

# What is the Role of Stroke Units in Overall Care?

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## Abstract

Stroke is a heterogeneous cerebrovascular disorder that is a major cause of death and disability in the industrialised world. Anecdotal clinical evidence and expert opinion has suggested that organised stroke care results in better patient outcomes compared with care provided in general medical units, although results from randomised control trials (RTC) have been inconclusive. However in 1993, a meta-analysis of 10 RTCs of patients assigned to acute care stroke units (ACSUs) versus routine ward care reported a reduction of early mortality rate of 28% for those assigned to ACSUs. In 1997, the Stroke Unit Trialist Collaboration conducted a meta-analysis of 18 RTCs and concluded that organised inpatient care is effective in reducing death, dependency and institutionalisation after stroke. The analysis also found that age, gender and stroke severity should not be restricting factors to stroke unit care because all categories benefit from organised stroke care. These important studies establish the efficacy of organised stroke care.

A variety of stroke care models are used throughout the world. The distinguishing characteristic, regardless of model, is the organisation of a specialised,

coordinated, multidisciplinary team of professionals who are interested and knowledgeable about stroke, and who provide comprehensive assessment, management and rehabilitation services for stroke patients. This article discusses a model of a dedicated ACSU used in some centres in the US. Dedicated ACSUs are gaining prominence because of the emergence of time-sensitive therapeutic strategies such as thrombolytics. The major organisational components of the ACSU include: policies and procedures; protocols, guidelines, and pathways; discharge planning; patient/family education; staff education; research; and outcomes management.

Leadership in stroke care includes creating a comprehensive programme of primary and secondary prevention and a comprehensive stroke recovery programme. Primary prevention strategies are supported through education of the public and health professionals about stroke risk factor identification and modification, and information about 'brain attacks'. A comprehensive stroke recovery programme creates a seamless continuum of care of timely emergency medical transport to an appropriate healthcare facility at the time of stroke, comprehensive acute, subacute and long term care, and secondary prevention strategies.

In the future, the challenge for practitioners will be to combine contemporary models of acute stroke care and the characteristics of care that have been shown to be effective in randomised trials.

Stroke, a major cause of death and disability in the industrialised world, covers a constellation of heterogeneous cerebrovascular problems that are managed in a variety of ways around the world. International differences in stroke from the perspective of epidemiology, pathogenesis, treatment approaches, and mortality rates, make it difficult to interpret and compare the effects of different management strategies on patient outcomes.<sup>[1]</sup> Once, a dismal diagnosis with only symptomatic treatment options for incurred deficits,<sup>[2]</sup> stroke has now entered a new era of acute tissue salvage. The advent of randomised controlled trials for thrombolytics and neuroprotective agents offers new management options and the need for reassessment of acute care management practices.

This article focuses on the role of the dedicated acute care stroke unit (ACSU) in the continuum of care from the perspective of past experience, current knowledge, philosophy of care and operational aspects related to improved outcomes for stroke patients and their families. The authors acknowledge that this article is presented from a US managed-care financed healthcare system perspective, is based on accepted guidelines of the American Heart Association and has an acute care unit focus.

This reimbursement system separates acute care and rehabilitative care, and requires movement of patients from expensive acute care units to less expensive rehabilitation units within the hospital once the patient is physiologically stabilised. However, what is fundamental to the stroke care is a dedicated stroke team that manages patients regardless of hospital geographical placement thus maintaining a continuum of coordinated care for the stroke patient.

## 1. History of Stroke Units

Initial reports of organised stroke care appeared from various countries in the 1960s. These reports described positive results from stroke rehabilitation units in decreasing early mortality and increasing the numbers of patients returning home with functional independence. Several models of stroke care have been discussed in the literature.<sup>[3,4]</sup> Table I describes the wide variations in models and approaches to stroke care. The dedicated stroke unit may refer to a geographically defined, disease-specific stroke unit or to a 'mobile team' dedicated exclusively to the management of stroke patients within the hospital. The distinguishing characteristic,

regardless of model, is the organisation of a specialised, coordinated, multidisciplinary team of professionals who are interested and knowledgeable about stroke, and who provide comprehensive assessment, management and rehabilitation services for stroke patients. The major focus in all models is comprehensive rehabilitation.

