical grounds only	5
Clinical grounds & CT scan	7
Haemorrhage in external ventricular drain/ lumbar drain with CT scan	1
CT scan only	10
Not answered	1
Total	**24**

Re-bleeding may occur both before and after treatment (Table 4.36). As considered earlier pre-intervention re-bleeding occurred more frequently in patients who were treated more than 48 hours after admission.

Table 4.36 Timing of re-bleeding *(Tertiary care clinician questionnaire)*

Timing of re-bleed	n
Before intervention	7
After intervention	5
No procedure	8
Subtotal	**20**
Unknown	4
Total	**24**

Re-bleeding, although the least common of the complications associated with aSAH, is perhaps the most serious with the clinical questionnaire reporting that only 6/22 (no information for 2) patients recovered to the same clinical condition as before their re-bleed whilst 10/24 died (Table 4.37).

Table 4.37: Outcome for patients with re-bleeding *(Tertiary care clinician questionnaire)*

Outcome	n
Delayed death	10
Persistent poor grade	2
Improvement and further treatment	3
Recovery to pre re-bleed condition	6
Suffered other complications and died	1
Not answered	2
Total	**24**

Hydrocephalus

Patients who suffer an aSAH are at risk of developing hydrocephalus and 94 patients required early CSF drainage (Table 4.38). This was achieved by a lumbar drain (n=14), an external ventricular drain (n=73) or by other means (n=9) with 15 patients experienced a complication of this procedure, most commonly infection/ventriculitis (7/15).

Table 4.38 Patients requiring CSF drainage *(Tertiary care clinician questionnaire)*

Hydrocephalus	n	%
Yes	94	27.8
No	244	72.2
Subtotal	**338**	
Not answered	6	
Total	**344**	

Table 4.39 Development of delayed cerebral ischaemia *(Tertiary care clinician questionnaire)*

Delayed cerebral ischaemia	n	%
Yes	76	22.6
No	260	77.4
Subtotal	**336**	
Insufficient data	8	
Total	**344**	

The Advisors also considered that 4/17 patients with deficient management in secondary care should have had treatment for hydrocephalus. Sixteen patients subsequently required long term CSF drainage with a ventriculo-peritoneal shunt. Complications of the procedure were recorded in two patients.

Delayed cerebral ischaemia

Delayed cerebral ischemia (DCI) occurs in a quarter to a third of the patients with aSAH 4-10 days after the onset of the aSAH and is an important factor in the pathogenesis of a poor outcome. Clinical features include focal neurological signs (aphasia, hemiparesis) or a decrease in the level of consciousness, often with a gradual or fluctuating onset. Although sometimes reversible it may progress to cerebral infarction, severe disability or even death. Although these events may occur with evidence of angiographic narrowing this may be co-incidental and a number of other factors have been suggested as contributors to its pathogenesis. These include 'early brain injury' within the first 72 hours after aneurysm rupture, cortical spreading depression, and microthrombosis.[61,62]

In the current study a diagnosis of DCI was made in 76/336 (22.6%) patients of whom 47/69 (7 unknown) developed a focal neurological deficit (Table 4.39).

Eighteen (of 76) patients (5 not known) also had abnormal electrolytes and this, particularly hyponatraemia, has been suggested as a metabolic factor that may promote the onset of DCI.

In the patients included in this study the clinical questionnaire indicated that the diagnosis of DCI was most frequently made on clinical grounds (Table 4.40). The use of more specific methods of assessing cerebral perfusion, particularly angiography and transcranial Doppler (TCD) was sporadic but may reflect the current belief that vasospasm is not necessarily the principle factor promoting its development.

Table 4.40 Diagnostic methods for DCI *(answers may be multiple n/73, 3 not answered) (Tertiary care clinician questionnaire)*

Diagnosis of delayed cerebral ischaemia	n
Clinical grounds only	20
Clinical grounds plus other investigation	34
CT perfusion	8
CTA	2
Other	5
DSA	14
CT scan	23
TCD	8

The variety of measures employed to reverse DCI may reflect uncertainty about its pathogenesis. These are summarised in Table 4.41.

Table 4.41 Treatment methods employed for DCI *(answers may be multiple n/76; tertiary care clinician questionnaire)*

Treatment for delayed cerebral ischaemia	n
Intravenous crystalloid fluids	57
Hypertonic saline	7
Intravenous colloidal fluid	19
Induced hypertension	38
Induced hypervolaemia	22
Induced haemodilution	16
Balloon angioplasty	2
Pharmacological (angiographic)	5
New/additional CSF drainage	6
Other	16

In a recent review Rowland and colleagues[62] have considered a range of potential therapeutic measures for DCI and concluded that induced hypertension, hypervolaemia, and haemodilution remain the mainstay of DCI management. It is apparent from Table 4.41 that this approach was used in some form in nearly all of the patients considered to have DCI in this study. Nevertheless the authors point out that the evidence for so-called "triple-H therapy" is only of moderate quality and that previous randomised trials have concentrated on prophylaxis rather than treatment.

Extensive research to identify a pharmacological solution for DCI has failed and only nimodipine has been shown to reduce the frequency of this complication. Thus, if it is already prescribed it seems logical to continue its use. In summary therefore the management of DCI in the present study seems to have been satisfactory.

The multi-disciplinary team

Good post-operative care is a crucial part of the clinical pathway and the Advisors therefore assessed the quality of multi-disciplinary management in the NSC. Their views are summarised in Table 4.42 which shows that the majority of patients received satisfactory care where a decision could be made. However, the proportion of patients in whom there was insufficient evidence for them to assess the level of care was high.

Table 4.42 Advisors opinion on adequacy of post-operative multi-disciplinary management *(Advisor assessment form)*

Adequate post-operative MDT management	n	%
Yes	186	93.0
No	14	7.0
Subtotal	**200**	
Insufficient data	77	
Total	**277**	

In most cases where the Advisors considered that care might have been inadequate the decision was made on the basis of poor documentation about management decisions and the progress of patients.

Data from the Advisor assessment form (Table 4.43) indicates the level of care to which patients were admitted following intervention.

The Advisors were of the opinion that an inappropriate level of care was provided to 10/260 patients where this could be assessed and Table 4.44 compares the level of care received with the level of care required.

Given the pressures on critical care beds in the NHS this data is possibly better than expected.

Post-operative monitoring

A further important aspect of care, particularly for the detection of post-intervention complications and the assessment of its treatment is the provision of good physiological monitoring both immediately after intervention and following discharge to the level of care described in Table 4.43. The range of methods and proportion of patients receiving each of these is shown in Table 4.45. In general this seems to reflect a good level of care.

Table 4.43 Level of care provided post-operatively *(Advisor assessment form)*

Level of care post-operatively	n	%
Level 1	45	17.0
Level 2	107	40.4
Level 3	113	42.6
Subtotal	**265**	
Insufficient data	12	
Total	**277**	

Table 4.44 For cases of inappropriate level of care provided post-operatively, the level of care that was required *(Advisor assessment form)*

	Level of care required			
Level of care received	**Level 1**	**Level 2**	**Level 3**	**Total**
Level 1	0	8	0	8
Level 2	0	0	1	1
Level 3	1	0	0	1
Total	**1**	**8**	**1**	**10**

Table 4.45 Post-operative monitoring *(Answers may be multiple n/300, not answered in 9) (Tertiary care clinician questionnaire)*

Post operative monitoring	n	%
Pulse oximetry	296	98.7
Non-invasive blood pressure	154	51.3
Intra arterial blood pressure	214	71.3
Central venous pressure measurement	94	31.3
Transcranial Doppler	54	18.0
Cardiac output	5	1.7
Intracranial pressure	22	7.3
Cerebral function monitoring or EEG	4	1.3
Other	12	4.0

Rehabilitation services, discharge and follow-up

Aneurysmal SAH is associated with both a high mortality and morbidity. Even in those patients who survive, a poor functional outcome is common and the requirement for rehabilitation services will be significant and protracted given that aSAH affects younger patients, some of whom will be unable to live independently in the future. Only one-third of surviving patients return to their pre-morbid employment and even those who have a good functional outcome are often left with significant neurocognitive impairment. The functional status of patients at discharge from tertiary care in this study is shown in Table 4.46.

Table 4.46 Functional status of patients at discharge
(Advisor assessment form)

Functional status of patients discharged from tertiary care	n	%
No symptoms	63	27
No significant disability despite symptoms	94	40.3
Slight disability	34	14.6
Moderate disability	12	5.2
Moderate-severe disability	26	11.2
Severe disability	4	1.7
Subtotal	**233**	
Patient died before discharge	39	
Insufficient data	31	
Total	**303**	

Grade	GCS	Motor deficit
I	15	-
II	14-13	-
III	14-13	+
IV	12-7	+/-
V	6-3	+/-

Figure 4.5 WFNS SAH grading scale

The potential outcome for patients undergoing treatment for aSAH is, in part dictated by their neurological status on admission to hospital. Some will present with an existing motor deficit or reduced GCS score. These symptoms and signs are combined to produce a WFNS grade that provides a guide to neurological outcome and mortality. Figure 4.5 indicates the definitions for each WFNS grade whilst Figure 4.6 shows the grades for patients in this study, both on admission to the NSC, and again immediately prior to intervention. Additional disability may also occur as a result of post-operative complications.

