

Fortnightly Review

So stroke units save lives: where do we go from here?

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Stroke is common, killing around 65 000 people each year in the United Kingdom and disabling even more.¹ The only certain means of reducing this burden till now has been primary and secondary prevention, in which several interventions are effective.²⁻⁶ Therefore, the results of a recently published statistical overview⁷ are important because, for the first time, they provide an additional means of reducing this burden.

All the randomised controlled trials comparing the outcome of patients with stroke cared for in a specialist stroke unit with the outcome of those cared for in general medical wards were examined and showed that patients managed in stroke units were less likely to die. Doctors are, however, not particularly interested in interventions which save lives possibly at the expense of keeping severely disabled and distressed people alive. Therefore, more importantly, do stroke units reduce disability in survivors and if so, how should these units be organised? Although the overview was unable to determine directly whether stroke units reduce disability, because no common measure of disability was used in all the trials, it found that stroke units reduce the risk of death or living in an institution at a median of 12 months after stroke (figure) (P Langhorne *et al*, second international stroke meeting, Geneva, May 1993).⁷

The trials included in the overview tested much more heterogeneous interventions than is usual in overviews of drug trials, in which the intervention can be defined in terms of a drug, dose, and timing. It is therefore more difficult to generalise from the stroke unit overview, and some important questions arise when applying the results to everyday clinical practice. To try to answer some of these questions we have set up the Stroke Unit Trialists' Collaboration under the auspices of the Cochrane Collaboration.¹⁸ This group aims at collecting details of all randomised trials (published, unpublished, in progress, and planned) that address questions relating to the organisation of stroke services. Until this is complete, however, we have to rely on the information already available and what we, and others, have learnt from setting up and running our own stroke units.

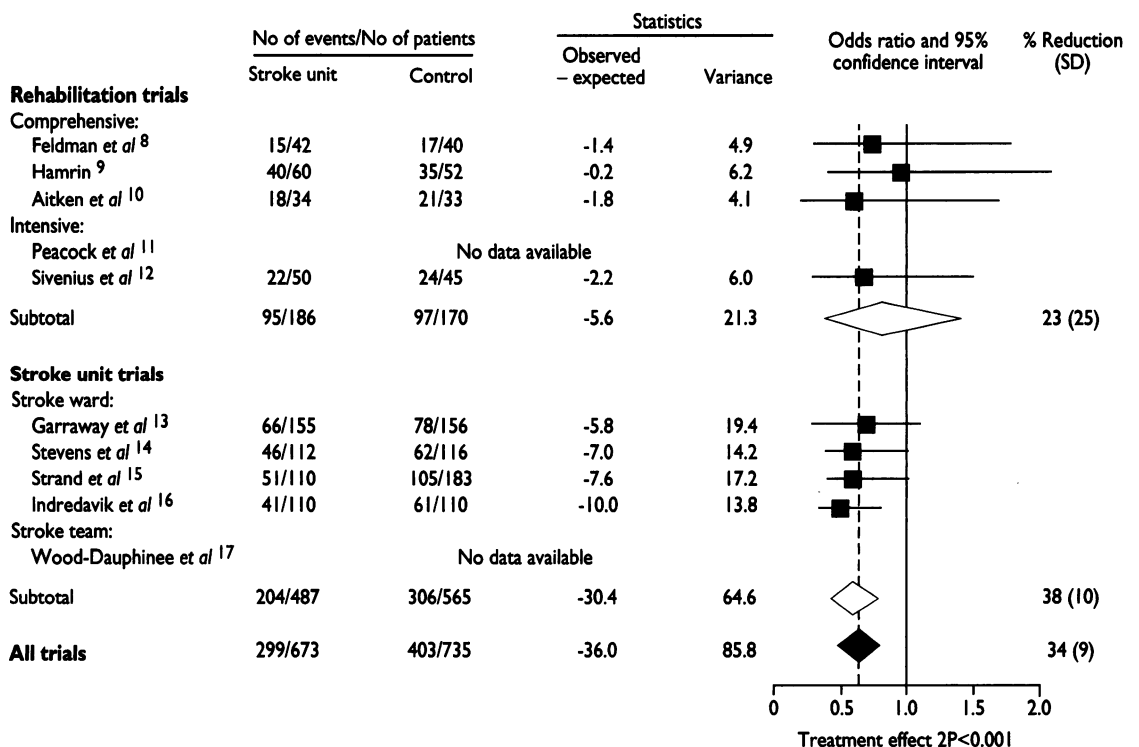
What are stroke units?