An alternative approach, 'stroke intensive care units' also known as 'intermediate-care stroke units' were developed mainly in the US. Modelled after coronary care units, this high intensity approach, while reducing complications associated with stroke, failed to show a significant difference in mortality or morbidity compared with traditional approaches.<sup>[5-7]</sup> Emphasis switched in the 1970s and 1980s to early identification and comprehensive rehabilitation of stroke patients. By the 1990s intermediate-care stroke units reappeared as a response to the high cost and inappropriate use of intensive care unit (ICU) beds.

Most stroke patients need careful assessment and monitoring by knowledgeable stroke specialists, not invasive monitoring or the high technology of an ICU. Clinical trials and anecdotal reports continued to be mixed about the value of stroke units especially on survival or long term recovery.<sup>[1,2,7,8]</sup> Because of the emergence of new therapeutic strategies (i.e. thrombolytics) requiring special exper-

tise and management, there is new interest in the dedicated ACSU that admits patients at onset of stroke. This is particularly evident in the US.

## 2. Clinical Evidence for Stroke Unit Care

For more than 30 years, clinicians have been debating whether organised inpatient stroke unit care is more effective than conventional care in reducing death, dependency and long term institutional care after stroke. Recent studies strongly support the value of the ACSU. In 1993, Langhorne et al.<sup>[9]</sup> performed a meta-analysis of the 10 randomised controlled trials of patients assigned to ACSU versus routine ward care. A reduced early mortality rate of 28% was found for those assigned to ACSUs.

Langhorne<sup>[10]</sup> points out that the evidence from the randomised trials refers to 'stroke units' which have a major emphasis on rehabilitation. In addition, he notes the lack of good randomised evidence regarding 'stroke intensive care units' and very limited evidence about the role of stroke teams.<sup>[8]</sup>

In 1997, using the rigorous methodology of the Cochrane Collaboration, a meta-analysis of 18 randomised controlled trials was conducted.<sup>[11]</sup> It concluded that organised inpatient care is effective in reducing death, dependency and institutionalisation after stroke. Additionally, age, gender or stroke severity should not restrict patient access to stroke unit care because all categories benefit from organised stroke care. Organised care was described as care provided by a coordinated, multidisciplinary team operating in a unit dedicated to stroke care which could offer a substantial period of rehabilitation, if required. This landmark review of the Stroke Unit Trialists' Collaboration confirmed the value of inpatient stroke units. Others have reported improved long term survival and functional state with an increased proportion of patients able to live at home 5 years after a stroke who were treated within a stroke unit.<sup>[12-14]</sup>

Future trials, according to the Stroke Unit Trialists' Collaboration,<sup>[11]</sup> should focus on the investigation of the potentially important components of stroke unit care and on direct comparisons of dif-

**Table 1.** Categories of stroke care (from Langhorne & Dennis,<sup>[3]</sup> with permission)

Type of unit/care	Description
Dedicated stroke unit	Disease-specific service in a geographically defined unit or mobile team dedicated exclusively to the management of stroke patients
Mixed assessment/rehabilitation unit	Generic disability service such as a ward or team focusing on the assessment and rehabilitation of disabling illness (including stroke)
Acute admission unit	Unit that admits patients at the onset (within 1 week) of illness
Delayed admission unit	Unit that admits patients after a delay of at least 1 week
General medical care	Conventional care in general medical units focusing on the management of acute medical illness, but not on subsequent rehabilitation

ferent models of organised stroke unit care. Additionally, outcome measures should be included that sample the domains of patient satisfaction and quality of life.

Donadabian<sup>[15]</sup> proposed a model of structure, process and outcomes to evaluate quality of care. Structure refers to the type of system (the organisation) and providers of care, while process is the set of activities that go on within and between the provider and the patient.<sup>[16]</sup> Patient outcomes are the result of the structure and processes of care.<sup>[16]</sup> Whereas inpatient stroke unit refers to structure, it is the processes of care that need further exploration to determine best practice.