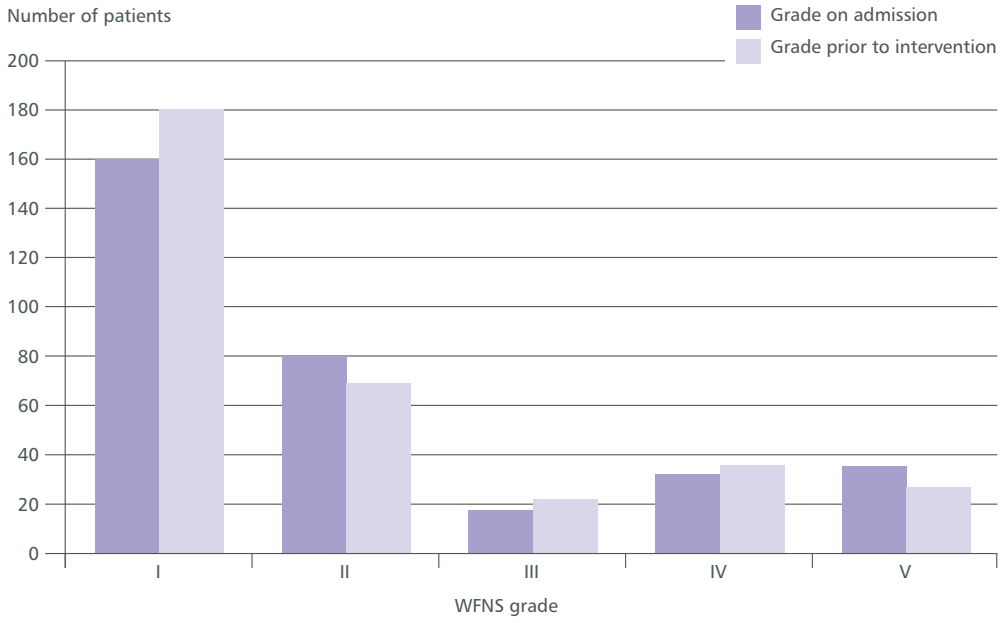


Figure 4.6 WFNS grades on admission to a NSC and prior to intervention
(WFNS grade on admission n=325; WFNS grade prior to intervention n=304; Tertiary care clinician questionnaire)

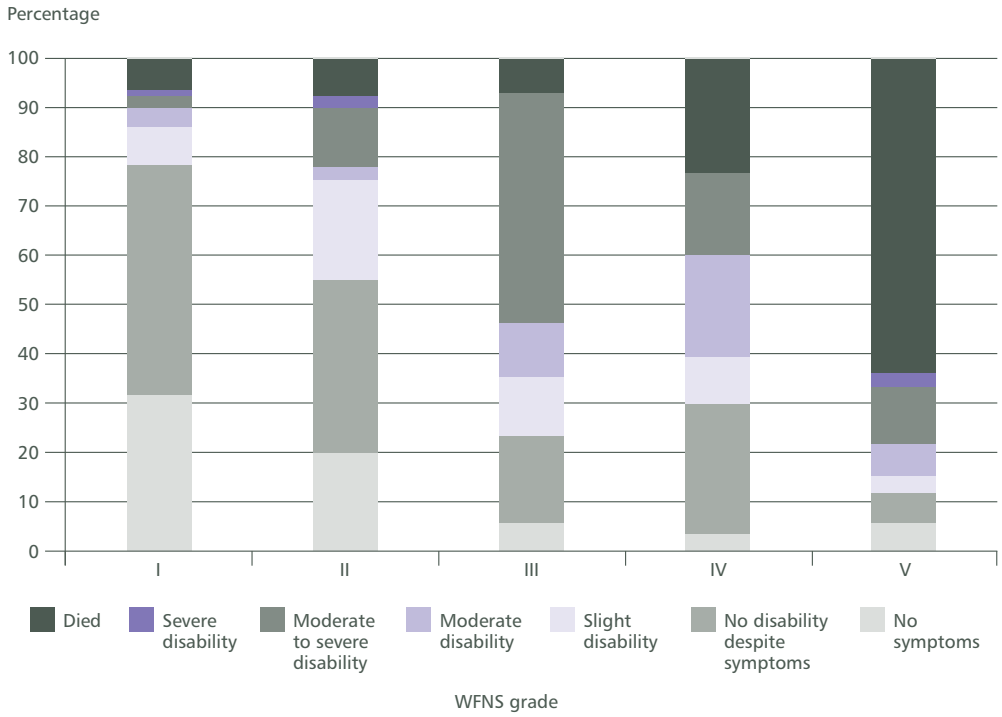


Figure 4.7 Functional outcome at discharge for each WFNS grade prior to intervention
(Tertiary care clinician questionnaire; n=315 (Insufficient data in 29))

Figure 4.7 links the pre-intervention WFNS grade with the functional status at discharge.

These data confirm that the WFNS grade prior to intervention is a reasonable guide to the outcome from treatment. The majority of grade I patients had either no symptoms or symptoms with no disability at discharge (124/161). Conversely only 11.8% of grade V patients achieved the same outcome (4/34) and more than 50% died. More importantly nearly 50% of grade II (34/76) and 70% of grade III or IV patients (35/50) either died or were discharged with some degree of disability. Further, that only a quarter of patients had neither symptoms nor disability at discharge means there is clearly a significant need for input from rehabilitation services for both before and after discharge from hospital. Although the WFNS grading has some prognostic value, aSAH patients with no major co-morbidities should not be denied treatment purely on the basis of a poor WFNS grade.

Table 4.47 shows the range of services that were provided to patients in the NSCs and indicates that 49 (18.8%) patients had no contact with any of them.

Table 4.47 The number of patients who accessed therapy services as an inpatient *(Answers may be multiple; n/260; 43 insufficient data; Advisor assessment form)*

Inpatient therapy services	n	%
Physiotherapy	163	62.7
Occupational therapy	127	48.8
Speech & Language therapy	68	26.2
Neuropsychology	33	12.7
None of these	49	18.8

These data were further analysed by identifying patients who survived to discharge from tertiary care with either symptoms or disability at the time of discharge. Despite their clinical status, 24/170 (14.1%) patients did not access any of these common rehabilitation services during their admission (Table 4.48). Further, only 28/170 (16.5%) were reviewed by a neuropsychologist.

Table 4.48 The number of patients with symptoms or disability who accessed therapy services as an inpatient in tertiary care - patients with a complete dataset
(Answers may be multiple, n/170; Tertiary care clinician questionnaire/Advisor assessment form)

Inpatient therapy services	n	%
Physiotherapy	112	65.9
Occupational therapy	58	34.1
Speech & Language therapy	53	31.2
Neuropsychology	28	16.5
None of these	24	14.1

The services that were provided for the same 170 patients following discharge were also assessed (Table 4.49). Unfortunately it was not possible to identify those patients who received no services following discharge. However, even if all the patients who received assistance only accessed one of these (answers could be multiple to accommodate patients receiving help from more than one service) it is clear that some patients with persisting symptoms or disability did not benefit from this type of help following discharge.

Table 4.49 Support arrangements for patients with symptoms or disability following discharge
(Answers may be multiple, n/170; Advisor assessment form)

Support post-discharge	n	%
Patient support via telephone contact	15	8.8
Neuropsychology referral	21	12.4
Patient issued with information on living post-aSAH	47	27.6
Referral to support organisations	12	7.1
Speech and Language therapy referral	10	5.9
Occupational therapy referral	25	14.7
Physiotherapy referral	24	14.1
Other post-discharge support	26	15.3
Insufficient data	15	8.8

Impaired cognitive function has a major role in preventing patients returning to work and leading a normal life following aSAH. Many patients who might be assumed to benefit from neuropsychology support did not receive this either as an in-patient or following discharge. From the data in Table 4.50 it would appear that services were not necessarily targeted to those who needed them most.

From a global perspective the Advisors were asked to assess whether there was an adequate rehabilitation plan in place at the time of discharge from secondary care (n=8) or a specialist neurosurgical centre (n=264). They felt that this was not the case in 35/164 (21.3%) patients where this could be determined (insufficient data in 86, not applicable in 22).

