

Improving access to evidence-based acute stroke services: development and evaluation of a health systems model to address equity of access issues

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Abstract

Level 1 evidence for management of patients with stroke in a dedicated Stroke Care Unit (SCU) demonstrates improved outcomes by about 20%. It has been estimated that 21% of Australian hospitals provide an SCU and that these SCUs are mainly located in either metropolitan sites and/or in hospitals with more than 300 beds. To address equity issues related to access to SCUs, the National Stroke Foundation and the Australian Government undertook the National Stroke Units Program. One program outcome was the development of a conceptual model of acute stroke service delivery. The development process and initial evaluation of the model are described. Use of the model to increase capacity within the health care system to treat stroke is discussed.

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IN AUSTRALIA, STROKE is the second greatest cause of total disease burden as calculated using disability adjusted life year methodology.¹ About 89% of Australians who suffer stroke are admitted to hospital,² with care provided mainly within the public health system. Well designed clinical trials continue to provide information about how best to manage and treat stroke. There is now evidence that the use of intravenous thrombolysis within 3 hours of ischaemic stroke onset,³ and aspirin within 48 hours,⁴ improves outcomes. Further, level I evidence for organised specialist care in a Stroke Care Unit (SCU) has also been shown to substantially improve outcomes compared with conventional (general) management.⁵ A recent systematic review provided evidence that mortality was improved by 18% and functional outcome by 22% at final follow up (median one year).⁶

What is known about the topic?

As in other developed countries, stroke is a major cause of mortality and morbidity in Australia. For over 10 years there has been evidence favouring organised specialist care in a Stroke Care Unit (SCU) over conventional care.

What does this paper add?

A conceptual model to address equity of access to SCUs was developed as part of a national program to improve evidence-based stroke care delivery. This paper describes the development process and initial evaluation of the model, identifying areas of potential improvement in the conceptual model, as well as the perceived strengths and barriers related to its implementation from the perspective of health service providers.

What are the implications for practice?

The Stroke Services Model provides a framework for clinicians to work with one another, within geographical regions, to provide specialist stroke management. The model categories also permit informed health services planning by enabling identification of hospitals that have the resources to potentially provide a dedicated SCU. ♦

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Various models of SCUs exist, and there are a number of potential reasons why they result in better outcomes. Those reported include: prolonged periods of rehabilitation if required; a coordinated multidisciplinary team; staff specialisation; and continuing education programs for staff, patients and carers.⁵ Evidence has emerged that localised SCUs (patients managed in one ward) have superior clinical results, as

measured by death and institutionalisation, to a mobile stroke service (care provided throughout different wards in a hospital by a dedicated multidisciplinary team) or domiciliary care.⁷ The literature does not identify whether solely acute (first 7–10 days following stroke) or subacute units are more effective. In Australia, SCUs tend to be discrete within either an acute or subacute setting.

I Conceptual Stroke Services Model

	Component of care	Category A	Category B	Category C	Category D
STRUCTURE	Immediate access to computed tomography (CT)	✓	✓	✓ (within 12 hours)	x Transfer to facility with CT with patient consent
	Access to High Dependency Unit*	✓	✓	x	x
	On site neurosurgery†	✓	x	x	x
	Geographically localised Stroke Unit	✓	✓	✓ (or a mobile stroke team with care plan)	x Recommend transfer. Provide care required on site via protocols
PROCESSES	Specialised, dedicated, multidisciplinary team	✓	✓	Multidisciplinary team supported by specialist team at Category A/B	Multidisciplinary team supported by specialist team at Category A/B
	Emergency Department protocols for rapid triage	✓	✓ (or transfer)	✓ (or transfer)	Protocols for transfer
	Access to regular professional development/education for stroke	✓	✓	Access to professional development relating to stroke and support from Category A and B	Access to professional development relating to stroke as required and support from Category A and B
CLINICAL PROFILE	Management of all strokes (including complex)	✓	x	x	x
	Moderately complex strokes with low to moderate risk of deterioration	✓	✓	x	x
	Patient with stable stroke	✓	✓	✓	x
	Elected deviation from model: patient/physician informed decision not to adhere to model transfer recommendation in particular cases such as			✓	✓
	– palliative care – low complexity care				

* High Dependency Unit (HDU): the recommendation for access to high dependency units at category A and B hospitals is made so patients who deteriorate may be appropriately managed.