### 3. Components of Stroke Unit Care

The foundation for any stroke programme is a philosophy of care that reflects the values and beliefs of the stroke team. A comprehensive programme of care extending beyond the confines of the inpatient acute stroke unit is created and refined by an enthusiastic, knowledgeable and competent multidisciplinary team. As noted in table I, the dedicated stroke unit is not a standard entity.<sup>[17]</sup> The organisational design depends on the philosophical conceptualisation of stroke care, available resources and local preference. In addition, how healthcare is financed (e.g. complete government financed, personal health insurance) often controls length of acute hospital stay and other resource utilisation as is the case in the US.

The ACSU, a dedicated geographically defined stroke unit that admits patients at the acute onset of stroke, is the model used for our discussion of the components of a stroke programme. It builds on the key elements identified from randomised trials, but is not an exact replication of the units used in the randomised trials. Research is underway to determine the efficacy of this model. Our model encompasses a multidisciplinary team approach to stroke assessment and diagnosis, intervention for secondary prevention of stroke, comprehensive rehabilitation, aggressive management of neurological and medical complications of stroke, and intensive patient and family education. The number of beds in

a unit will vary depending on need, but generally range from 4 to 6 beds.<sup>[5]</sup>

Because the ACSU occupies a specific site within a hospital, it utilises unit-based specially trained and experienced nurses, a vitally important component of the stroke team.<sup>[5,18]</sup> The multidisciplinary team includes neurologists, rehabilitation physicians (physiatrists), nurses, therapists (physical, occupational, speech), and a social worker. The common bond among all providers is a focus on stroke management and comprehensive rehabilitation. A member from each discipline sees the patient from admission and actively participates in the comprehensive rehabilitation programme.

Major organisational components of an ACSU include: policies and procedures; protocols, guidelines and pathways; discharge planning; patient and family education; staff education; research; and outcomes management. Examples of each category are provided in the following subsections.

#### 3.1 Policies and Procedures

An example of admission and discharge criteria (see table II) establishes inclusion/exclusion criteria for admission and discharge practices. Both should be based on the specific ACSU model, the organisation of acute care services and available resources to provide safe care. Patients who require a ventriculostomy or a ventilator are usually managed in an ICU setting. These patients are still followed by the stroke team and participate in the rehabilitation focused care of the stroke programme.

A policy for transport of patients within and outside the hospital for diagnostics or other purposes is important. Best practice recognises the high incidence of haemodynamic instability and subsequent secondary injury related to transport. A knowledgeable transport team that includes a health professional (often a nurse) can oversee and expedite the transport process. Monitoring and emergency equipment must be available for on route management. A priority status for elevator use and diagnostics must be established.<sup>[19,20]</sup>

Multidisciplinary, collaborative rounds are foundational for coordinated, comprehensive, collabo-

**Table II.** Sample admission and discharge criteria for the acute stroke unit<sup>a</sup>

Admission criteria	Discharge criteria
Acute ischaemic or haemorrhagic stroke	Stable neurological status
NIHSS >5	Stable NIHSS within 2 points deviation in past 24 hours
Thrombolytic therapy initiation or immediate follow-up	Stable respiratory function (not at risk for respiratory depression or hypoxia)
Vacillating neurological deficits/status	Stable and acceptable PaO <sub>2</sub>
Frequent neurological monitoring	Heart rhythm stable
Frequent vital sign assessment	Hypotension or hypertension controlled
<b>Exclusion criteria<sup>b</sup></b>	
Ventilator dependent	
Swan-Ganz catheter	
ICP monitoring or ventriculostomy	
Vasoactive drugs requiring vital sign monitoring every 15 minutes for >2 hours	
<p>a This criteria is based on our experience and judgment for safe, efficient and cost-effective care within our facility. It is not based on randomised trials.</p> <p>b These patients are admitted to an intensive care unit.</p>	
<p>ICP = intracranial pressure; NIHSS = National Institutes of Health Stroke Scale.</p>	

rative and efficient care. Daily multidisciplinary rounds provide a forum for discussion, sharing of information and planning of care. Patient presentation should follow a template to methodically collect data for clinical reasoning and decision making. A climate of openness and collegiality must prevail for open exchange of patient issues. Based on these discussions, decisions are made regarding the plan of care and targeted short term and long term goals are established.