Table 4.50 Patients receiving neuropsychology support classified by functional status at discharge *(Tertiary care clinician questionnaire/Advisor assessment form n/171)*

Functional status	Neuropsychology In-patient	%	Neuropsychology Post-discharge	%	Total
No significant disability despite symptoms	**15**	16.0	**12**	12.8	**94**
Slight disability	**5**	14.7	**3**	8.8	**34**
Moderate disability	**2**	16.7	**2**	16.7	**12**
Moderate to severe disability	**4**	16.0	**3**	12.0	**26**
Severe disability	**2**	50.0	**1**	25.0	**4**
Total	**28**	**16.5**	**21**	**12.4**	**170**

Finally, where there were delays in transfer to a rehabilitation facility these all occurred in patients awaiting transfer from an NSC (14/264).

The previous literature on neuropsychological rehabilitation is scanty, perhaps reflecting the low level of importance that has been attached to this. In the ISAT trial post-discharge cognitive function was assessed in a cohort of non-disabled patients approximately one year after discharge.[63] Of these, a third demonstrated significant cognitive impairment together with a reduction in health-related quality of life. Although impairment was less common in the endovascular group it still occurred in 28% of these patients.

A number of other studies have also identified important psychosocial deficits in the post-operative period in patients with a good neurological recovery. These include mood disturbance, abnormally low independence (up to 50%), poor social functioning and a failure of most patients to return to productive employment.[64,65]

These findings highlight the need for structured support and treatment after intervention for aSAH. It is clear from the data presented in this study that there is an under provision of neurorehabilitation services and perhaps little in the way of targeted support for those who might benefit the most.

The Royal College of Physicians has recently published the 4th edition of the National Clinical Guideline for Stroke.[6] A brief summary of this states that:

"A Patients should be offered a minimum of 45 minutes of each appropriate therapy for a minimum of 5 days per week for as long as they are continuing to benefit.

B Promote practice of skills gained in therapy in the patient's daily routine and encouraged as much practise as possible.

C Therapy assistants and nurses should facilitate practice under the guidance of a qualified therapist."

Although these guidelines may be more appropriate for in-patient care other guidance also covers the post-discharge provision of support. They stress the importance of regular assessments of progress against set goals and modifying these or the intervention if they are not achieved. This may include stopping rehabilitation. If this decision is made then other appropriate support should continue and mechanisms for re-contacting the rehabilitation team for further assessment or support should be in place.

Discharge from neurosurgical units

The final outcome and discharge destination for patients admitted to a NSC is shown below. Table 4.51 shows the discharge information for the whole study group whilst Tables 4.52 and 4.53 show the same information for patients admitted to a NSC and for those who were not transferred from secondary care.

Table 4.51 Discharge destination of patients *(Advisor assessment form)*

Discharge destination	n	%
Place of residence	190	44.5
Nursing home	5	1.2
Other hospital for neurorehabilitation	33	7.7
Same hospital that referred the patient	36	8.4
Other hospital for further treatment	8	1.9
Patient died	155	36.3
Total	**427**	

Of the whole group 155/427 (36.3%) patients died thus highlighting the serious nature of aSAH. It is of note that only 33/427 (7.7%) of patients received further in-patient care for rehabilitation representing less than half of the patients discharged with moderate or more severe disability.

Table 4.52 Discharge destination for all patients admitted to an NSC *(Advisor assessment form)*

Discharge destination	n	%
Place of residence	187	61.7
Other hospital for neurorehabilitation	33	10.9
Same hospital that referred the patient	36	11.9
Other hospital for further treatment	8	2.6
Patient died	39	12.9
Total	**303**	

Table 4.53 Discharge destination for all patients that remained in secondary care *(Advisor assessment form)*

Discharge destination	n	%
Other hospital	3	2.4
Nursing home	5	4.0
Patient died	116	93.5
Total	**124**	

Follow-up

Of the 299 patients discharged alive from a NSC (according to the tertiary care clinician questionnaire), 241 were seen for follow-up at a median of 12 weeks. (data not shown) When reviewed by the neurosurgeons their functional status, as a group, was slightly but not dramatically better than at the time of discharge (Table 4.54). This would be consistent with the expected clinical picture.

Table 4.54 Functional status at follow up *(Tertiary care clinician questionnaire)*

Functional status	n	%
No symptoms	76	33.5
No significant disability despite symptoms	97	42.7
Slight disability	33	14.5
Moderate disability	10	4.4
Moderate to severe disability	10	4.4
Severe disability	1	<1
Subtotal	**227**	
Unknown	8	
Not answered	6	
Total	**241**	

Following endovascular treatment for aSAH there is a small but definite chance of re-bleeding which is greater than that after surgical clipping. Furthermore, patients who suffer aSAH are more likely to develop further aneurysms particularly if they are hypertensive or smoke. Thus some authors consider that patients who survive this catastrophic event should be screened every five years to exclude the development of further aneurysms.[66] Similarly if patients presenting with aSAH have a second, non-ruptured aneurysm then follow-up screening should be performed and intervention considered if the aneurysm reaches a diameter of 6mm. This is based on the low risk of rupture for aneurysms <7mm diameter in the International Study of Unruptured Intracranial Aneurysms.[67]

The Advisors could find evidence that a suitable plan for follow-up had been made in 80.2% (182/227) of patients who survived to discharge (Table 4.55). Such follow-up is also recommended for further assessment of rehabilitation needs.

Table 4.55 An adequate plan was in place for follow-up following discharge *(Advisor assessment form)*

Follow-up plan	n	%
Yes	182	80.2
No	45	19.8
Subtotal	**227**	
Insufficient data	45	
Total	**272**	

Case study 13

A patient was admitted to their local hospital with a GCS of 13 following a seizure. An MRI scan arranged by the emergency department demonstrated aSAH with early hydrocephalus. The regional neurosurgical centre (NSC) declined admission and suggested that a lumbar puncture was performed. The CSF was blood stained. The NSC was contacted again the next day and requested a CT scan. This confirmed the MRI findings. On this occasion the NSC agreed to the transfer, following which an external ventricular drain was inserted and endovascular treatment of an aneurysm was performed 24 hours later. The patient's GCS had fallen to 3 by this time and the patient ultimately died.

The Advisors commented that the patient should have been accepted by the NSC following the MRI scan on the day of admission to the DGH. The delay resulted in a significant deterioration in the clinical condition with an inevitable outcome despite intervention.

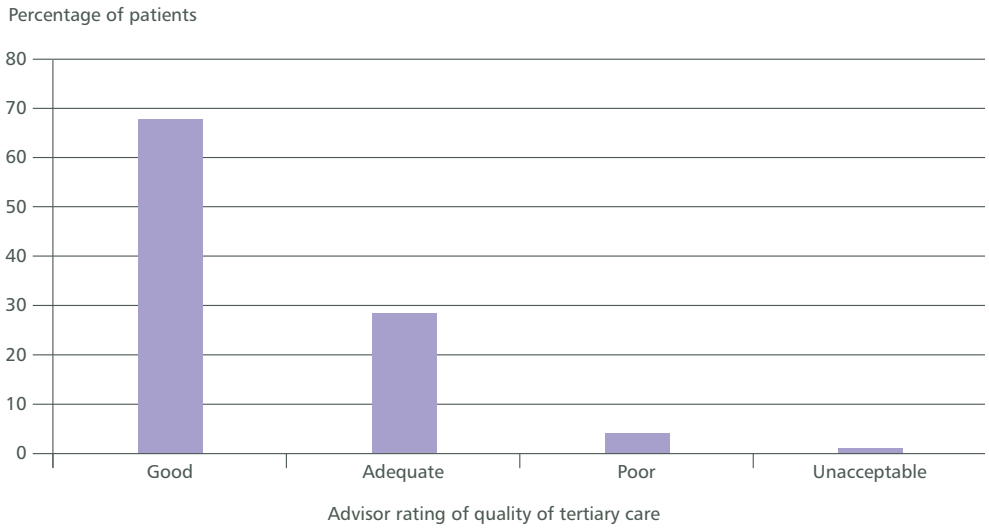


Figure 4.8 Advisors opinion on individual patient quality of care in NSC
(Advisor assessment form)

Quality of care in tertiary care

The Advisors were asked to make an assessment of the quality of care provided in the tertiary centre. Their views are summarised in Figure 4.8 together with the reasons for assessing care as poor or unacceptable (Table 4.56). The rating is similar to that for secondary care, with 198/294 (67.3%) receiving good care and 141/294 (48.0%) classified as having poor/unacceptable management. An example of a patient receiving poor care is highlighted in Case Study 13.

Table 4.56 Reasons for poor/unacceptable care in NSC
(Advisor assessment form)

Reasons for poor/unacceptable rating	n
Deficiencies in treatment planning	2
Documentation of MDT care and next of kin discussion	1
intraventricular hemorrhage treatment insufficient	1
Multiple delays	4
Poor MDT documentation, treatment planning	1
Post-op care	1
Re-bleed and premature discharge from HDU	1
Delayed acceptance by NSC	1
Discharged too soon	1
Post-op care should have been on HDU	1
Total	**14**

Key findings

95.1% (270/284) of patients were admitted to an appropriate level of care following transfer to the neurosurgical/neuroscience centre and 96.2% (250/260) after definitive treatment.

