



48 hours: Improving stroke management in the critical window

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Purpose

Rapid assessment and management of stroke is fundamental to reducing mortality and disability. This paper is intended to support health services and clinicians to identify **models of care and processes** for expedient delivery of care recommended in the NSF, NHMRC approved Clinical Guidelines for Stroke. It focuses on the first 24-48 hours of stroke care from the moment health services are notified (dialing 000) through to hospital based care and multi-disciplinary assessment.

Not all the models of care described in this paper have been evaluated using randomised controlled trials; however, they are examples of good clinical care, or system organisation for which some level of evidence of effectiveness has demonstrated improved patient outcomes or a reduction in barriers to rapid assessment and management of stroke. They are developed within the context that integration across services and phases of care will minimise delays and enable efficient streaming of stroke patients to evidence based care.

Introduction

For people who have a stroke, care provided in the first 24-48 hours is critical in shaping their long-term recovery and prognosis. The success of thrombolysis has demonstrated this, but also emphasised diminishing returns as time progresses. There is robust evidence demonstrating significant reductions in death and disability with early interventions in acute stroke care, including thrombolysis,¹ early aspirin² in acute ischaemic stroke and stroke unit care.³

The Clinical Guidelines for Stroke Management (2010)⁴ which review the best available evidence, outline the care that should be given as early as possible after stroke onset. Despite this, uptake of these many time critical interventions remains limited. The 2013 NSF Acute Audit of Australian stroke patients revealed that among ischaemic stroke patients only 64% received aspirin within 48 hours and only 7% received thrombolysis. Only 58% of all stroke patients are being treated in a stroke unit.⁵

The clear priority for improving stroke care outcomes is closing the evidence-practice gaps by improving timely access to early interventions of demonstrated effectiveness. Facilitating this requires health services and clinicians to identify and overcome barriers to the patient moving through the health care system smoothly and quickly. Mechanisms to enable this include increasing awareness of the urgency of stroke through public education; pre-hospital (community, ambulance, emergency services and primary care) assessment, triage and transport protocols to facilitate rapid transfer to stroke ready hospitals, systems to ensure rapid assessment and triage in the Emergency Department or immediate stroke assessment, followed by rapid admission to a stroke unit including rapid instigation of multidisciplinary assessment and management.

Patient journey – success factors

The paper describes key factors contributing to success at each stage of the patient journey from the first call to 000. It is based on the following conventions:

Rapid assessment	Stroke is an emergency and rapid assessment and treatment improves outcomes.
Early identification	Early identification of acute stroke will improve access to time dependent interventions.
Pre-hospital services facilitate access	Organised pre-hospital services improve outcomes by increasing access and decreasing delays to time dependent acute stroke treatments.
Emergency department systems	Systems that prioritise assessment and management of acute stroke in the emergency department will minimise treatment delays and maximise proportion of eligible patients receiving thrombolysis.
Stroke unit access	Rapid flow of acute stroke patients from emergency department to stroke unit improves outcomes for stroke patients.
Multi-disciplinary assessment and treatment	Co-ordinated and rapid onset of specific treatments by a multi-disciplinary team within stroke units will improve outcomes.
Whole of system quality improvement	Quality improvement activities will improve performance within all aspects of care / system performance.

Models of care - Pre-Hospital

Improving access to rapid assessment and management of stroke at each stage of the patient journey

Early identification of acute stroke will improve access to time dependent interventions

The Australian Stroke Coalition has endorsed the FAST message as the key message to improve recognition of stroke and calls to 000. This paper will not explore models by which this message may be effectively disseminated, instead it commences at the point at which health services are first contacted.

Rapid transfer to hospital with stroke unit

Key factors in models of care that contribute to timely transfers of stroke patients include:

- a. Recognition of stroke and appropriate screening at point of first contact with the health care system (ambulance call centre, GP, help lines) is required to prompt appropriately urgent response by pre-hospital services.
- b. Validated screening tools in the pre-hospital setting assist in identification and appropriate triage and destination
- c. Systems to transport patients with possible stroke and where time from onset is within thrombolysis eligibility periods to hospitals that provide 24 hour hyper-acute treatments increase thrombolysis rates
- d. Pre-arrival notification of acute stroke team by pre-hospital services improves access to thrombolysis and decreases time to treatment
- e. Transport of all acute stroke patients to hospitals with an acute stroke unit will maximise access to Stroke Unit Care.

