Emergency Department **Stroke** and **Transient Ischaemic Attack** Care Bundle

Information and implementation package

Improving the management of stroke and TIA
in the emergency department

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Part 1: Introduction

This resource has been developed by the National Institute of Clinical Studies (NICS) in association with the NICS Stroke Clinical Reference Group (see Appendix A for reference group membership), for use in Australian emergency departments (EDs) to support clinicians to improve the care of acute stroke patients, in accordance with the National Stroke Foundation (NSF) *Clinical guidelines for acute stroke management*.[1]

This introductory section outlines what a care bundle is, how it should be used and how it can help emergency clinicians in delivering best practice acute stroke and transient ischaemic attack (TIA) care.

This document also contains:

• a summary of each component of the bundle, including the rationale for its inclusion, audit measures, and an evidence summary taken from selected guidelines (see Appendix B for included guidelines)

• an implementation guide (Part 3: Implementation), including an audit tool (Appendix C) and a project plan template (Appendix D).

Why focus on stroke?

Acute stroke is a medical emergency. Appropriate initial management can reduce disability and mortality resulting from stroke.[2]

Stroke is Australia's second single greatest killer after coronary heart disease and is a leading cause of disability.[2] There are approximately 60,000 new and recurrent strokes in Australia every year and this number is expected to increase as the population ages.[4] Approximately a third of people with stroke will die within the first 12 months.[1]

In 2005, the estimated cost of stroke in Australia was $2.14 billion per annum.[4] Effective, evidence-based stroke care aims to promote maximum recovery and prevent costly complications and subsequent strokes.[1]

Management of acute stroke was identified by the NICS Emergency Care Community of Practice (EC CoP) as an area of clinical concern. For more information about NICS EC CoP, go to **www.nhmrc.gov.au/nics/programs/emergency**.

What is a care bundle?

A care bundle is a group of evidence-based practice points that, when combined, define best care and significantly improve patient outcomes.

The NICS Stroke Bundle is derived from the NHMRC-endorsed National Stroke Foundation (NSF) *Clinical guidelines for acute stroke management.*[1]

Care bundles are designed to influence practice by providing an easily memorised 'bundle' of evidence-based practice points that should trigger a number of follow-on tasks, and also by providing a simple audit tool to measure the actual delivery of the practice points.[5]

There are several elements that are fundamental to a care bundle:

• The components must be undertaken in the same space and time interval (in this case, presentation to the ED and care provided by ED staff prior to transfer to a ward or discharge).

• The completion of each component must be auditable with a simple 'yes' or 'no' response.

• The completion of the whole bundle must be auditable with a simple 'yes' or 'no' response.

Developers of the care bundle concept, the Institute for Healthcare Improvement[6], suggest that to be effective each component must meet the following criteria:

• each component must be **based on sound evidence**

• the delivery of each component must be **in need of improvement**

• the delivery of each component must be **achievable** in terms of resources

• no component should be a **major source of controversy**

• the delivery of each component must be **measurable**.

It should be noted that the components in a care bundle are not the only elements of care that are necessary to deliver evidence-based care, but they are a subset selected using the above criteria. Other interventions will be necessary within the continuum of care, based on clinical presentation.

A care bundle encourages clinicians to examine the way they deliver interventions. It also provides a method to improve the efficiency and effectiveness of care by standardising clinical care.

Bundles aim to ensure that all patients with the same clinical condition are managed consistently.

What makes a care bundle different?

A care bundle is an all or nothing intervention. It requires compliance with, and measurement of, a set of items, not just individual items.

Unlike a checklist, all components in a care bundle need to be completed in the same space and time interval (in this case the ED stay) for compliance with the bundle. If one element of a bundle is not completed, the bundle has not been completed.[6] This approach allows for those bundle elements that have lower compliance levels to be specifically targeted for improvement.[5]

Unlike a protocol or procedure, only a subset of care interventions are included in a care bundle. This subset is chosen, using the criteria detailed above, with the aim of providing the greatest improvement in patient care outcomes.[6]

A care bundle is deliberately kept small and straightforward to maximise implementation and sustainability.[7] It is not as comprehensive as a guideline and assumes the user either has a certain level of clinical knowledge, or will refer back to the evidence or guideline as required. Each component is therefore a very simple, initial intervention which should trigger a number of follow-on tasks.

A key strength of the care bundle concept is that it provides a simple mechanism for timely measurement of compliance and, with it, the ability to influence clinical practice accordingly. While similar to a standard 'audit cycle', the difference is the speed with which feedback can be provided. Quick compliance audits are possible using a simple yes/no checklist (see Appendix C – Audit Tool Template).