Most of the stroke unit trialists did not describe their units in detail, but a common feature is that care was organised and coordinated by a multidisciplinary team of professional staff who were interested and knowledgeable about stroke (box 1). Beyond this it is not possible to determine whether the effectiveness of

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Results of statistical overview of all available randomised trials comparing outcomes in patients managed in stroke units and those managed in general medical wards (control). Odds ratio is odds of being dead or living in an institution at a median of 12 months (event) after stroke in patients cared for in stroke units divided by same odds in patient cared for in general medical wards. Odds ratio <1.0 indicates that outcome of care in a stroke unit is better. Length of horizontal lines or width of diamonds indicates 95% confidence interval of estimate of odds ratio

Summary points

- A systematic review of randomised controlled trials found that patients with stroke treated in specialist units were less likely to die than those treated in general medical wards
- The most obvious factors contributing to the effectiveness of stroke units are their organisation and the presence of a multidisciplinary team that is knowledgeable and enthusiastic about treating stroke
- Treating stroke has three main components: acute care, rehabilitation, and prevention. A comprehensive stroke service therefore includes an assessment area for acute stroke, a stroke rehabilitation unit, and continuing care
- Although the admission of patients to a defined geographical assessment area has several important advantages, it does not necessarily need more resources
- A system is needed to identify patients who are most likely to benefit from a stroke rehabilitation unit
- Geographically defined stroke rehabilitation units facilitate the participation of nursing staff in the rehabilitation process
- Stroke services with a geographically defined stroke unit must develop a system for dealing with fluctuations in demand
- An organised stroke service may reduce the cost of caring for patients with stroke in hospital
- Stroke services should be tailored to local conditions

stroke units is due to the total package of care or particular components. Members of the stroke module of the Cochrane Collaboration are systematically reviewing the completed randomised trials of individual components of care in stroke units—for example, physiotherapy—in order to inform clinical practice and direct future research. Some of the less well defined components and the possible synergy between them will, however, be difficult to test in randomised trials. For example, communication between health professionals, patients with stroke, and their carers, which a recent report from the Audit Commission suggests is often inadequate and a major source of dissatisfaction,¹⁹ may partly explain the success of stroke units.

The term stroke unit means different things to different people. We therefore need to clarify what we mean by the terms we will use in this review. We use the term stroke service to describe the overall organisation for delivering care to patients with transient ischaemic attacks and strokes. The components of care and the facilities required to deliver them are shown in boxes 2 and 3.

A stroke service may well include but is not just a stroke unit. An acute stroke assessment area is where patients with stroke are admitted directly to be assessed and cared for acutely before moving when appropriate to a stroke rehabilitation unit, where the emphasis is on rehabilitation rather than acute care. An acute stroke unit is where patients are admitted directly and may remain for a variable time to be rehabilitated—that is, it combines the functions of an acute stroke assessment area with those of a stroke rehabilitation unit. This is distinct from a stroke intensive care unit, where patients are admitted directly for only a short time to be closely monitored in

an environment similar to that in a coronary care unit.

In this article stroke unit refers to the units included in the overview which all had a multidisciplinary team at their heart, although the balance between acute care and rehabilitation varied and was often unclear.

Should units admit only patients with stroke?