Detail of the models to support rapid transfer to hospital

An important part of pre-hospital care is the use of a validated stroke assessment tool and first responders who are trained to recognize and rapidly respond to stroke. Paramedics, who are able to rapidly determine the diagnosis, assist in early pre-hospital care and in other decisions such as pre-notification or routing to a stroke unit, or thrombolysis capable hospital.

A number of different pre-hospital assessment screens, including FAST,⁶ Melbourne Ambulance Stroke Scale,⁷ and Hunter GAS-T⁸ have been investigated or are being used in Australia. All have demonstrated reasonable sensitivity and acceptable specificity. A Belgian study compared four different scales and reported higher sensitivities (95%) but lower specificity (33%) for Face Arm Speech Test (FAST) and Cincinnati Pre Hospital Stroke Scale compared to MASS (Melbourne Ambulance Stroke Scale) (sensitivity 74% specificity 67%) and Los Angeles Pre Hospital Stroke Screen (sensitivity 74% specificity 83%).⁹ In addition, use of the FAST tool via an Emergency Medicine Communications Centre and also an Emergency Medical Services (EMS) team in Sweden, demonstrated that approximately half of patients identified as potential stroke were subsequently diagnosed as stroke or TIA.¹⁰ Use of the GAS-T in the Hunter region of Australia resulted in delivery of tPA to 24 / 51 patients meeting Pre-hospital Acute Stroke Triage (PAST) criteria for urgent transport to a thrombolysis centre for consideration of treatment.⁸

Training programs for paramedics improves accuracy of diagnosis and speed of transfer to hospital. Such educational programs often include training on the use of screening tests such as the FAST, MASS which have shown that paramedic training significantly improved sensitivity of paramedic identification of stroke (from 78% to 94%) compared to untrained paramedics without use of the tool (78% to 80%).⁷

Training and education models that integrate across services and sectors by training paramedics and emergency department staff in use of a validated stroke screening tool, along with community awareness campaigns (such as the FAST campaign) are effective in reducing times to assessment for stroke.^{11, 12} Training should cover clinical assessment of patients with suspected stroke using a validated stroke screening tool, the need for rapid transport to hospital, followed by rapid triage of patients in the ED to facilitate rapid access to imaging and

acute therapies.¹³ This approach has been found to significantly reduce times to presentation to hospital. In some instances it has been coupled with helicopter transfers.^{14, 15}

Once the diagnosis of probable stroke is confirmed, time from onset determines both the urgency of transfer and destination. For those presenting within possible thrombolysis timeframes, urgent transfer to the nearest centre providing thrombolysis is essential. An increase in ambulance dispatch priority category (from 'within 30 minutes' to 'immediate') for patients with suspected acute stroke (identified using the FAST tool) was associated with improvement in thrombolysis rates from 10 to 24% without adverse effect on other priority 1 emergency cases.¹⁰

Pre-hospital notification of the stroke team by the EMS has been shown to further improve times and numbers receiving treatment.¹⁶ Early notification allows rapid assessment, minimizes delays to neurological imaging and can allow additional information and onset history to be obtained from relatives / informants prior to patient arrival. This can be facilitated by having agreed criteria for pre-notification such as time of stroke onset, presence of a persistent, observable deficit and no pre-existing severe disability.¹⁷ Pre-notification of impending arrival to the emergency department was associated with higher-priority triage in the emergency department, and subsequent shorter times for door to medical review (15 min vs. 31 min, $p < 0.001$) and door to computed tomography (CT) scan.¹⁸

Coordinated regional systems of acute stroke care can improve thrombolysis rates and outcomes using strategies such as EMS redirection to stroke centres,⁸ particularly those admitting large numbers of stroke patients¹⁹ and telemedicine services (especially for regions with greater geographical distribution).²⁰ Such a system has been adopted in NSW where thrombolysis eligible stroke patients are transferred to the nearest Acute Stroke Thrombolysis Centre.²¹ Given that hospitals that administer tPA to large volumes of patients are more likely to have efficient thrombolysis processes and better outcomes¹⁹ associated with this treatment than smaller centres the notion of redirection to thrombolysis centres of preferable.