12.1% (35/289) of patients had deficiencies in their examination and 8.3% (24/289) in their management planning when first assessed in a neurosurgical/neuroscience centre, in the view of the Advisors.

35.4% (87/246) of patients did not have a review by a consultant neurosurgeon within 12 hours of admission to neurosurgical/neuroscience centre according to the tertiary care clinician questionnaire. The timing of the consultant review was unknown in a further 93 cases.

86.3% (239/277) of patients, who had a procedure, were treated by endovascular techniques.

52.7% (156/296) of the patients in neurosurgical/neuroscience centres, who had an intervention, did not have the decision on their treatment method made in a multi-disciplinary team meeting.

23.2% (67/289) of patients who had an intervention did not have their treatment decision (either from an MDT or from discussions between the responsible clinicians) recorded in the case notes.

9.6% (24/250) of patients admitted to a neurosurgical/neuroscience centre had a delay in treatment planning in the view of the Advisors.

13.9% (34/244) of patients had deficiencies in the consent process identified by the Advisors. These included poor documentation of risk (16/34) and limited or poorly documented discussion with the next of kin (15/34).

20.5% (42/205) of patients who gave consent may have had impaired mental capacity to do so.

72% (108/150) patients admitted to a neurosurgical/neuroscience centre Monday-Thursday had their aneurysm treated within 24 hours of admission, compared with 28% (42/150) of patients admitted Friday-Sunday.

Consultant neurosurgeons and neuroradiologists were present for all interventions.

8.5% (26/307) of procedures were performed by trainees. These were all supervised by a consultant. This low percentage raised questions about training opportunities.

18.8% (49/260) of patients did not receive in-patient rehabilitation (e.g. physiotherapy, occupational therapy and neuropsychology) in neurosurgical/neuroscience centres. Furthermore 21.3% (35/164) of patients had no rehabilitation plan at the time of discharge.

16.5% (28/170) of patients received neuropsychological support as an in-patient in a neurosurgical/neuroscience centre, and 12.4% (21/170) of patients received it post-discharge.

Recommendations

8. Relevant professional bodies should develop a nationally-agreed and audited protocol for the management of aneurysmal subarachnoid haemorrhage in tertiary care that addresses initial assessment, multi-disciplinary management and documentation, informed consent, timing of interventions, peri-operative care, management of complications and rehabilitation. *(Royal Colleges and Specialist Associations)*

9. Mental capacity of aneurysmal subarachnoid haemorrhage patients to give their own consent should be reviewed and a consensus document developed (with consideration of the Mental Capacity Act 2005). *(Royal Colleges and Specialist Associations)*

10. The nationally-agreed standard *('National Clinical Guideline for Stroke')* of securing ruptured aneurysms within 48 hours should be met consistently and comprehensively by the health care professionals who treat this group of patients. This will require providers to assess the service they deliver and move towards a seven-day service. *(Medical Directors)*

11. Neurosurgical /neuroscience centres must ensure that trainees in neurosurgery and neuroradiology develop the appropriate competencies for future consultant practice. *(Local Education and Training Boards/Deaneries, Royal Colleges, Medical Directors and Clinical Directors)*

12. Appropriately funded rehabilitation for all patients following an aneurysmal subarachnoid haemorrhage should include, as a minimum, access to information for patients and relatives, specialist subarachnoid haemorrhage nurses and comprehensive in-patient and out-patient rehabilitation services including appropriate neuropsychological support. *(Specialist Associations, Medical Directors and Commissioners)*

5 – End of life care in secondary care and tertiary care

Morbidity and mortality meetings

For those patients that died during the study clinicians were asked to indicate whether the case was discussed at a morbidity and mortality (M&M) meeting.

In the NSC it was reported that 35/45 patients were discussed compared to only 22/146 (15.1%) of patients dying in secondary care.

For those cases in whom serious morbidity or mortality occurred in a NSC these meetings should also involve the relevant clinicians from secondary care, particularly when factors prior to transfer may have influenced outcome. Unfortunately we did not ask about this.

End of life care

The Advisors were of the opinion that end of life care should have been in place for 128 patients included in this study and concluded that this aspect of care was satisfactory in 121 patients (94.5%). Thus there do not seem to be any important messages arising from this part of the study.

Organ donation

Deaths following aneurysmal subarachnoid haemorrhage (aSAH) often occur in relatively young and otherwise healthy patients and thus despite their tragic death organ donation is often highly appropriate. Indeed, for 2012/3, 622/1212 cadaveric donors had died from intracranial haemorrhage. The frequency with which organ donation occurred in patients who died during this study was therefore examined.

The Advisors were asked to identify whether brainstem death testing had been performed in those patients who died. In 142 patients, with appropriate documentation, testing was performed in 53 (37.3%) and brainstem death confirmed in 51. However, the Advisors were of the opinion that 91 patients were suitable for organ donation but this only occurred in 44 instances (Tables 5.1 and 5.2).

Table 5.1 Suitability of patients who died for organ donation *(Advisor assessment form)*

Suitability of patients for organ donation	n	%
Yes	91	70.5
No	38	29.5
Subtotal	**129**	
Unknown	24	
Not answered	2	
Total	**155**	

Table 5.2 Occurrence of donation in suitable donors *(Advisor assessment form)*

Donation occurred	n
Yes	44
No	43
Subtotal	**87**
Unknown	4
Total	**91**

In this data it could be seen that only half (44/87) of potential donations occurred and non-donation rates were similar in both secondary (32/59) and tertiary care (11/28). The reasons for non-donation are summarised in Table 5.3.

Table 5.3 Reasons for no organ donation when suitable *(Advisor assessment form)*

Reason for lack of donation	n
Not considered by medical staff	11
Refused by next of kin	24
Other	8
Total	**43**

Clearly, where donation was refused by the next of kin organ donation was not possible. Nevertheless it is of concern that more than a quarter of potential donors were lost because the medical staff did not pursue this option. In addition, organ donation did not occur in seven patients for "other" reasons (Table 5.4) and in four of these the Advisors felt that there was a missed opportunity.

Table 5.4 Other reasons for no organ donation *(Advisor assessment form)*

Other reasons	n
Delay with organ retrieval team	2
Died despite support before donation could occur	1
No organ donation team immediately available. Patient deteriorated prior to donation	1
Originally for donation but passed away on ward so timing difficult	1
Refused by intensive care consultant	1
Plan to discuss with next of kin but no outcome of the discussion recorded	1
Refused by transplant co-ordinator – unclear why	1
Total	**8**

Key finding

Organ donation did not occur in 43/87 of potentially suitable donors. After excluding refusal by next of kin more than half of the remainder (11/19) did not occur because medical staff did not pursue this option. *(see key finding on page 38 of the full report with regard to the availability of this policy)*

Recommendation

13. Organ donation rates following fatal aneurysmal subarachnoid haemorrhage should be audited and policies adopted to increase the frequency with which this occurs. *(Medical Directors)*

6 – Overall quality of care and summary

Overall quality of care – secondary and tertiary care

All cases reviewed by study Advisors had their overall quality of care assessed according to a scale ranging from: good practice, room for improvement either in clinical or organisational aspects of care or both clinical and organisational aspects of care, or less than satisfactory. The results of this review are summarised in Figure 6.1. In 58.1% (248/427) of patients the overall standard of care was considered as good. Conversely there was room for improvement or the care was unsatisfactory in 41.5% (177/427) of cases. These figures followed a similar pattern if split between the cohort managed conservatively in secondary care, and those admitted to tertiary care, although the proportion of cases rated as 'good practice' was greater in the conservatively managed group (85/124 (68.5%) compared with 163/303 (53.8%)), and the proportion of cases rated as 'room for improvement in organisational aspects of care' was greater in the cohort that was admitted to tertiary care (34/303 (11.2%) compared with 2/124 (1.6%)).

Much of the care provided in this study was good and Case study 14 is an example of this.