Most of the trials in the overview compared units dealing specifically with stroke with acute general wards. A more recently published trial, whose overall results are compatible with those of the overview, also compared care in a stroke rehabilitation unit with general rehabilitation.^{20,21} Unfortunately, although there were no obvious differences, this trial lacked the power to indicate whether stroke specific care is more or less effective than that provided in a general rehabilitation unit.^{11,12} Services specific for stroke certainly allow more specialisation among the team members, which may be an advantage.

Should units be geographically defined?

The overview included mainly trials of geographically defined stroke units, but it included one trial of a stroke team that cared for patients in different wards of a hospital.¹⁷ Although there are no data to suggest that one model is definitely superior, we have experience of both types of service. The most important advantage of having the patients in one place is that the nursing staff can play a greater part in the rehabilitation process. Inevitably, when patients are scattered it is more difficult to incorporate the nurses into the team. Also, patients with stroke managed in acute areas have to compete for nursing time with patients who are perceived as having more urgent needs—for example, those with chest pain. Patients with stroke may, for example, need regular toileting to maintain continence and thus dignity. These aspects of care are important but can be seen as less urgent and, when nursing resources are limited, may not be a priority. A geographically defined stroke unit removes this competition for nursing time and allows the nurses to take on a new role as facilitators of patients' independence and the providers of continued therapy over the 24 hours.

Acute stroke units or stroke rehabilitation units, or both?

About half of the trials in the overview were of acute stroke units,^{13,15-17} the remainder being primarily stroke rehabilitation units. Admitting all patients with acute stroke directly into a unit makes the introduction of assessment protocols easier, allows skills to be focused, and facilitates the large randomised trials of acute treatments which are needed to identify effective treatments. Alternatively, this might be achieved by setting up a stroke assessment area in an acute general

Box 1— Members of multidisciplinary stroke team

- Physician
- Physiotherapist
- Occupational therapist
- Speech and language therapist
- Nursing staff
- Social worker
- In addition the team may need to ask advice from or refer to
 - Other medical and surgical specialists
 - Dietitian
 - Psychologist
 - Chiropodist
 - Dentist
 - Orthotist

Box 2—Components of management of patients with transient ischaemic attacks and stroke

- Prompt and accurate diagnosis and assessment of patients whether admitted to hospital or not
- Appropriate acute medical and surgical treatment
- Rehabilitation
- Terminal care when appropriate
- Discharge into the community
- Secondary prevention
- Follow up to prevent or identify problems of late onset—for example, depression

Box 3—Facilities required to provide a comprehensive stroke service

- Neurovascular clinic for prompt assessment and investigation of non-admitted patients, initiation of secondary prevention, and follow up of some patients
- Acute stroke assessment area for admission of patients to assess and manage their acute medical and surgical problems
- Stroke rehabilitation unit to rehabilitate patients with persisting functional problems
- Outpatient, day hospital, or domiciliary rehabilitation facilities for patients who do not need to be in hospital
- Continuing care and support facilities, either institutional or in the community, for severely dependent patients
- Close links with primary health care and social services and the voluntary sector

medical ward, which would need some organisational changes but may not necessarily require extra resources. There have been several non-randomised studies of stroke intensive care units,²²⁻²⁴ but there is no evidence that they improve patient outcome. Because of their high staffing levels and expensive equipment, however, they inevitably require extra resources.

Although we believe that rehabilitation should start on the day of the stroke, some patients are more appropriately cared for in an acute ward than in one where the emphasis is on rehabilitation. For example, very sick patients might require care that would disrupt a rehabilitation unit and at a time when they are unlikely to benefit from a rehabilitative environment. We believe that the best model is one in which patients are admitted into an acute assessment area, either on a medical ward or as part of an acute stroke unit (depending on local circumstances), and then moved without delay to a stroke rehabilitation unit as soon as they can benefit from that environment. Potential disadvantages of adopting this model are that this may disorient some patients (and their families) and can reduce continuity of care. In our experience disorientation is not a common problem, and the lack of continuity can be reduced by ensuring that the stroke team works beyond the confines of the rehabilitation unit and participates closely in the patient's care from the time of admission.

Which patients gain most from care in stroke units?