Models of care - Hospital

Rapid assessment and management of acute stroke in emergency department

Key factors in models of care that contribute to timely assessment and management of stroke patients in the ED include:^{4, 22}

- a. Applying Australasian Triage Scale (ATS)²³ Category 2,²⁴⁻²⁶ (to be seen within 10 minutes) to acute stroke patients
- b. Rapid accurate assessment using a validated stroke screen tool,^{4, 27}
- c. Agreed policy with radiology to facilitate urgent access to imaging (including pre-arrival notification) to treatment delays
- d. Systems to urgently notify thrombolysis services such as "code stroke" which decrease "door to needle time"
- e. Targets for door to needle time integrated with monitoring of performance

Detail of the models to support assessment and management in the ED

Management of stroke in ED is highly variable. While triage times of 10 minutes or less (ATS Category 1 or 2) have been recommended for stroke patients,²⁴⁻²⁶ a Victorian study showed <20% of stroke patients were triaged to ATS Category 2, the majority (51%) were triaged to Category 3 (to be seen in < 30 minutes) while 21% were triaged Category 4 (seen in < 1 hour).²⁸ ED length of stay also is variable. A study of 32 NSW hospitals demonstrated a median transfer time to the stroke unit of 8 hours²⁹ with data from Victoria demonstrating an average ED length of stay of 11 hours for stroke patients with 20% of patients remain in ED in excess of 20 hours before transfer to a stroke unit.²⁸ Furthermore, frequency of physiological assessment deteriorates the longer the patient is in the ED.³⁰ Thus, while prompt triage and transfer to stroke units is recommended, delays occur.

Pre-notification of incoming stroke patients not only enable rapid dispatch of stroke patients needing tPA to a thrombolysis centre, but can also facilitate rapid assessments and processes of care in the ED.³¹ This demonstrates the importance of considering strategies that target the entire pathway of care from first call to transfer to a stroke unit in acting to ensure time dependent treatments are available.

The use of the 'Code Stroke' protocol and its modifications³² has been found to reduce times in ED and facilitate rapid referrals to the stroke team.³³ The Code Stroke protocol uses a centralized pager system to alert members of the acute stroke team when a person with suspected stroke presents to ED.³³ Modifications to the Code Stroke Protocol include agreed policy with radiology to facilitate urgent access to imaging (including pre-notification of the ED and stroke team) to decrease treatment delays. This ensures the entire acute stroke team is ready to meet the stroke patient in ED and rapidly imaging takes place.^{8, 17, 34}

Other principles of good management in ED that may be supported by the use of protocols include avoidance of oral intake (including medications) before screening or assessment for dysphagia, identification and early commencement of treatment of fever and hyperglycaemia, and early treatment of hypertension post thrombolysis, and in acute haemorrhagic stroke.³⁵

Case study – Royal Melbourne Hospital³²

In 2012, the Royal Melbourne Hospital implemented an adapted Helsinki Stroke Thrombolysis model, which built on RHM's existing 'code-stroke' protocol. The new approach demonstrated a significant reduction in door-to-needle time; from a pre-trial median rate of 61 minutes to 46 minutes. This reduction was achieved using many of the mechanisms described in this paper and in the absence of a number of systemic enablers available in Finland including a dedicated neurologic emergency department and electronic patient records.

Features of the adapted Helsinki protocol at Royal Melbourne Hospital include:

- Ambulance pre-notification including, where possible, patient data collection to support faster registration and clinical background checking
- Medical history established through contact with GP before patient arrives at hospital
- Patient registration achieved before patient arrives at hospital

- Lab tests pre-ordered - POC / INR
- IV access available on arrival or inserted on CT table
- Patient transferred to CT on ambulance stretcher
- Imaging interpreted by the stroke team
- tPA and infusion kit brought to CT room beforehand. Bolus and infusion initiated on CT table.

The efficiency of the adapted Royal Melbourne Hospital model was achieved through cooperation across the neurology, emergency and Ambulance Victoria. An informal working group of representatives from these groups reached consensus on adaptations to the new model.