† Neurosurgery: access to neurosurgery is recommended for Category A hospitals. This recommendation is made so that neurosurgical opinions and intervention of complex patients can be accessed (eg, those diagnosed with hydrocephalus). ◆

Providing optimal stroke services equitably across Australia is complex. This is mainly because the majority of the population resides along the coastal perimeter and specialist services are not proportionally distributed. In a survey of public and private hospitals with more than 40 beds conducted in 1999, it was estimated that 21% had an SCU.⁸

Nationally, health policy to encourage greater uptake of SCUs has been established as part of the National Stroke Unit Program (NSUP). This program was auspiced by the National Stroke Foundation and funded by the federal government through the National Health Priority Areas initiative (<http://www.health.gov.au/internet/wcms/publishing.nsf/Content/health-pq-cardio-nsup.htm>). The NSUP included a stroke services policy review and development of acute care guidelines and acute performance indicators, and outlined a proposed stroke services model to increase capacity within the Australian health system to optimally treat stroke. This paper outlines the development of the conceptual model and its initial qualitative evaluation that explores factors which support or limit the delivery of optimal stroke services.

Study design

Methods for the development of the Stroke Services Model

A literature review failed to reveal a model for providing optimal stroke services in or across all acute settings. Consequently, the model development was novel for acute stroke services. The model was developed in 2002 through:

- establishment of a steering committee comprising stroke care experts, state and federal government and consumer representatives;
- evidence review to determine the core elements of SCUs, including consideration of their suitability for different settings;
- a national workshop with local experts and government and consumer representatives to discuss innovative practice throughout Australia and define potential SCU models;
- technical review by the NSUP steering committee;
- ongoing consultation via telephone, face-to-face meetings and email with key stakeholders, stroke experts unable to attend the workshop, and international experts in stroke unit development;
- a feasibility study to pre-test concepts of the agreed integrated stroke services model. Two sites in Victoria (suburban hospital linked with a tertiary hospital SCU) and two sites in Queensland (regional hospital linked with tertiary hospital SCU) were consulted about their perceptions of how this model might work. Organisational, cultural and geographical issues at a clinical level were explored using a semi-structured interview format, with the findings fed back to the steering committee to finalise the NSUP model.

Stroke Services Model evaluation methods

In 2003 an evaluation of a convenience sample of category A and B sites (hospitals with on-site computed tomography [CT] scanning, a high dependency or intensive care unit, and, if category A, a neurosurgical unit) was conducted employing qualitative interview methods. Demonstration sites in Qld and New South Wales volunteered to participate in the evaluation as an adjunct to concurrent state government initiatives. This permitted a collaborative effort in examining best practice delivery of urban and regional stroke care. The Qld demonstration hospitals had operationalised the model for a period of 12 months (2002–2003) as part of the Zonal Stroke Care Network project.⁹ In NSW, implementation was more recent, tied to the 2002 Greater Metropolitan Transition Taskforce (GMITT) initiative,¹⁰ which saw the establishment of 18 SCUs in Greater Metropolitan NSW.¹¹ These were the only sites in Australia implementing an integrated model of stroke service delivery that reflected the model concepts, permitting this early demonstration evaluation exploring implementation issues. To our knowledge, there were no category C and D hospitals (essentially, hospitals without access to on-site CT scanning) involved in setting up and integrating stroke care according to the model principles.