The trials included in the overview usually selected patients before randomisation. Entry criteria varied, but most trials adopted a system of triage based on the patients' likely needs. The evidence of benefit is strongest for patients with stroke of intermediate severity—that is, not for patients with non-disabling stroke or those with little hope of survival. A recent trial comparing outcomes in three groups of patients with mild, moderate, and severe strokes confirmed that patients with moderate strokes gain most from care in stroke units. Those with severe strokes managed in the stroke unit still had a significantly shorter stay in hospital and a significantly lower mortality than those managed in general medical wards.²⁰

The priorities for patients who have been admitted with a non-disabling stroke are accurate diagnosis, defining the cause of the stroke, and initiating a strategy for secondary prevention. Ideally, such patients should be managed mainly as outpatients so long as the delays which are so frequently associated with outpatient investigation can be overcome. Patients with severe strokes and reduced conscious-

ness who are unlikely to survive are probably better managed in an acute ward until they either die or improve to a point when they can actively take part in rehabilitation. These patients obviously need skilled nursing to prevent complications such as pressure sores, aspiration pneumonia, and shoulder injuries; such care can be provided in an acute general ward, albeit with input from the stroke team—for example, advice on positioning and assessment of swallowing.

Should age be a criterion for admission?

Although we think that needs rather than age should dictate where and by whom patients are managed, local conditions will often dictate whether an age related service is a better option. For example, when an age related geriatric service provides effective stroke rehabilitation there may be a case for adding a new service for younger patients with stroke rather than dismantling the current service. Our unit takes patients of any age, although some older patients with other diseases, pre-existing severe disability, or particularly complex social situations are managed by the geriatric services. There is some evidence that elderly patients with stroke may benefit from care in geriatric assessment or rehabilitation units as much as from care in stroke units.²⁰

How long should patients remain in stroke units?

Some units, in particular those which admit patients with acute stroke, set maximum lengths of stay. It seems to us that the only reason to do so is to stop blocking of beds to allow admission to new patients. If the unit is of sufficient size for the population's needs, works flexibly, and is efficient in discharging patients then a defined maximum length of stay should not be needed. If a maximum length of stay is established, however, facilities and staff must be able to deliver appropriate continuing care so that patients are not left to languish in an acute medical ward. It could be argued that patients who are no longer improving but are having to wait for placement in the community or an institution should not be kept in a stroke unit. For some people, however, the unit may offer the best environment to maintain any functional improvement gained. In addition, to move them to another part of the hospital to await their placement may not be optimal for a patient and family who have built up close relationships with the staff. Moves under these circumstances should be considered only when beds are limited and patients who it is judged will gain more from the unit environment are waiting to be admitted.

How big should stroke units be?

Age and sex specific data on the incidence of stroke, details of the hospital catchment population, and hospital activity data should allow an estimate of the number of patients who are likely to require admission to hospital each year. Unfortunately, the number, severity, and length of stay of patients admitted will not be constant around the year. The pressure on the stroke unit will fluctuate, usually being heavier in the winter than the summer. During a survey in our own medical unit, which admits between 200 and 250 patients each year, the number of patients with stroke in the wards on any one day varied between nine and 35 over a year. Therefore, whatever organisation is set up to manage these patients must be able to cope with such fluctuations. To ensure best use of beds the unit, whether for acute assessment, rehabilitation, or both, should be flexible enough to accommodate different proportions of men and women as this, too, is bound to fluctuate appreciably from time to time.

One problem of a geographically defined stroke unit is the inevitable limit on places. This problem may be overcome, however, by ensuring that the stroke unit is part of a larger area so that it can expand and contract with demand. The patients we cannot immediately accommodate in our rehabilitation unit are cared for in acute medical wards, although their care is still coordinated by the stroke team. Ideally, the excess patients would be in a rehabilitation area rather than an acute general ward so that they would not have to compete for nursing time with patients with acute illnesses. Such arrangements also mean that at times patients who have not had a stroke are cared for in the unit. When large fluctuations in demand exist, it is also important that the team can draw on extra resources to manage the larger number of patients. We have tried to address this problem by identifying lead stroke therapists who can call upon their less specialised colleagues when necessary. Inevitably, there are times when resources are not adequate to meet all the needs of the patients, and it is then important for the team to support its members in the difficult task of prioritising or rationing.