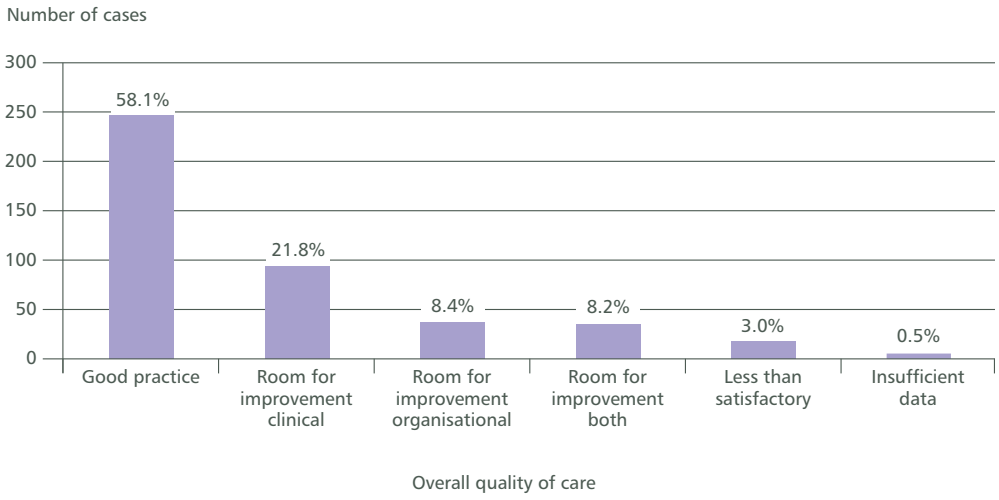


Figure 6.1 Overall quality of care (n=427)
(Advisor assessment form)

Case study 14

A middle aged patient suffered the sudden onset of a headache and a 10-minute seizure. When the paramedics arrived the patient was confused. On admission to the emergency department at the local district general hospital, the patient had a GCS of 14 and remained confused. They underwent an immediate CT scan and an aSAH was diagnosed. The patient was referred to the regional neurosurgical centre (NSC), received IV fluids and nimodipine and was transferred within 2 hours. The patient was seen by a consultant neurosurgeon within 6 hours of admission to the NSC, and underwent coil embolisation within 17 hours. An uneventful recovery was made.

The Advisors considered that at all stages this patient's care was exemplary.

For the dataset as a whole (secondary and tertiary care) it was evident that 184 patients suffered a delay in at least one part of their treatment pathway and Table 6.1 shows where the first delay occured.

The Advisors stated that 68 separate patients had their outcome affected by deficiencies in management across their pathway. Deficiencies in primary, secondary and tertiary care affected outcomes in 25, 33 and 10 patients respectively.

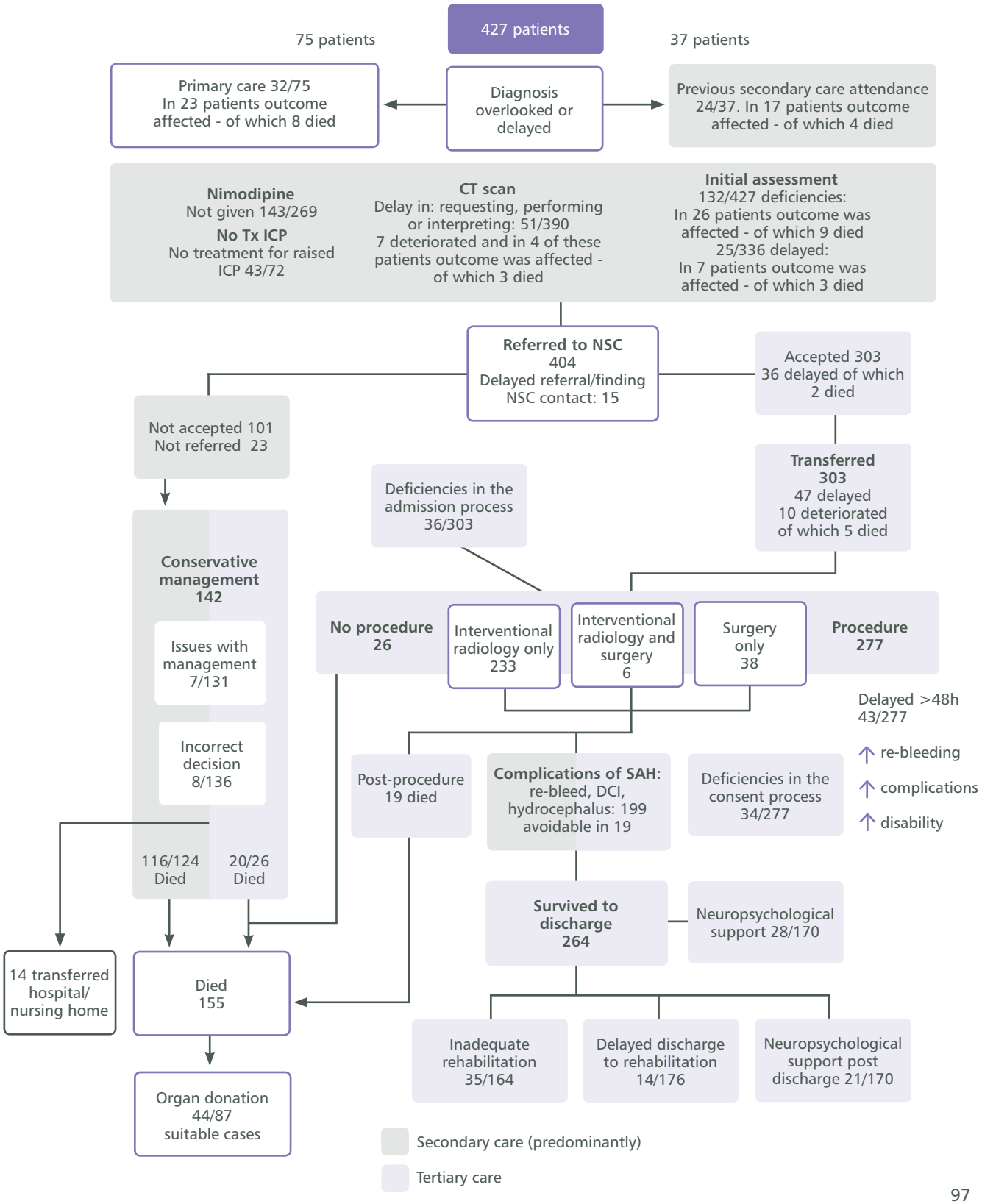
Table 6.1 The number of separate patients experiencing the first of one or more delays in their management at each point in the pathway in either secondary or tertiary care *(Advisor assessment form)*

Delay	Overall
General practitioner	32
Paramedical service	6
Previous presentation to secondary care	17
Initial assessment in secondary care	18
Delayed diagnosis in secondary care	18
Delayed request/performing/interpreting CT scan in secondary care	11
Delay in referral/finding contact at NSC	15
Delay in acceptance by NSC	18
Delay in transfer to NSC	19
Delay in consultant review in NSC	12
Delay in treatment planning	6
Delay in performing procedure	10
Delay in access to level 3 care post-procedure	2
Total	**184**

Summary

This study examined the care of patients with aneurysmal subarachnoid haemorrhage (aSAH) from the time they present with symptoms until they are discharged from hospital following treatment, or they die.

Figure 6.1 provides an overview of the complexity of patient pathways seen in this study and it highlights the main issues at various points.


427 patients
75 patients
37 patients
Primary care 32/75
In 23 patients outcome affected - of which 8 died
Diagnosis overlooked or delayed
Previous secondary care attendance 24/37. In 17 patients outcome affected - of which 4 died
Nimodipine
Not given 143/269
No Tx ICP
No treatment for raised ICP 43/72
CT scan
Delay in: requesting, performing or interpreting: 51/390
7 deteriorated and in 4 of these patients outcome was affected - of which 3 died
Initial assessment
132/427 deficiencies:
In 26 patients outcome was affected - of which 9 died
25/336 delayed:
In 7 patients outcome was affected - of which 3 died
Referred to NSC
404
Delayed referral/finding NSC contact: 15
Accepted 303
36 delayed of which 2 died
Not accepted 101
Not referred 23
Transferred
303
47 delayed
10 deteriorated
of which 5 died
Deficiencies in the admission process
36/303
Conservative management
142
Issues with management
7/131
Incorrect decision
8/136
No procedure
26
Interventional radiology only
233
Interventional radiology and surgery
6
Surgery only
38
Procedure
277
Delayed >48h
43/277
re-bleeding
complications
disability
Post-procedure
19 died
Complications of SAH:
re-bleed, DCI, hydrocephalus: 199
avoidable in 19
Deficiencies in the consent process
34/277
116/124
Died
20/26
Died
Survived to discharge
264
Neuropsychological support 28/170
14 transferred hospital/ nursing home
Died
155
Inadequate rehabilitation
35/164
Delayed discharge to rehabilitation
14/176
Neuropsychological support post discharge 21/170
Organ donation
44/87
suitable cases
Secondary care (predominantly)
Tertiary care

There are important lessons highlighted in each step of the patient pathway starting with a need for a higher index of suspicion, in both primary and secondary care, that patients might have had an aSAH. Simple guidelines, if followed, should avoid delays in the diagnosis and management of acute severe headaches.

There are many opportunities to improve the quality of initial care provided to aSAH patients, such as avoiding delays in performing CT scans and subsequent transfer to a specialist neurosurgical/neurosciences centre (NSC) when this is appropriate. Better lines of communication between secondary care and the NSCs need to be established to avoid delays in contacting the appropriate person in the NSC and to expedite transfer of patients.

The administration of nimodipine (which is of proven benefit) was not uniform following diagnosis in secondary care. Standard operating protocols for the management of patients are needed to ensure patient outcomes are optimised and delays abolished.