### 3.2 Protocols, Guidelines and Pathways

Protocols set a standard for management of common problems or disease processes within a given environment. Stroke protocols include acute stroke standing orders.<sup>[21]</sup> Use of stroke protocols has resulted in decreased length of hospital stay and reduced cost.<sup>[22]</sup> Guidelines provide suggestions in managing particular problems and administering

care. Many are published by specialty organisations such as the American Heart Association and are based on expert opinion and limited research (usually not randomised controlled trials). Implementation of guidelines requires judgement to determine the appropriateness of application to the particular patient.

A clinical pathway is a disease-specific map of the necessary components of care to provide comprehensive care along a timeline (usually a daily basis). Since stroke is a heterogeneous diagnosis with different treatment options depending on type, pathways must match the patient's specific diagnosis (e.g. ischaemic stroke, haemorrhagic stroke). However, all pathways are focused on timely, comprehensive rehabilitation. Implementation of a clinical pathway requires interdisciplinary coordination to plot diagnostics, treatments, therapies, drugs, protocols and patient education on a timeline designed to avoid fragmentation of care and needless delays along the continuum of care, and to control costs. Use of stroke clinical pathways is associated with reduced length of stay and fewer complications.<sup>[22]</sup>

#### 3.2.1 Stroke Management

Many resources based on evidence-based practice and best practice consensus reports are available to guide clinicians in developing stroke protocols. For efficient management, a stroke protocol should be specific to the patient's type of stroke and should include comprehensive standing orders. Where protocols have been developed for specific aspects of care such as blood pressure management (see section 3.2.4), standing orders can refer to the specific protocol (e.g. 'institute blood pressure management protocol') to maintain systolic and diastolic blood pressure within specific target levels. By including such protocols, a 'best practice' standard of care is provided for all patients. Finally, patient-specific orders (e.g. protein C and protein S to evaluate hypercoagulability) may be added as needed.

Specific protocols for management of respiratory (i.e. supplemental oxygen, peripheral oxygen saturation monitoring), cardiac and fluid/electrolyte

systems are necessary. Cardiac monitoring is important to detect arrhythmias, hypotension and respiratory failure.<sup>[23]</sup> Maintaining fluid and electrolyte balance (e.g. potassium replacement for hypokalaemia) can be guided by protocols.

Types of patient assessments and their frequencies are components of stroke protocols. For example, vital signs, detailed neurological assessment and use of stroke scales such as the National Institutes of Health Stroke Scale are useful in monitoring change. Changes may be subtle, such as slight weakness in a previously strong and functional arm, or significant, such as difficulty arousing a patient previously conversant. Frequency of assessment is often every 2 hours in the first 24 hours until stable and every 4 hours thereafter. More frequent assessment is needed for patients receiving thrombolytics.

### **3.2.2 Prevention of Complications**

A major benefit of ACSUs is a decline in the number of medical complications of stroke.<sup>[17,24]</sup> Major complications associated with stroke include deep vein thrombosis, aspiration pneumonia and urinary tract infection. Protocols should be established, based on best practice, to prevent these complications. For example, indwelling catheters should not be used except in unconscious patients and very unstable patients. In these situations, a condom catheter may be used for a male patient. If needed, a bladder programme of intermittent catheterisation (4 to 5 times a day) ought to be considered to prevent urinary tract infection. Other problems (e.g. skin breakdown, constipation and falls) are associated with bedrest and immobility. Identification of high-risk patients and early institution of appropriate protocols by the nursing staff will promote optimal functional patient outcomes.

### **3.2.3 Nutrition and Feeding**

The ability to swallow and manage oral secretions is essential before oral feeding is resumed. A feeding protocol that includes keeping all patients nil by mouth until swallowing has been assessed, is critical in preventing aspiration. The assessment of swallowing, usually by the speech therapist, should include the authority to 'hold oral feeding'

if swallowing criteria has not been met. Once a patient has been cleared for feeding, the diet should be slowly advanced and monitoring should continue for evidence of aspiration. If resumption of oral feeding is not recommended, then enteral feeding should be considered. The protocol may include a calorie count to ensure adequate caloric, protein and other nutrient intake.