Voluntary, semi-structured, in-depth 1-hour interviews with stroke service providers working in four demonstration hospitals were conducted during May 2003. Staff from each demonstration site were nominated and organised by the stroke serv-

ice itself. A request to interview a minimum of three clinicians per hospital with at least one clinical representative from allied health, nursing and medical disciplines was made to the head of each participating stroke service. A standard inter-

2 Demonstration sites and Stroke Services Model

		Hospital model category and location				
		A, metro	A, regional	A, regional	B, regional	B, regional
STRUCTURE	Immediate access to computed tomography	✓	✓	✓	✓	✓ (off-campus)
	Access to High Dependency Unit	✓	ICU	✓	ICU/HDU	✓
	On site access to neurosurgery	✓	✓	✓	x	x
	Geographically localised Stroke Unit	✓	Trial*	✓	x	x
PROCESSES	Specialised, dedicated, multidisciplinary team	✓	✓ [†]	✓	x [‡]	x [‡]
	Emergency Department protocols for rapid triage	✓	✓	✓	✓*	✓*
	Access to regular professional development and education	✓	✓*	✓	✓*	✓*
CLINICAL PROFILE	Management of all strokes	✓	✓	✓	x	x
	Moderately complex strokes with low to moderate risk of deterioration	✓	✓	✓	✓	✓
	Stable stroke	✓	✓	✓	✓	✓
	Elected deviation from model: patient/physician informed decision not to adhere to model transfer recommendation in particular cases such as – palliative care – low complexity care	✓	✓	✓	✓	✓
	Additional features useful for categorisation					
STRUCTURE	Number of dedicated beds	12	4	4	x	x
	Ward type	Neurology	Medical	Neurology	Medical	Medical
	Clinician Leader	✓	✓	✓	x	x
	Clinical Nurse Specialist	✓	Stroke Project Officer*	✓	Stroke Project Officer*	Stroke Project Officer*
	Outreach multidisciplinary teams	x	✓	✓	x	x
	Dedicated stroke service educator	x	x	✓	x	x
PROCESSES	Weekly multidisciplinary meetings	Bi-weekly	Bi-weekly [#]	✓	✓ (entire ward)	✓ (entire ward)
	Guidelines and care plans on wards	✓	✓ [§]	✓	✓ [§]	✓ [§]
	Stroke register/database with electronic discharge summary generation	✓	x	✓	x	x
	Number of strokes per year	400	100–150	360	146	70

metro = metropolitan. * Limited position tied to project funding. † An experienced (generalist) allied health team. ‡ Access is available to allied health professionals who manage a general caseload, including stroke. § Initiated as part of recent project initiatives. ◆

view schedule was used following piloting at a non-participating site. The nine questions were open ended and explored factors that supported or impaired the delivery of optimal stroke care, and an integrated network of stroke service providers. The same researcher conducted all interviews.

Responses were transcribed and verified by respondents. Interviews were then analysed by content and emergent themes coded.^{12,13} Two researchers using the same coding tree coded the data for Qld and NSW. Additional sub-themes as relevant to the interview responses were included. Care was taken to ensure codes accurately captured the respondent's meaning. Coded interview data from the respondents with different professional backgrounds from Qld and NSW were then manually triangulated under the broad themes identified, and recoded by one interviewer for consistency.

Results

Stroke Services Model

The resultant Stroke Services Model was constructed in a table format and describes four categories of hospitals (categories A to D) defined by three main factors: structure (organisation and resources), processes of management, and clinical profiles of patients (Box 1). The stakeholder committee deemed classification of the model categories according to metropolitan, regional and rural boundaries as inappropriate due to diversity between hospitals in terms of size, population catchment and settings. The resources available in health care settings were ultimately used to differentiate the categories, as well as the clinical complexity of the stroke patients. The components of care for each model factor