Following transfer to a NSC definitive treatment should be carried out earlier to particularly reduce the risk of re-bleeding and the development of "other" complications. To ensure timely treatment within 48 hours as recommended by the Royal College of Physicians, an increased neuroradiology service may be required in all NSCs accepting emergency referrals.

Despite prompt and appropriate treatment complications will occur following aSAH and there is undoubtedly an urgent need to improve rehabilitation services for survivors of aSAH, both within hospitals and in the community, following discharge from the hospital environment.

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Appendices

Appendix 1 – Glossary

Aneurysmal Subarachnoid Haemorrhage - aSAH	A subarachnoid hemorrhage is when blood leaks into the space between two membranes that surround the brain. The bleeding occurs in the arteries just below the arachnoid membrane and above the pia mater - just below the surface of the skull. There are three membranes that surround the brain; the pia mater is the innermost one while the arachnoid is the middle one. The bleeding may occur spontaneously, typically from a ruptured cerebral aneurysm. An aneurysm is a bulge that develops in a blood vessel caused by a weakness in the blood vessel wall.
Aphasia/dysphasia	This is characterised by either partial or total loss of the ability to communicate verbally or using written words. A person with aphasia may have difficulty speaking, reading, writing, recognising the names of objects, or understanding what other people have said.
Balloon Angioplasty	Balloon angioplasty involves the stretching of the narrowed section of the artery from the inside using a tiny balloon attached to the end of a fine tube.
Cerebral angiography	This is a test that uses X-rays and a special dye to create pictures of the blood vessels that supply the brain.
Clipping	A tiny clip is placed across the neck of an aneurysm to stop or prevent an aneurysm from bleeding. The aim of surgical clipping is to isolate an aneurysm from the normal circulation without blocking off any small arteries nearby.
CSF - Cerebrospinal fluid	This is a clear, colourless liquid that fills and surrounds the brain and the spinal cord and provides a mechanical barrier against shock.
CT - Computerised tomography	Sometimes called a CAT scan, this uses X-rays and a computer to create detailed images of the inside of the body.
CTA - Computerised tomography angiography	This is a test that combines the technology of a conventional CT scan with that of traditional cerebral angiography to create detailed images of the blood vessels in the body.
DCI - Delayed Cerebral Ischaemia	This is the development of new neurological signs and/or deterioration in level of consciousness, lasting for more than one hour, or the appearance of new infarctions on CT or MRI. The underlying pathophysiology is thought to be vasospasm (see definition).

Appendix 1 – Glossary (continued)

DSA - Digital Subtraction Angiography	A computer-assisted x-ray technique that subtracts images of bone and soft tissue to allow viewing of the blood vessels.
Endovascular coiling/ treatment	Tiny coils are packed into an aneurysm to promote blood clotting and close off the aneurysm. Coils accomplish from the inside what a surgical clip would accomplish from the outside: they stop blood from flowing into the. aneurysm but allow blood to flow freely through the normal arteries
EVD - External Ventricular Drain	This consists of a thin plastic tube (catheter) which is placed into the ventricles of the brain and connected to an external drainage system. The two main reasons they are inserted are 1) To divert infected CSF away from the brain and allow antibiotics to be given directly into the CSF to remove infection. 2) To reduce the pressure inside the brain caused by a build up of CSF due to a blockage or abnormal flow of CSF within the brain.
GCS - Glasgow Coma Scale/Score	This is a neurological scale that aims to give a reliable, objective way of recording the conscious state of a person for initial as well as subsequent assessment. A patient is assessed against the criteria of the scale, and the resulting points give a patient score between 3 (indicating deep unconsciousness) and either 14 (original scale) or 15 (the more widely used modified or revised scale).
Hemiparesis	This is weakness on one side of the body.
Hydrocephalus	Also known as "water on the brain," is a condition in which there is an abnormal accumulation of cerebrospinal fluid (CSF) in the ventricles, or cavities, of the brain.
Level of care: 1, 2, 3	Ward care, High Dependency Units and Intensive Care Units.
Lumbar puncture	A lumbar puncture is a procedure where a needle is inserted into the lower part of the spine, in order to look for evidence of conditions affecting the brain, spinal cord or other parts of the nervous system.
MRA - Magnetic Resonance Angiography	This is a test that combines the technology of a conventional MRI scan with that angiography to create detailed images of the blood vessels in the body.
MRI - Magnetic Resonance Imaging	This is a medical imaging technique used in radiology to visualise internal structures of the body in detail. MRI can create more detailed images of the human body than are possible with X-rays.

Networks of care	Formal network: a group of health professionals and organisations from primary secondary and tertiary care and social care and other services working together in a coordinated manner with clear governance and accountability arrangements. Informal network: a collaboration between health professionals and/or organisations from primary, secondary and/or tertiary care and other services aimed to improve services and patient care but without specified accountability to the commissioning organisation.
Nimodipine	Nimodipine relaxes and widens blood vessels. It reduces the risk of damage after a subarachnoid haemorrhage.
Primary care	In this report this refers to General Practitioners.
Secondary care	In this report this refers to hospitals that do not provide neurosurgical services.
TCD - Transcranial Doppler	This is an ultrasound technique used to assess blood flow in the blood vessels in the brain.
Tertiary care	In this report this refers to Neurosurgical Centres. Hospitals that provide surgical or endovascular treatment of subarachnoid haemorrhage.
Thrombolysis	This is the breakdown of blood clots by the use of medication.
Thrombosis	This is the formation of a blood clot inside a blood vessel.
Triple H- therapy: Hypertension, hypervolaemia, haemodilution	This is often used as a measure to treat vasospasm when it causes symptoms; this is the use of intravenous fluids to achieve a state of hypertension (high blood pressure), hypervolemia (excess fluid in the circulation) and hemodilution (mild dilution of the blood).
Vasospasm	A sudden constriction of a blood vessel, reducing its diameter and flow rate.
Ventriculitis	Ventriculitis is the inflammation of the ventricles in the brain.

Appendix 2 - The role and structure of NCEPOD

The National Confidential Enquiry into Patient Outcome and Death (NCEPOD) is an independent body to which a corporate commitment has been made by the Medical and Surgical Colleges, Associations and Faculties related to its area of activity. Each of these bodies nominates members on to NCEPOD's Steering Group.

Steering Group as at 22nd November 2013

Dr W Harrop-Griffiths	Association of Anaesthetists of Great Britain and Ireland
Mr F Smith	Association of Surgeons of Great Britain & Ireland
Dr C Mann	College of Emergency Medicine
Vacancy	Faculty of Public Health Medicine
Professor R Mahajan	Royal College of Anaesthetists
Dr A Batchelor	Royal College of Anaesthetists
Vacancy	Royal College of General Practitioners
Mrs J Greaves	Royal College of Nursing
Dr E Morris	Royal College of Obstetricians and Gynaecologists
Mr W Karwatowski	Royal College of Ophthalmologists
Dr I Doughty	Royal College of Paediatrics and Child Health
Dr A McCune	Royal College of Physicians
Dr M Ostermann	Royal College of Physicians
Dr M Cusack	Royal College of Physicians
Vacancy	Royal College of Radiologists
Mr R Lamont	Royal College of Surgeons of England
Mr M Bircher	Royal College of Surgeons of England
Mr K Altman	Faculty of Dental Surgery, Royal College of Surgeons of England
Dr M Osborn	Royal College of Pathologists
Ms S Panizzo	Lay Representative
Ms S Payne	Lay Representative

Observers

Mrs J Mooney	Healthcare Quality in Partnership (HQIP)
Dr R Hunter	Coroners' Society of England and Wales
Mr W Tennant	Royal College of Surgeons of Edinburgh
Dr M Jones	Royal College of Physicians of Edinburgh

NCEPOD is a company, limited by guarantee (Company number: 3019382) and a registered charity (Charity number: 1075588), managed by Trustees.

Trustees

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Dr D Justins	Honorary Treasurer
Professor M Britton	
Professor L Regan	
Professor R Endacott	
Mr I Martin	
Dr D Mason	
Professor T Hendra	
Company Secretary	Dr M Mason

Clinical Co-ordinators

The Steering Group appoint a Lead Clinical Co-ordinator for a defined tenure. In addition there are six Clinical Co-ordinators who work on each study. All Co-ordinators are engaged in active academic/clinical practice (in the NHS) during their term of office.

Lead Clinical Co-ordinator	Dr M Juniper (Medicine)
Clinical Co-ordinators	Dr K Wilkinson (Anaesthesia)
	Dr A P L Goodwin (Anaesthesia)
	Professor M J Gough (Surgery)
	Dr V Srivastava (Medicine)
	Dr S McPherson (Radiology)

Supporting organisations

This project was undertaken as part of the Clinical Outcome Review Programme into Medical and Surgical Care.