Who should run stroke units?

The units included in the overview were run by geriatricians, neurologists, general (internal) physicians, and specialists in rehabilitation. We believe that whoever is responsible should have the necessary knowledge, training, and above all enthusiasm to take on the task. The most appropriate professional group will vary from place to place. For example, in Italy most patients with stroke are managed by neurologists, while in the United Kingdom most are managed by general physicians and geriatricians. British neurologists may have the knowledge and training to diagnose and investigate stroke, but unfortunately most do not have the time (because they are few and have other responsibilities) or access to beds or training in rehabilitation to run a stroke service alone. In the United Kingdom geriatricians are often in the best position to take a leading role, although most would need some extra training in neurology and the support of a neurologist in dealing with younger patients and patients with unusual causes of stroke and in diagnosing "funny turns" and the varied neurological problems which are inevitably referred to neurovascular outpatient clinics.

What should happen in stroke units?

Few of the trials included in the overview gave details of the process of care within the unit. Although some identified particular aspects of care—for example, routine use of heparin,¹⁶ which could account for some of the improvement in outcome (although there is no definite evidence to support the widespread use of heparin²⁵—most did not. We believe that, despite the lack of evidence, there are several elements of care which account for at least some of the improvement in outcomes. Some are specific interventions such as detection of swallowing difficulties to avoid aspiration, early mobilisation to reduce the risk of complications, and early detection and aggressive treatment of complications.

In addition to these specific interventions, the way that care is planned and coordinated at meetings of a multidisciplinary stroke team, with particular attention being paid to detail, may be important (box 4). This is different from a weekly ward round, the traditional model of care, in which a consultant ceremoniously waves at the patients with stroke, who are placed at the far end of the medical ward. Indeed, consultants may believe that such patients are

Box 4—Functions of meetings of stroke team

- Introduction of new patients to team members
- Identification of problems and potential problems
- Goal setting—short, medium, and long term goals
- Planning and coordination of interventions to achieve goals
- Review of progress and goals
- Detailed planning of discharge, maintenance, and follow up

being rehabilitated because physiotherapy has been requested. They may not recognise that rehabilitation is a complex process that is not synonymous with physiotherapy, although of course this is a vital component.

A stroke unit will often encourage other activities such as the establishment of carer groups, the participation of volunteers, and fund raising, which may all help to maintain the morale of staff, patients, and carers. Improved communication between professionals, patients, and carers may result from care in a stroke unit and probably contributes to the unit's effectiveness.

Are stroke units expensive?

It is usually assumed that developing a new service will inevitably cost more money. However, this may not be the case with stroke units. The patients are usually already being managed, predominantly in expensive beds in acute hospitals. The main benefit from a stroke unit seems to derive from improved organisation and team work rather than extra staff and expensive facilities. We have looked at the direct costs to a hospital caring for patients with stroke and found that about 93% of the costs were accounted for by nurses' salaries and hospital overheads—for example, heating and lighting—while the remainder was accounted for by the salaries of doctors and therapists and the costs of investigations and drugs. Thus the cost of managing stroke patients in an acute hospital will be closely related to the length of stay. Data from the randomised trials suggest that stroke units may reduce the length of stay and therefore might reduce the cost of managing each patient with stroke in hospital,^{13-16, 20} although this has not been an invariable finding. As patients seem to have a better functional status on discharge from stroke units hospital resources are unlikely to be saved simply at the expense of community resources and the family (where they are less easily measured). The table shows the comparatively modest staffing levels on our own 15 bedded stroke rehabilitation unit.