3 Summary of perceived facilitators and barriers to an integrated stroke model

Facilitators	No. of interviews citing issue (n=26)	Barriers to an integrated service	No. of interviews citing issue (n=26)
Educational programs		Resources	22
Regular in-service training	15	Funding	9
Work-shadowing	3	Staff recruitment	6
Professional development	11	Staff attrition	3
Dedicated project officer to initiate change	7	Time constraints	19
Communication between health professionals	20	Care practices	14
Access to a multidisciplinary team	21	Staff expertise	6
Generic templates for care plans/management guidelines that can be locally adapted	20	Transfer of patients from local community and issue of returning home	2
Clinician leader	10	Lack of inter-sectoral policies such as for patient ambulance transfer	3
Clinical nurse specialist	26	Culture shift and local politics regarding "ownership" of patients	4
Seed funding or dedicated state government programs	4	Motivation of staff to take on new practices	4
Staff commitment and collaboration	11	Lack of practice standards between service providers	7
		Local executive support and commitment	7
		Evidence of costs and benefits over the short term	4

describe fundamental elements of stroke service provision, based on current evidence and clinical expertise. The categories are not intended to differentiate in care quality, but are based on obtaining the right level of care given the complexity of patients. For example, both category A and B sites are equally able to manage stroke patients except where surgical intervention is needed, as in the case of subarachnoid haemorrhage, which would occur in very few cases (less than 4%). The importance of the patient's right to an informed choice to be managed near to their home was also acknowledged, and is incorporated as an "elected deviation from model".

Stroke is a heterogeneous condition in terms of pathogenesis and severity/range of symptoms. Given this variability among patients and of resources between hospital categories, it was necessary that the model make some broad distinctions between patient groups in terms of care complexity that would permit decision rules about appropriate patient transfers within a network of hospitals. The model's clinical profile categories were defined as follows:

- *Complex stroke*: patients who may require potential surgical intervention, who are unconscious or semi-conscious and/or have a tracheotomy and are not medically stable.
- *Moderately complex stroke*: patients who may be semi-conscious with multiple deficits, which could potentially lead to associated medical complications and/or have a number of comorbid medical conditions that need either investigation and/or management.
- *Stable stroke*: patients who may have a stroke-related deficit without complex medical comorbidities, are conscious and are not anticipated to deviate from a standard, non-complicated admission for stroke. Ideally these patients should be managed in a setting with multidisciplinary clinicians and appropriate diagnostic services to investigate the cause of stroke.
- *Elective deviation patients*: patients who have low complexity care needs (minimal or no deficits), or alternatively require palliative care. This category accommodates patient/family

choice as well as physician discretion to address individual circumstances and needs.

There is an assumption that all category A and B sites have the required attributes to have a dedicated stroke unit. At present this is not the case, as not all B sites have neurosurgical units. Category C sites do not have either neurosurgical units or access to high dependency units. Category D sites have the most limited resources including no on-site access to brain imaging services. Given that resources vary between categories of hospitals, some system of communication between different hospital categories was required (eg, patient transfer protocols) to ensure access to appropriate stroke care. Tools and strategies to facilitate access to evidence-based care for optimal practice (ie, telehealth and access to staff education) were also considered. Depending on local needs and level of clinical experience, a system of flow-on support may be provided between hospital categories. This necessitates the development of a formalised network of stroke service providers, with more specialised services supporting centres with fewer resources. These networks may operate on the basis of administrative regions or clinical service networks.

Model evaluation

Box 2 indicates how each demonstration site fitted the model criteria. Additional features found to be useful in categorising hospitals that were elicited from the interview process have also been included. Demonstration sites in NSW and Qld represented model categories A and B. These sites had informal links to category C and D sites, but these were not part of this evaluation, as new systems of care were only applicable to the A and B sites.

All of the nominated clinicians agreed to participate, and there was representation from each discipline, including a range of allied health professionals. Seventeen interviews were conducted with 19 people from four sites in Qld and nine interviews from a regional stroke service in NSW. In Qld, twelve respondents were from a participating regional hospital and seven were from the major urban tertiary centre. All respond-

ents were health professionals (medical doctors $n = 5$ [18%]; nurses $n = 10$ [36%]; allied health $n = 12$ [43%]), except one with a background in education. The mean number of years working in a respondent's current position was 3.5 years (minimum, 1 month; maximum, 11 years).

Box 3 summarises the principal issues raised that were perceived to enhance or impede the operation of the model. As there were instances where there was more than one participant in an interview, the unit of analysis was the number of interviews ($n = 26$).