### **3.2.4 Blood Pressure Management**

Fluctuations in blood pressure, particularly episodes of hypotension, can lead to secondary ischaemic cerebral injury.<sup>[23,25]</sup> Therefore, a blood pressure management protocol must be carefully implemented with therapy targeted to maintain blood pressure within ranges adequate to support cerebral perfusion. Stroke specialists generally support maintaining the blood pressure at higher levels in the early acute phase after stroke.<sup>[25]</sup>

### **3.2.5 Management of Comorbidity**

Stroke patients frequently have comorbid conditions that are risk factors for stroke (e.g. diabetes mellitus and hypertension). Tight control of glucose in patients with diabetes is recommended to promote better patient outcomes.<sup>[25]</sup> A protocol for managing glucose which includes an algorithm is helpful in guiding management. For known patients with hypertension, evaluation of previous management and patient compliance is vital. For newly identified patients with hypertension, an appropriate work-up and evaluation is warranted to determine the cause and to make treatment decisions. Patients may also be taking drugs for other conditions that may influence therapeutic decisions. For example, if anticoagulation therapy with warfarin is planned, patients taking nonsteroidal anti-inflammatory drugs for arthritis must be identified because of the potential for drug interactions.

## **3.3 Discharge Planning**

The goal of early discharge planning is to efficiently move patients through in-hospital acute and rehabilitative care and post-hospital discharge care. Multidisciplinary discharge planning is related to decreased length of stay, reduced frequency

of discharge to a nursing home and potentially reduced cost.<sup>[17]</sup> Once the patient is physiologically stabilised, the focus turns to appropriate assessments to determine comprehensive rehabilitation needs. Early (within 24 hours of admission) evaluation of patients by rehabilitation specialists expedites rehabilitation and is related to decreased mortality, complications and length of stay.<sup>[26-28]</sup> The social worker, case manager or nurse usually assumes responsibility to coordinate discharge planning, make interagency referrals and prepare the patient and family.

### 3.4 Patient and Family Education

Patient and family stroke education begins on admission and continues through the rehabilitation process and beyond. The nurse assumes the major responsibility for education of patients and families. Patients need to know about what has happened to them, what to expect and prevention of recurrent stroke. Active participation of the patient and the family through education is linked to better functional outcomes and decreased need for long term care.<sup>[29,30]</sup> Family instruction should include information on what a stroke is, patient care needs including response to stroke and recovery, self-care strategies for stress management, future needs, stroke prevention and the availability of resources such as support groups.<sup>[31,32]</sup>

Computer technology and Internet web sites are rapidly including patient education sites. These resources will surely become important resources in the near future. Patients often have special educational needs related to the treatment plan. For example, if warfarin therapy is instituted, considerable education and monitoring for safe use of the drug must be provided. See table III for examples of patient education resources.

### 3.5 Staff Education

Each member of the stroke team needs continuing education about stroke and stroke management to provide the best care as determined by evidence-based practice and best practice. Staff education has been associated with decreased costs and im-

**Table III.** Selected resources for patient/family and professional education

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#### **American Heart Association**

Printed pamphlets on a variety of topics such as types of stroke, aphasia, emotional response to stroke and living at home (patient/family)

Audio-visual material about stroke signs and symptoms and recovery (patient/family)

A wide variety of printed and audiovisual material for professional education

#### **National Stroke Association**

Printed pamphlets on atrial fibrillation, signs and symptoms of stroke, recurrent stroke, stroke as a 'brain attack' etc.

A wide variety of printed and audiovisual material for professional education

#### **Patient/family educational material from pharmaceutical companies and others**

A Patient's Guide to Coumadin (Dupont)

Taking Ticlid (Roche)

Recovery after a Stroke (US Department of Health and Human Services)

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proved patient outcomes.<sup>[29,33]</sup> The nursing staff spend the most time with the patient and must develop excellent assessment, monitoring and clinical reasoning skills to provide competent care and to work collaboratively with the physician and other team members. Physicians rely on the nursing staff to recognise changes in a patient's condition that require physician involvement. Ongoing education and mentoring is needed to develop and maintain competent nurses (see table IV).

### 3.6 Research

Future treatment options and management strategies for tissue salvage, facilitating recovery and prevention of stroke will result from research. Randomised multicentre clinical trials, meta-analyses and other research models will provide the scientific foundation for new knowledge. Commitment to research as an integral part of the pursuit of evidence-based practice must be incorporated in practice settings. Clinical research as well as basic laboratory research must be financially supported and investigators should be trained to conduct research and to secure informed consent.