Overcoming resistance to change

Although there is now good evidence for the effectiveness of stroke units, their development is often resisted by professional colleagues who perceive the development as a threat. They fear that it might divert resources from their own specialty, but they should be reassured that stroke units probably make more efficient use of existing resources and beds, which may eventually increase the resources available to other specialties. They may worry that a specialised stroke team will reduce the skills of their junior medical, nursing, and paramedical staff and reduce their access to patients for teaching undergraduates, but this can be overcome by rotating staff and students through the unit.

Staffing of a 15 bedded stroke rehabilitation unit

Staff member	No of whole time equivalents
Consultant physician	0.3
Junior medical staff	0.5
Nurses:	
Grade G	1.0
Grade E	5.0
Grade D	5.5
Grade A	6.0
Physiotherapists:	
Senior 1	1.0
Basic grade	0.6
Helper	0.3
Occupational therapist:	
Senior 1	1.0
Helper	0.5
Speech therapist	0.5
Social worker	0.5

Opposition may be reduced by adopting an evolutionary approach to developing the service. For example, an assessment protocol might be introduced before trying to set up an acute assessment area or a stroke team working in the general medical wards before trying to set up a geographically defined stroke unit. When resistance remains local purchasers might be influenced to exert pressure for change as they are generally keen to purchase services for which there is scientific evidence of efficacy and which relate to problems targeted in the *Health of the Nation*.¹ The type of stroke service adopted needs to be flexible as its structure must be tailored to local conditions—that is, needs, resources, geography, people, and politics.

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Grand Rounds—Hammersmith Hospital

Cardiac arrest and hypertrophic cardiomyopathy

Role of the implantable defibrillator

Hypertrophic cardiomyopathy is a common cause of sudden death in apparently healthy young adults, and antiarrhythmic drugs may not prevent this outcome. Implantable defibrillator technology has progressed sufficiently for these devices to correct malignant cardiac arrhythmias and prevent sudden death in patients with hypertrophic cardiomyopathy. The identification of suitable patients is an important challenge since the non-arrhythmic prognosis of hypertrophic cardiomyopathy is relatively good.

Case history

A 35 year old woman collapsed at the wheel of her car after nearly hitting a lorry. Another car driver went to help and found her unconscious, cyanosed, and breathing noisily. Her pulse was initially very rapid and then disappeared. He started cardiopulmonary resuscitation by the roadside, and an ambulance arrived in about seven minutes. Defibrillation immediately ended the ventricular fibrillation and her pulse returned. After admission to hospital, her return to consciousness was slow but computed tomography of the brain showed no abnormality. Apart from some retrograde amnesia of the events leading up to her cardiac arrest, she recovered completely and was transferred to our hospital for further evaluation.

In 1990, she had had a single syncopal episode, and had been admitted to our hospital, where echocardi-

graphy had shown hypertrophic cardiomyopathy. At that time tilt testing caused abnormal hypotension associated with marked bradycardia after 34 minutes of tilting the head up 60°. In addition, the signal averaged surface electrocardiogram showed late potentials in the QRS complex, which suggested a predisposition to ventricular tachyarrhythmias. However, no episodes of ventricular tachycardia were observed on 24 hour electrocardiographic monitoring. She was started on amiodarone 200 mg daily and had no further syncopal episodes. She was therefore allowed to retain her driving licence. One year later her amiodarone dose was reduced to 200 mg three times weekly because of photosensitivity. Subsequently, she conceived and gave birth to healthy twins.

Family screening showed that her father (aged 67) and one of her sisters also had hypertrophic cardiomyopathy but had no symptoms. Neither of her father's parents had died prematurely.

On arrival at our hospital after her cardiac arrest her amiodarone dose was increased to 200 mg daily and atenolol 50 mg daily was started. She had left ventricular hypertrophy and an ejection murmur that was loudest at the left sternal edge, and unaffected by posture. The electrocardiogram taken at the roadside showed ventricular fibrillation followed by a defibrillation pulse and a period of asystole and a gradual return of sinus bradycardia. The subsequent 12 lead electrocardiogram showed Q waves in leads II, III, and



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