Factors supporting delivery of optimal stroke services

First, the factors most consistently cited as supporting optimal stroke care delivery were: access to a multidisciplinary team; clinician leaders; dedicated positions; and standardised approaches to care. Other perceived strengths included: adequate funding to support initiatives; administrative support; commitment to in-service training and professional development; and good communication among health care providers.

Second, all interviewees saw the creation of dedicated nursing positions as enhancing the quality of care. These positions were perceived to "maintain interest level and focus" and to "motivate and coordinate advances". In Qld, these positions were part-time with limited funding. In addition, the Clinical Nurse Specialist position was seen as instrumental in facilitating communication among team members, organising educational programs and progressing management advances. Nursing knowledge and specialisation for the management of stroke was reported to be enhanced with the development of a geographically localised SCU.

Third, the development and use of clinical management plans and guidelines, adapted to local circumstances, were perceived by Qld respondents (where these activities had had time to be implemented) as being a key driver of practice change.

Fourth, it was emphasised that application of a new integrated service model at the category B

sites resulted in "a unified . . . approach to patient care" with "pro-active education that is face-to-face", and the recognition "that it [stroke management] is bigger than their own district" had encouraged forming "good networks". At these sites, staff felt that expert knowledge was "close at hand".

Finally, the existence of a management committee at one category A regional site, comprising representatives of specific disciplines rather than hospital sites, was perceived as avoiding potential "territorialism" and promoting dialogue among the regional stroke care providers.

Perceived barriers to an integrated network of stroke service providers

The main perceived barriers to the model are outlined below. Additional barriers included: distance to facilities (such as computed tomography scanning); size of regions; variations in level of service across regions; and different management practices among hospital providers.

First, limited resources in terms of staff, funding and time was the most important barrier. Difficulties in regional areas of attracting and retaining professional staff were reported. References to "overwhelming case loads" were made. Limited allied health in district areas was perceived to delay patient assessments and treatment. Absence of a stroke clinician leader (medical) at the category B sites was cited as a barrier. The effects of an integrated model on other health system resources and the need for inter-sectoral policies and clarity of funding responsibilities were also highlighted. An example was negotiating the prioritisation of stroke patients using the Royal Flying Doctor Service.

Second, time constraints were mentioned in relation to work planning, education, peer support and the ability to review evidence about stroke. It was expressed that any formal requirement to provide peer support to category C and D sites would impact further on patient therapy time. In addition, it was felt that staff would want to know that they could deliver the same (optimal) service to the broader network and that bed demand/referral patterns would need to be

reviewed as these could change markedly for category A and B sites if transfer protocols were implemented.

Third, barriers to providing evidenced-based stroke care reflected the difficulty arising when clinicians have “different methods of doing things” (at peripheral sites), and were highlighted in terms of specialist care as opposed to generalist care and the lack of “standardised care plans between centres”. Interviewees at regional sites considered specialisation to be more “difficult as [we] have to cover lots of areas”, and many perceived a lack of specialist skills or knowledge in the area of stroke. A “lack of expertise in other [hospital] environments” was seen as resulting in fewer specialised staff making decisions, and that it would be “hard to pick up problems or explain treatment [to them]”. Further to the difficulty of trying to problem solve for staff at other hospitals was their “different circumstances and [limited] available resources when quite different from [category A or B sites]”. This was compounded by distance, which was seen as creating “a lack of continuous feedback from other individuals in the team”.

Motivating staff to change their clinical practice was considered the fourth barrier. One respondent explained that most of the changes in stroke care were perceived to be “medically owned and driven” and believed it was often difficult for allied health and/or nursing staff to draw the link to their own practice. Another explained that hospitals without dedicated stroke services were perceived to hold traditional views of stroke, such as “[we] can’t really do anything to affect outcomes”, and this in itself created a barrier for changing practice in these sites.