The Clinical Outcome Review Programme into Medical and Surgical Care is commissioned by the Healthcare Quality Improvement Partnership (HQIP) on behalf of NHS England, NHS Wales, the Northern Ireland Department of Health, Social Services and Public Safety (DHSSPS), the States of Jersey, Guernsey, and the Isle of Man.

The organisations that provided additional funding to cover the cost of this study:
Aspen Healthcare
Beneden Hospital
BMI Healthcare
BUPA Cromwell
East Kent Medical Services Ltd
Fairfield Independent Hospital
HCA International
Hospital of St John and St Elizabeth
King Edward VII's Hospital Sister Agnes
New Victoria Hospital
Nuffield Health
Ramsay Health Care UK
Spire Health Care
St Anthony's Hospital
St Joseph's Hospital
The Horder Centre
The London Clinic
Ulster Independent Clinic

Appendix 3 - Participation

Trust Name	No. of hospitals	No. of Org. Q. returned	No. of 2° care Q. sent	No. of 2° care Q. returned	Valid reason for non return of 2° care Q.	No. of sets of 2° care case notes returned	No. of 3° care Q. sent	No. of 3° care Q. received	Valid reason for non return of 3° care Q.	No. of sets of 3° care case notes returned
Abertawe Bro Morgannwg University Health Board	3	3	8	7	1	5	0	0	0	0
Aintree Hospitals NHS Foundation Trust	1	1	2	2	0	2	0	0	0	0
Airedale NHS Foundation Trust	1	1	3	3	0	3	0	0	0	0
Aneurin Bevan Local Health Board	2	2	3	2	0	1	0	0	0	0
Ashford & St Peter's Hospital NHS Trust	2	2	4	4	0	4	0	0	0	0
Barking, Havering & Redbridge University Hospitals NHS Trust	2	2	3	3	0	3	16	16	0	16
Barnet and Chase Farm Hospitals NHS Trust	2	2	0	0	0	0	0	0	0	0
Barnsley Hospital NHS Foundation Trust	1	1	5	5	0	5	0	0	0	0
Barts Health NHS Trust	4	4	2	1	1	1	3	3	0	3
Basildon & Thurrock University Hospitals NHS Foundation Trust	1	1	0	0	0	0	0	0	0	0
Bedford Hospital NHS Trust	1	1	1	1	0	1	0	0	0	0
Belfast Health and Social Care Trust	2	2	3	3	0	3	14	11	1	12
Betsi Cadwaladr University Local Health Board	4	3	11	7	1	3	0	0	0	0
Blackpool Teaching Hospitals NHS Foundation Trust	1	1	4	4	0	4	0	0	0	0
Bradford Teaching Hospitals NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
Brighton and Sussex University Hospitals NHS Trust	3	3	3	1	2	3	6	6	0	6
Buckinghamshire Healthcare NHS Trust	2	0	3	0	0	0	0	0	0	0
Burton Hospitals NHS Foundation Trust	1	1	0	0	0	0	0	0	0	0
Calderdale & Huddersfield NHS Foundation Trust	2	2	2	2	0	1	0	0	0	0
Cambridge University Hospitals NHS Foundation Trust	1	1	1	1	0	1	22	20	2	21
Cardiff and Vale University Health Board	2	2	6	5	1	5	16	16	0	16
Central Manchester University Hospitals NHS Foundation Trust	2	2	5	2	2	0	0	0	0	0
Chelsea & Westminster Healthcare NHS Trust	1	0	2	1	0	1	0	0	0	0
Chesterfield Royal Hospital NHS Foundation Trust	1	1	4	4	0	4	0	0	0	0

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City Hospitals Sunderland NHS Foundation Trust	1	1	5	5	0	5	0	0	0	0
Colchester Hospital University NHS Foundation Trust	2	2	3	2	1	2	0	0	0	0
Countess of Chester Hospital NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
County Durham and Darlington NHS Foundation Trust	2	2	3	2	0	3	0	0	0	0
Croydon Health Services NHS Trust	1	1	1	1	0	1	0	0	0	0
Cwm Taf Local Health Board	5	2	6	6	0	6	0	0	0	0
Dartford & Gravesham NHS Trust	1	0	3	3	0	2	0	0	0	0
Derby Hospitals NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
Doncaster and Bassetlaw Hospitals NHS Foundation Trust	4	4	2	0	2	0	0	0	0	0
Dorset County Hospital NHS Foundation Trust	1	1	3	3	0	3	0	0	0	0
Ealing Hospital NHS Trust	1	0	2	1	0	1	0	0	0	0
East & North Hertfordshire NHS Trust	2	2	1	1	0	1	0	0	0	0
East Cheshire NHS Trust	1	1	1	1	0	1	0	0	0	0
East Kent Hospitals University NHS Foundation Trust	5	0	9	6	0	3	0	0	0	0
East Lancashire Hospitals NHS Trust	2	2	2	2	0	1	0	0	0	0
East Sussex Healthcare NHS Trust	3	3	2	1	0	0	0	0	0	0
Epsom and St Helier University Hospitals NHS Trust	2	2	2	1	0	0	0	0	0	0
Frimley Park Hospitals NHS Trust	1	1	1	1	0	1	0	0	0	0
Gateshead Health NHS Foundation Trust	2	1	3	3	0	3	0	0	0	0
George Eliot Hospital NHS Trust	1	1	1	1	0	1	0	0	0	0
Gloucestershire Hospitals NHS Foundation Trust	2	0	3	2	0	1	0	0	0	0
Great Western Hospitals NHS Foundation Trust	1	1	0	0	0	0	0	0	0	0
Guy's & St Thomas' NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
Hampshire Hospitals NHS Foundation Trust	2	0	6	4	0	1	0	0	0	0

Appendix 3 - Participation (continued)

Trust Name	No. of hospitals	No. of Org. Q. returned	No. of 2º care Q. sent	No. of 2º care Q. returned	Valid reason for non return of 2º care Q.	No. of sets of 2º care case notes returned	No. of 3º care Q. sent	No. of 3º care Q. received	Valid reason for non return of 3º care Q.	No. of sets of 3º care case notes returned
Harrogate and District NHS Foundation Trust	1	1	0	0	0	0	0	0	0	0
Health and Social Services Department, States of Guernsey	2	0	0	0	0	0	0	0	0	0
Heart of England NHS Foundation Trust	3	3	5	5	0	5	0	0	0	0
Heatherwood & Wexham Park Hospitals NHS Foundation Trust	1	1	6	6	0	6	0	0	0	0
Hillingdon Hospitals NHS Foundation Trust (The)	1	1	3	3	0	2	0	0	0	0
Hinchingbrooke Health Care NHS Trust	1	1	0	0	0	0	0	0	0	0
Homerton University Hospital NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
Hull and East Yorkshire Hospitals NHS Trust	1	1	2	2	0	2	17	13	4	17
Hywel Dda Local Health Board	5	4	7	4	0	1	0	0	0	0
Imperial College Healthcare NHS Trust	3	1	3	3	0	3	14	14	0	14
Ipswich Hospital NHS Trust	1	1	3	2	1	1	0	0	0	0
Isle of Man Department of Health & Social Security	1	1	0	0	0	0	0	0	0	0
Isle of Wight NHS Primary Care Trust	1	0	0	0	0	0	0	0	0	0
James Paget Healthcare NHS Trust	2	2	3	3	0	3	0	0	0	0
Kettering General Hospital NHS Foundation Trust	1	1	0	0	0	0	0	0	0	0
King's College Hospital NHS Foundation Trust	1	1	2	1	1	0	21	14	3	13
Kingston Hospital NHS Trust	1	1	1	1	0	1	0	0	0	0
Lancashire Teaching Hospitals NHS Foundation Trust	2	1	1	1	0	1	10	7	0	7
Lewisham Hospital NHS Trust	1	1	1	1	0	1	0	0	0	0
Luton and Dunstable Hospital NHS Foundation Trust	1	1	3	2	0	1	0	0	0	0
Maidstone and Tunbridge Wells NHS Trust	2	1	3	3	0	3	0	0	0	0
Medway NHS Foundation Trust	1	1	4	4	0	4	0	0	0	0
Mid Cheshire Hospitals NHS Foundation Trust	2	2	0	0	0	0	0	0	0	0