**Table IV.** Nursing staff education: selected content

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Basic concepts of brain anatomy and cerebrovasculature
Signs and symptoms of major stroke syndromes
Neurological assessment and related pathophysiology of stroke
Use of assessment instruments (e.g. National Institutes of Health Stroke Scale, Scandinavian Stroke Scale, Barthel Index, Rankin Scale)
Prevention of complications related to stroke and immobility (swallowing assessment, deep vein thrombosis prophylaxis, urinary tract infections prevention)
Principles and goals of diagnostics, management and treatment
Supportive nursing management (e.g. blood pressure and glucose management, prevention of hypotension)
Recognition of complications (arrhythmias, respiratory compromise)
Multidisciplinary collaboration
Patient and family education (e.g. plan of care, stroke prevention, drug therapy)
Discharge planning (assessing patient needs, referrals, preparing patient/family)
The continuum of care and meeting patient needs
Outcomes management and outcomes-based practice

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### 3.7 Outcomes Management

Attention to outcomes is mandatory in stroke programmes. Outcomes research is defined as any research that attempts to link either structure or process or both to the outcomes of medical care at the community, system, institution or patient level.<sup>[34]</sup> Outcomes management refers to the process of using outcomes research to improve the medical care process. To monitor outcomes, developing and maintaining a database to demonstrate efficacy and cost-effectiveness of care is critical for ongoing institutional financial support of the stroke programme. Slater<sup>[34]</sup> suggests a 5-step approach:

- identify and select variables
- monitor and pool data
- describe variations and identify problems
- analyse and explain variations
- disseminate findings to team members and decision makers.

Data entry directly into a laptop computer facilitates data collection and statistical analysis. Appropriate stroke benchmarking data is helpful for

comparison to operational data,<sup>[35]</sup> and subsequent analysis should be directed at improving processes of care and determination of best practice.

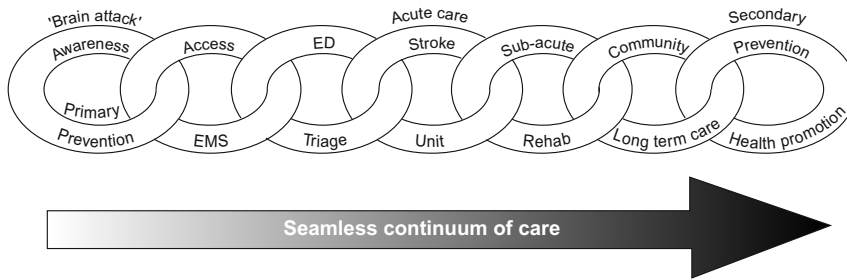
## 4. Creating a System for Stroke Care

The stroke programme and the leadership of the stroke team extend beyond the boundaries of the ACSU. The ACSU is a link along the stroke continuum chain (fig. 1). When considering factors that influence overall patient outcomes, the stroke trajectory must be followed to appreciate the settings and sequencing of care before and after the ACSU. The sequence of events prior to ACSU admission most likely includes a stroke event at home, transport to the hospital by emergency medical services (EMS), and hospital entry via the emergency department (ED) with triage to the ACSU or elsewhere in the hospital. The timeliness and quality of care in each setting has major implications for treatment options and patient outcomes.

A lack of public awareness about 'brain attack', recognition of symptoms of stroke, or activation of EMS delays timely treatment of stroke patients.<sup>[36-38]</sup> Many potential candidates for thrombolytic therapy arrive long after the 3-hour treatment window, and are thus ineligible for tissue salvage. Once EMS is contacted, recognition of possible stroke and rapid transport to the nearest facility providing aggressive acute stroke care is imperative. Concurrent notification of the stroke team is paramount in activating personnel for system coordination for timely diagnosis and treatment decisions. When the patient arrives in the ED, rapid triage, diagnosis, establishing exact time of symptom onset, obtaining a noncontrast computed tomography (CT) scan, and screening according to criteria within a 3-hour time frame is necessary for thrombolytic therapy candidates.