Fifth, another important issue raised was the resistance of general physicians to relinquishing stroke patients to a specialist or dedicated team. There was a perception that general physicians “thought (they) were going to lose educational opportunities and skills in managing stroke and training registrars,” which created a “political process” despite the availability of “funding and evidence that stroke units make a difference”. Similarly, the interviews conducted in the

regional sites reported that the transfer of patients away from their district hospital and local area could potentially result in isolation from families. Family support was perceived to “provide better outcomes if present in rehabilitation ... so how can we get family to be part of that scenario, that is to undertake transfer training and provide emotional support?”

Finally, lack of executive support was a perceived barrier to an integrated stroke care model, with a sense that there was “pressure for achievement of short-term outcomes and evidence of cost savings”. One respondent stated that there was a continued need to convince “district managers to set up stroke units” and, “even though under-resourced”, these units would still be better than the alternative. The resistance to setting up dedicated stroke services was perceived as “ironic as all stroke patients usually end up in the one medical ward” (as there is usually only one in regional hospitals).

Discussion

Networks (linked groups of health professionals and organisations) are perceived as a way of optimising the use of scarce specialist expertise, standardising care, improving patient access to expertise and increasing interaction between health disciplines and organisations.¹⁴ The Stroke Services Model, developed by a broad range of stakeholders, attempts to provide a plausible framework for increasing the capacity of the Australian health system to provide access to SCUs. The model highlights how hospitals can work together through peer support systems and formal patient transfer policies. These strategies have been recently emphasised by the American Stroke Association’s Task Force on the Development of Stroke Systems.¹⁵

The model categories are not uniform, with category A and B sites providing a high level of resources to manage stroke compared with C and D categories. The categorisations reflect different patient care complexity needs, and do not indicate varying levels of care quality. The model can be used for health services planning as it categor-

ises hospitals into those with the resources sufficient to have a dedicated SCU or not. For example, where category A and B hospitals are identified as not having an SCU, these can be prioritised as potential “new” SCU sites.

Qualitative methods are valuable for researching peoples’ attitudes¹³ as part of early evaluations of health services. To date, the model has been partially piloted in category A and B hospitals in NSW and Qld with variable experience in stroke management. Strengths of the evaluation include using a number of different sites and interviewing a range of health professionals, ensuring the elicitation of a broad range of key issues and enabling data triangulation to draw relevant conclusions. The results may be limited in terms of transferability to non-regional category B (or those with more established stroke services), C and D settings. While there was variation in model implementation stages between the Qld and NSW sites, this evaluation allows important insights into the perceived barriers and strengths of the proposed model. The broad issues raised in Qld and NSW interviews would be applicable to other parts of Australia. A priority for Australia is to ensure all category A and B sites have dedicated SCUs. Because stroke services lack formal integration across settings and are only available in about 19% of acute public hospitals, there was a justifiable rationale for undertaking this evaluation in category A and B sites with “recent” experience in establishing SCU networks. At the time of this evaluation, no category C or D sites had been involved in implementing any of these processes.

In general, survey participants considered the Stroke Services Model to have merit for addressing regional issues around the lack of specialisation and adherence to evidence-based practice. Peer support links and educational opportunities between sites were valued, as was having a geographically localised unit for enhancing specialisation. Factors for enhancing the delivery of optimal stroke services included a multidisciplinary team, clinician leaders, dedicated positions, standardised approaches to care, adequate funding to support initiatives, administrative support,

commitment to in-service training and professional development and good communication among health care providers. These factors are consistent with other evaluations exploring health service systems and/or stroke services.^{6,16,17} In this demonstration period the identified critical success factors for enhancing a stroke service were largely levered through external resources, although established sites had previously undertaken some of the activities within existing hospital resources.