Trust Name	No. of hospitals	No. of Org. Q. returned	No. of 2º care Q. sent	No. of 2º care Q. returned	Valid reason for non return of 2º care Q.	No. of sets of 2º care case notes returned	No. of 3º care Q. sent	No. of 3º care Q. received	Valid reason for non return of 3º care Q.	No. of sets of 3º care case notes returned
Mid Essex Hospitals NHS Trust	1	1	1	0	1	1	0	0	0	0
Mid Staffordshire NHS Foundation Trust	2	1	0	0	0	0	0	0	0	0
Mid Yorkshire Hospitals NHS Trust	4	4	3	3	0	3	0	0	0	0
Milton Keynes Hospital NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
Newcastle upon Tyne Hospitals NHS Foundation Trust	2	1	3	3	0	3	23	23	0	23
Norfolk & Norwich University Hospital NHS Trust	2	1	6	4	0	4	0	0	0	0
North Bristol NHS Trust	2	1	0	0	0	0	20	17	1	19
North Cumbria University Hospitals NHS Trust	2	2	2	2	0	2	0	0	0	0
North Middlesex University Hospital NHS Trust	1	0	0	0	0	0	0	0	0	0
North Tees and Hartlepool NHS Foundation Trust	1	1	3	3	0	3	0	0	0	0
North West London Hospitals NHS Trust	2	2	5	5	0	5	0	0	0	0
Northampton General Hospital NHS Trust	1	1	3	3	0	3	0	0	0	0
Northern Devon Healthcare NHS Trust	1	1	0	0	0	0	0	0	0	0
Northern Health & Social CareTrust	2	2	4	2	1	1	0	0	0	0
Northern Lincolnshire & Goole Hospitals NHS Foundation Trust	2	2	3	2	1	0	0	0	0	0
Northumbria Healthcare NHS Foundation Trust	5	5	5	5	0	5	0	0	0	0
Nottingham University Hospitals NHS Trust	1	1	1	1	0	1	17	17	0	17
Oxford University Hospitals NHS Trust	1	1	1	1	0	1	26	24	2	23
Papworth Hospital NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
Pennine Acute Hospitals NHS Trust (The)	3	3	6	3	1	3	0	0	0	0
Peterborough & Stamford Hospitals NHS Foundation Trust	1	1	0	0	0	0	0	0	0	0
Plymouth Hospitals NHS Trust	1	1	2	2	0	2	15	10	3	11
Poole Hospital NHS Foundation Trust	1	1	1	1	0	0	0	0	0	0

Appendix 3 - Participation (continued)

Trust Name	No. of hospitals	No. of Org. Q. returned	No. of 2º care Q. sent	No. of 2º care Q. returned	Valid reason for non return of 2º care Q.	No. of sets of 2º care case notes returned	No. of 3º care Q. sent	No. of 3º care Q. received	Valid reason for non return of 3º care Q.	No. of sets of 3º care case notes returned
Portsmouth Hospitals NHS Trust	1	1	5	3	0	2	0	0	0	0
Queen Victoria Hospital NHS Foundation Trust	1	1	0	0	0	0	0	0	0	0
Royal Berkshire NHS Foundation Trust	1	1	3	3	0	3	0	0	0	0
Royal Bolton Hospital NHS Foundation Trust	1	0	2	2	0	1	0	0	0	0
Royal Bournemouth and Christchurch Hospitals NHS Trust	1	1	4	4	0	4	0	0	0	0
Royal Cornwall Hospitals NHS Trust	1	1	3	3	0	3	0	0	0	0
Royal Devon and Exeter NHS Foundation Trust	1	1	2	2	0	2	0	0	0	0
Royal Free London NHS Foundation Trust	1	1	0	0	0	0	10	6	4	6
Royal Liverpool & Broadgreen University Hospitals NHS Trust	1	1	3	3	0	3	0	0	0	0
Royal Marsden NHS Foundation Trust (The)	1	1	1	1	0	0	0	0	0	0
Royal Surrey County Hospital NHS Trust	1	1	4	3	1	3	0	0	0	0
Royal United Hospital Bath NHS Trust	1	1	10	10	0	10	0	0	0	0
Royal Wolverhampton Hospitals NHS Trust (The)	1	1	2	2	0	0	0	0	0	0
Salford Royal Hospitals NHS Foundation Trust	1	1	2	2	0	2	23	13	4	21
Salisbury NHS FoundationTrust	1	1	0	0	0	0	0	0	0	0
Sandwell and West Birmingham Hospitals NHS Trust	2	2	8	6	1	6	0	0	0	0
Sheffield Teaching Hospitals NHS Foundation Trust	3	3	3	3	0	3	21	14	0	14
Sherwood Forest Hospitals NHS Foundation Trust	2	2	2	2	0	2	0	0	0	0
Shrewsbury and Telford Hospitals NHS Trust	2	2	6	3	3	5	0	0	0	0
South Devon Healthcare NHS Foundation Trust	1	0	0	0	0	0	0	0	0	0
South Eastern Health & Social Care Trust	3	3	1	1	0	0	0	0	0	0
South London Healthcare NHS Trust	2	1	5	2	1	5	0	0	0	0
South Tees Hospitals NHS Foundation Trust	2	2	1	1	0	1	4	4	0	4

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South Tyneside NHS Foundation Trust	1	1	0	0	0	0	0	0	0	0
South Warwickshire NHS Foundation Trust	1	1	0	0	0	0	0	0	0	0
Southampton University Hospitals NHS Trust	1	1	2	0	0	0	16	11	0	11
Southend University Hospital NHS Foundation Trust	1	1	2	1	0	1	0	0	0	0
Southern Health & Social Care Trust	5	2	1	1	0	0	0	0	0	0
Southport and Ormskirk Hospitals NHS Trust	1	1	0	0	0	0	0	0	0	0
St George's Healthcare NHS Trust	1	1	0	0	0	0	22	11	1	18
St Helens and Knowsley Teaching Hospitals NHS Trust	2	2	3	3	0	3	0	0	0	0
States of Jersey Health & Social Services	1	1	1	1	0	1	0	0	0	0
Stockport NHS Foundation Trust	1	1	4	4	0	3	0	0	0	0
Surrey & Sussex Healthcare NHS Trust	1	1	3	1	0	1	0	0	0	0
Tameside Hospital NHS Foundation Trust	1	1	1	1	0	0	0	0	0	0
Taunton & Somerset NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
The Dudley Group NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
The Leeds Teaching Hospitals NHS Trust	2	2	5	3	1	2	17	9	3	3
The Princess Alexandra Hospital NHS Trust	1	1	1	1	0	1	0	0	0	0
The Queen Elizabeth Hospital King's Lynn NHS FoundationTrust	1	1	0	0	0	0	0	0	0	0
The Rotherham NHS Foundation Trust	1	1	1	1	0	1	0	0	0	0
The Walton Centre NHS Foundation Trust	1	1	0	0	0	0	40	27	3	25
United Lincolnshire Hospitals NHS Trust	3	3	2	2	0	2	0	0	0	0
Univ. Hospital of South Manchester NHS Foundation Trust	1	1	2	2	0	2	0	0	0	0

Appendix 3 - Participation (continued)

Trust Name	No. of hospitals	No. of Org. Q. returned	No. of 2º care Q. sent	No. of 2º care Q. returned	Valid reason for non return of 2º care Q.	No. of sets of 2º care case notes returned	No. of 3º care Q. sent	No. of 3º care Q. received	Valid reason for non return of 3º care Q.	No. of sets of 3º care case notes returned
University College London Hospitals NHS Foundation Trust	2	2	3	1	2	1	17	12	0	13
University Hospital of North Staffordshire NHS Trust	1	1	2	2	0	2	15	6	2	6
University Hospitals Birmingham NHS Foundation Trust	1	1	2	2	0	2	20	15	5	16
University Hospitals Coventry and Warwickshire NHS Trust	2	2	1	0	1	0	6	6	0	6
University Hospitals of Bristol NHS Foundation Trust	1	1	2	1	0	1	0	0	0	0
University Hospitals of Leicester NHS Trust	1	1	7	6	1	6	0	0	0	0
University Hospitals of Morecambe Bay NHS Trust	3	2	5	4	1	4	0	0	0	0
Walsall Healthcare NHS Trust	1	1	4	3	0	1	0	0	0	0
Warrington & Halton Hospitals NHS Foundation Trust	2	2	2	2	0	2	0	0	0	0
West Hertfordshire Hospitals NHS Trust	1	0	2	2	0	2	0	0	0	0
West Middlesex University Hospital NHS Trust	1	1	1	0	1	0	0	0	0	0
West Suffolk NHS Foundation Trust	1	1	2	2	0	2	0	0	0	0
Western Health & Social Care Trust	3	1	1	1	0	0	0	0	0	0
Western Sussex Hospitals NHS Trust	2	2	8	7	0	8	0	0	0	0
Weston Area Health Trust	1	0	3	2	0	0	0	0	0	0
Whittington Health	1	1	2	2	0	2	0	0	0	0
Wirral University Teaching Hospital NHS Foundation Trust	1	1	2	1	1	1	0	0	0	0
Worcestershire Acute Hospitals NHS Trust	2	1	9	2	2	0	0	0	0	0
Wrightington, Wigan & Leigh NHS Foundation Trust	1	1	1	0	0	1	0	0	0	0
Wye Valley NHS Trust	1	1	1	1	0	1	0	0	0	0
Yeovil District Hospital NHS Foundation Trust	1	1	2	2	0	2	0	0	0	0
York Teaching Hospitals NHS Foundation Trust	2	2	2	1	1	1	0	0	0	0

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