Bratina et al.<sup>[39]</sup> reported that transport, initial evaluation and ED care is generally slow. Presence of a stroke team shortened the time to examination and CT scan by 13 and 63 minutes, respectively. Thus, a critical role of a stroke team is supporting and participating in public education and awareness campaigns, and educating EMS and ED per-





**Fig. 1.** Links in the chain of care in a comprehensive stroke programme. **ED** = emergency department; **EMS** = emergency medical services; **rehab** = rehabilitation (from Hickey JV, with permission).

sonnel for rapid response to stroke patients. Such a perspective transforms stroke care from a 'programme' to a 'system' of care for a geographical area. Building a seamless system of care that links all components of care is challenging, but is the only way to provide optimal stroke care to a community.

The trajectory of care continues after discharge from the ACSU and depends on the patient's health status, needs, resources/economics, personal preference and available care options. Options may include comprehensive rehabilitation programmes, general medical units, postacute care, long term care facilities, community-based care or home care. The setting for continuation of recovery has a major impact on short term and long term patient outcomes and cost. The stroke team exerts its influence in a complex system of stroke care through collaboration and coordination of care with external providers and follow-up care. Follow-up care is directed at facilitating optimal recovery and prevention of recurrent strokes. Identification of risk factors along with appropriate treatment, education and referral is the mainstay of prevention. Patient education is directed at lifestyle changes and control of comorbidity associated with stroke.

## 5. Conclusions

Dedicated acute stroke units have a major role in the overall care and comprehensive rehabilitation of stroke patients. The efficacy of the 'stroke

unit' is supported by research and is now part of evidence-based practice. We have described a model of an acute stroke unit and have highlighted key components of acute stroke unit care. The stroke team sets the standards for stroke management by creating the philosophy of care and the policies, procedures, protocols, guidelines, pathways and infrastructure that guides the scope and quality of the stroke programme. A stroke management 'system' for a geographical area incorporates components of care administered before and after a patient interacts directly with the stroke team. Through outreach, leadership, education, research, coordination and comprehensive system development, a 'stroke programme' has a profound influence on best practice for stroke management and stroke prevention and, more importantly, improved patient outcomes.

In the future, the challenge for those who care for stroke patients will be to combine contemporary models of acute stroke care and the characteristics that have been shown to be effective in the randomised trials.

## References

1. Davis SM, Rosen DM, Donnan GA. Acute stroke management around the world. In: Bogousslavsky, J, editor. Acute stroke treatment St. Louis: Mosby, 1997: 1-14
2. Biller J, Love BB. Nihilism and stroke therapy. *Stroke* 1991; 22: 1105-7
3. Langhorne P, Dennis M. Stroke units: an evidence based approach. London: BMJ Books, 1998: 25