Many of the barriers were related to health system-wide problems such as high attrition rates and limited health professionals in rural/regional areas. Some of these broader issues are being addressed through the federal government’s rural health initiatives including the “More Doctors, Better Services Regional Strategy”.¹⁸ Other barriers included the absence of inter-sectoral policies and achievement of a culture shift among health professionals to be aware of and implement evidence-based stroke care. The model attempts to overcome some of these barriers through innovation and commitment to education and training, facilitated by more specialised sites. Evidence of this occurring and being valued was highlighted in this evaluation. Minor modifications to the model should include the additional categories of number of stroke episodes per year; presence of a clinician leader; presence of a clinical nurse specialist; and use of guidelines and/or care plans. This would assist in improving the classification of hospitals and in stroke services infrastructure planning. Obtaining quantitative data in terms of adherence to evidence-based care at these sites would provide clinical evidence of the effectiveness of these initiatives.

Conclusion

This paper has outlined the first attempt to develop and assess in relevant settings an integrated model for the hospital management of acute stroke. The partial qualitative evaluation of the Stroke Services Model provides evidence that it appears to be plausible from the perspective of health professionals. The model provides a clear

format for increasing universal access to evidence-based stroke care. However, further testing to assess its generalisability to other jurisdictions and potential to improve process and outcomes of care through quantitative assessment are needed.

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Competing interests

The authors declare that they have no competing interests.

References

- Mathers CD, Vos ET, Stevenson CE, Begg SJ. The burden of disease and injury in Australia. *Bull World Health Organ* 2001; 79: 1076-84.
- Thrift AG, Dewey HM, Macdonell RAL, et al. Stroke incidence on the east coast of Australia. The North East Melbourne stroke incidence study (NEMESIS). *Stroke* 2000; 31: 2087-92.
- Wardlaw JM, del Zoppo G, Yamaguchi T. Thrombolysis for acute ischaemic stroke. *Cochrane Database Syst Rev* 2000(2): CD000213.
- Chen ZM, Sandercock P, Pan HC, et al. Indications for early aspirin use in acute ischemic stroke: a combined analysis of 40000 randomized patients from the Chinese acute stroke trial and the international stroke trial. On behalf of the CAST and IST collaborative groups. *Stroke* 2000; 31: 1240-9.
- Stroke Unit Trialists' Collaboration. Collaborative systematic review of the randomised trials of organised inpatient (stroke unit) care after stroke. Stroke Unit Trialists' Collaboration. *BMJ* 1997; 314: 1151-9.
- Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev* 2002(1): CD000197.
- Kalra L, Evans A, Perez I, et al. Alternative strategies for stroke care: a prospective randomised controlled trial. *Lancet* 2000; 356: 894-9.
- Smarreli F, Cadilhac D, Pearce D. Access to organised stroke care in Australia: results of a national survey of acute stroke treating hospitals. *Cerebrovasc Dis* 2001; 11(suppl 4): 93.
- Read S, Levy J. Zonal Stroke Care Network Project: National Health Development Fund – general practitioners integration project. Health Outcomes Plan – integrated disease management initiative. Brisbane: Queensland Health, 2003.
- NSW Health Department. Report of the Greater Metropolitan Services implementation group. Sydney: NSW Government, 2001.
- Donnan GA, Davis SM, Levi CR. Strategies to improve outcomes after acute stroke. *Med J Aust* 2003; 178: 309-10.
- Patton MQ. Qualitative evaluation and research methods (2nd Ed). Newbury Park: Sage Publications, 1990.
- Fitzpatrick R, Boulton M. Qualitative methods for assessing health care. *Qual Health Care* 1994; 3: 107-13.
- Edwards N. Clinical networks. Advantages include flexibility, strength, speed, and focus on clinical issues. *BMJ* 2002; 324: 63.
- Schwamm LH, Pancioli A, Acker JE 3rd, et al. Recommendations for the establishment of stroke systems of care: recommendations from the American Stroke Association's Task Force on the Development of Stroke Systems. *Circulation* 2005; 111: 1078-91.
- Redfern S, Christian S. Achieving change in health care practice. *J Eval Clin Pract* 2003; 9: 225-38.
- Baker CD, Lorimer AR. Cardiology: the development of a managed clinical network. *BMJ* 2000; 321: 1152-53.
- Australian Government. More doctors, better services: Regional Health Strategy. Canberra: Australian Government, 2000.

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