Rapid admission to the stroke unit

Key factors in models of care that facilitate rapid admission to the stroke unit include:

- a. Protocols to ensure people are admitted directly to the stroke unit³⁶
- b. Pre-notification of incoming stroke to the stroke team³⁷

Detail of the models to support rapid admission to the stroke unit

An important factor in ensuring stroke patients are rapidly admitted to a stroke unit is the pre-hospital routing processes described above. Most (89%) of the 27,269 stroke patients in Australia admitted to hospitals participating in the 2013 National Stroke Audit were admitted to one of 83 hospitals admitting over stroke 100 patients per year, hospitals in which stroke units are recommended and generally available.⁵ However, the remaining 11% of patients are admitted to smaller, often non-stroke unit hospitals. Protocols to ensure patients are either bypass these hospitals, or that these hospitals have protocols for assessment, stabilisation and transfer to a larger centre, will ensure more people are admitted rapidly to the stroke unit. The latter will be especially important in isolation and rural areas where telehealth services may bridge geographical gaps. Having processes that ensure patients are immediately transported to a stroke unit hospital (avoiding smaller, non-equipped centres) with direct admission improves outcomes and access to time dependent treatments.³⁸

Even once a patient is transported to a hospital with a stroke unit, timeliness and access are critical factors. There is general evidence that excess waiting times in emergency departments is associated with poorer outcomes and higher mortality in the hospital and some evidence to support improved outcomes for stroke if the patients is admitted rapidly to the stroke unit.^{36, 39} The effect of admission to a holding ward prior to SU care is unknown but current best practice is considered to be direct admission to a SU.

A survey completed in 2010 by the Australian Stroke Coalition (ASC) of 56 hospitals (50 with a stroke unit) throughout Australia⁴⁰ identified bed availability and bed management as the **greatest barriers** to patients accessing the stroke unit. Poor stroke unit staffing and ED culture was identified as a barrier by a third of respondents.

Bed availability and bed management barriers are identifiable through the National Stroke Audit which demonstrated that whilst 78 of the 83 large hospitals had a stroke unit, only 65% of stroke patients in stroke unit hospitals, received stroke unit care.⁵ About one third of the stroke unit beds were not

managing stroke patients suggesting there were problems with bed access and management.⁵

The ASC survey also identified the **greatest facilitators** for patients accessing a stroke unit were proactive staff, education, written stroke unit admission policies and having a registrar with responsibility for stroke.⁴⁰ Stroke unit access may be enhanced by implementing systems to ensure these facilitators to stroke unit access are in place.

Rapid assessment and management of common impairments after stroke by early referral to the multidisciplinary team

Key factors in models of care that facilitate rapid assessment and management of common impairments after stroke include:

- a. Protocols to ensure people are admitted directly to the stroke unit
- b. Pre-notification of incoming stroke to the stroke team
- c. Blanket referral to the multidisciplinary team, i.e. speech pathology, physiotherapy
- d. Protocols and training to support early screening for common impairments prior to full assessment and management if required.

Detail of the models to support rapid assessment and management of common impairments after stroke

A recently completed study – the Quality in Acute Stroke Care (QASC) trial³⁵ demonstrated that the implementation of evidence-based clinical treatment protocols addressing management of fever, sugar and swallow in conjunction with multidisciplinary team building and a standardized interactive staff education program can improve 90-day patient outcomes following stroke and also impact positively on clinician behavior.

The use of formal dysphagia screens has also been associated with a better screening of dysphagia before food and drink, a significantly decreased risk of pneumonia.⁴¹

Quality improvement

Quality improvement activities will improve performance within all aspects of care / system performance

A number of quality improvement activities have been shown to improve the uptake of evidence based care, and to ensure processes and protocols like those described above are used most effectively.⁴² These include :

1. Audit and feedback using validated clinical indicator data
2. Identification of barriers and enablers linked to processes of care
3. Education
4. Reminders
5. Use of local opinion leaders
6. Inter-professional collaboration

Resources to support these QI activities, and protocols to assist in delivery of evidence based care (such as those used in the QASC trial) are available at <http://www.estroke.com.au/>

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