4. Stroke Unit Trialists' Collaboration. A collaborative systematic review of the randomized trials of organised inpatient (stroke unit) care after stroke. *BMJ* 1997; 314: 1151-9
5. Mansbach HH. Stroke units. In: Welch KMA, Caplan LR, Reis DJ, et al., editors. *Primer on cerebrovascular diseases*. San Diego (CA): Academic Press, 1997: 774-5
6. Norris JW, Hachinski VC. Stroke units or stroke centres? *Stroke* 1986; 17 (3): 360-2
7. Norris JW, Hachinski VC. Intensive care management of stroke patients. *Stroke* 1976; 7 (6): 573-7
8. Wood-Dauphinee S, Sharpiro S, Bass E, et al. A randomised trial team care following stroke. *Stroke* 1984; 5: 864-72
9. Langhorne P, Williams BO, Gilchrist W, et al. Do stroke units save lives? *Lancet* 1993; 342: 395-8
10. Langhorne P. The role of stroke units. *Irish Med J* 1995; 5: 150
11. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care after stroke (Cochrane Review). In: *The Cochrane Library*, issue 4. Oxford: Update Software, 1998
12. Indredavik B, Sjordahl SA, Bakke F, et al. Stroke unit treatment long-term effects. *Stroke* 1997; 28: 1861-6
13. Ronning OM, Guldvog B. Stroke units versus general medical wards, I: twelve-and eighteen-month survival: a randomized, controlled trial. *Stroke* 1998; 29: 58-62
14. Ronning OM, Guldvog B. Stroke unit versus general medical wards, II: neurological deficits and activities of daily living: a quasi-randomized controlled trial. *Stroke* 1998; 29: 586-90
15. Donabedian A. Evaluating the quality of medical care. *Milbank Mem Fund Q* 1966; 44 (Pt 2): 166-206
16. Donabedian A. Explorations in quality assessment and monitoring. Vol. 1. The definition of quality and approaches to its assessment [dissertation]. Ann Arbor (MI): University of Michigan, 1980
17. Jorgensen HS, Nakayama H, Raaschou HO, et al. The effect of a stroke unit: reduction in mortality, discharge rate to nursing home, length of hospital stay, and cost. *Stroke* 1995; 24: 1178-82
18. Langhorne P, Dennis MS. Stroke units: their role in acute stroke management. *Vascular Med Rev* 1995; 6: 33-44
19. Brokalaki HJ, Brokakakis JD, Digenis GE, et al. Intrahospital transportation: monitoring and risks. *Intensive Crit Care Nurs* 1996 Jun; 12 (3): 183-6
20. Szem JW, Hydo LJ, Fischer E, et al. High-risk intrahospital transport of critically ill patients: safety and outcome of the necessary 'road trip'. *Crit Care Med* 1995 Oct; 23 (10): 1660-6
21. Wentworth DA, Atkinson RP. Implementation of an acute stroke program decreases hospitalization costs and length of stay. *Stroke* 1996; 27: 1040-3
22. Bowen J, Yaste C. Effect of a stroke protocol on hospital costs of stroke patients. *Neurology* 1994; 44: 1961-4
23. Brott T, Reed RL. Intensive care for acute stroke in the community hospital setting. *Curr Concepts Cerebrovasc Dis Stroke* 1989; 24: 1-5
24. Odderson IR, McKenna BS. A model for management of patients with stroke during the acute phase: outcome and economic implications. *Stroke* 1993; 24: 1823-7
25. Saver JL, Starkman S. State of the art medical management of acute ischemic stroke. *J Stroke Cerebrovasc Dis* 1997; 6 (4): 189-94
26. Indredavik B, Bakke F, Solberg F, et al. Benefit of a stroke unit: a randomized controlled trial. *Stroke* 1991; 22: 1026-31
27. Kalra L. The influence of stroke unit rehabilitation on functional recovery from stroke. *Stroke* 1994; 25: 821-5
28. Stroke Unit Trialists' Collaboration. How do stroke units improve patient outcomes? *Stroke* 1997; 28: 2139-44
29. Strand T, Asplund K, Eriksson S, et al. A non-intensive stroke unit reduces functional disability and the need for long-term hospitalization. *Stroke* 1985; 16: 29-34
30. Patel M, Potter J, Perez I, et al. The process of rehabilitation and discharge planning in stroke: a controlled comparison between stroke units. *Stroke* 1998; 29: 2484-7
31. Hickey JV. Preparation of family caregivers for recovery from stroke: how well are we doing? *J Neurovasc Dis* 1996; 1 (1): 12-20
32. Kalra L. Role of stroke rehabilitation units in managing severe disability after stroke. *Stroke* 1995; 26: 2031-4
33. Alberts MJ, Bennett CA, Rutledge VR. Hospital charges for stroke patients. *Stroke* 1996; 27: 1825-8
34. Slater CH. What is outcomes research and what can it tell us? *Eval Health Prof* 1997 Sept; 20 (3): 243-64
35. Berry TB. Using benchmarking to support performance improvement efforts. *J Am Health Information Manage Assoc* 1998 Nov/Dec; 69: 26-8
36. New era for acute stroke treatment [editorial]. *JAMA* 1997; 277 (3): 199-200
37. Timely and appropriate treatment of acute stroke: what's missing from the picture [editorial]. *JAMA* 1998; 279 (16): 1307-9
38. Broderick JP. Practical considerations in the early treatment of ischemic stroke. *Am Fam Physician* 1998 Jan; 57 (1): 73-80
39. Bratina P, Greenberg L, Pasteur W, et al. Current emergency department management of stroke in Houston, Texas. *Stroke* 1995; 26: 409-14

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