By measuring actual performance and comparing it to expected performance, clinical and non-clinical staff can make informed local organisational changes to improve care. When auditing, data are generally analysed retrospectively and/or sporadically. Conversely, care bundle data are designed to be audited prospectively and fed back to staff in as close to 'real time' as possible.

Development of the stroke care bundle

Management of acute stroke was identified by the NICS Emergency Care Community of Practice as an area of clinical concern. In response to this, the NICS Stroke Clinical Reference Group was formed in early 2008 to develop an acute stroke care resource for the ED.

Given the ED setting and the varied requirements of acute stroke management, the care bundle approach was selected by the reference group as the most appropriate model to prioritise core guideline recommendations for implementation. It is anticipated that this model will have a positive impact on clinical outcomes for stroke patients across all EDs, regardless of size or available resources. An evaluation phase is planned in order to test the effectiveness of this approach.

The care bundle was developed by the reference group using a decision matrix designed for this purpose. All recommendations from the NSF guidelines[1] relevant to the ED were considered as part of the decision matrix. Recommendations were included according to a majority ruling following discussion of each element. Justification for each decision was noted. Bundle components based on each included recommendation, or group of recommendations, were developed. Following finalisation of the bundle components, this supporting document was drafted.

The bundle itself and the supporting document have been reviewed externally in a two stage process. Emergency clinicians and stroke specialists from each state and territory, as well as international experts, were invited to review the bundle. See Appendix E for external reviewers.

All other resources associated with this project have been developed from this document.

Recommendations, recommendation gradings and levels of evidence

Recommendations, recommendation gradings and evidence levels listed in this document under each component have been quoted directly from the NSF *Clinical guidelines for acute stroke management.*[1] The grading and level of evidence listed for each recommendation were assigned by the NSF, according to the NHMRC interim levels of evidence pilot.[8] See Appendix F for the levels of evidence and grading system tables.

Scope and focus of the stroke care bundle

This bundle addresses the ED assessment and management of acute ischaemic stroke and TIA in adults only; it does not specifically include care of children.

This bundle has been developed for use in the ED by ED staff. It has not been developed for pre-hospital use or for use by other specialities that may attend the ED, such as acute stroke unit clinicians. See Figure 1 for the domain in which the care bundle can be applied.

Figure 1: Applicable domain of the care bundle

The NICS care bundle has been designed for use in the emergency department

| Prehospital care | Presentation | Assessment | Management | Ongoing management |

| | Emergency Department care: Context for care bundle | |
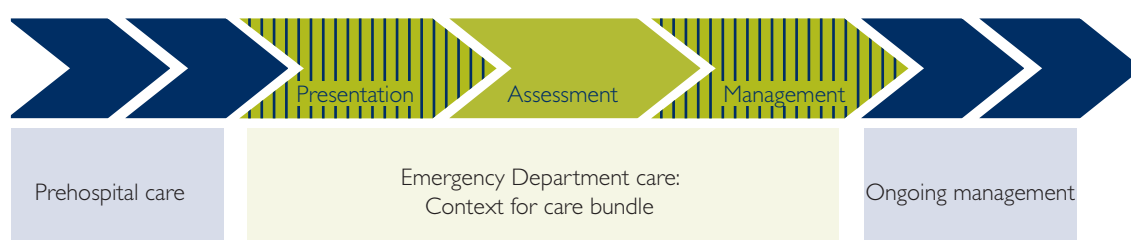
The components of this bundle are derived from the NSF C*linical guidelines for acute stroke management.*[1] Evidence summaries developed for each bundle component have been based on an international shortlist of stroke guidelines. These guidelines, along with the criteria for their inclusion, are listed in Appendix B (see Table 1 for abbreviations of guideline titles or developers used in the evidence summaries).

Unless otherwise described, due to strong similarities between minor ischaemic stroke and TIA, principles and management of TIA should follow that outlined for ischaemic stroke.[1]

The following two sections, Stroke units and Thrombolysis, address two aspects of stroke care that are not included in the bundle as discrete components.

Stroke units

Stroke unit care is the highest priority for clinicians and administrators to consider in acute stroke management.[1] Stroke unit care is defined as dedicated, co-ordinated care for stroke patients in hospital under a multidisciplinary team who specialise in stroke management.[3]

Stroke unit care significantly reduces death and disability after stroke compared with conventional care in general wards for all people with stroke.[1]

Ideally, all patients suspected of having a stroke should be admitted as quickly as possible to an acute stroke unit.[1,9]

This NSF recommendation has not been included in the bundle for the following reasons:

- Currently only about a third of hospitals across Australia offer stroke unit care.[2] Inclusion of stroke unit care or referral to a stroke unit as a component of the bundle would not be in line with the care bundle approach, which is to develop a resource that can be implemented in all situations.

- The 'Rapid initial stroke screen' bundle component supports early referral to a stroke unit where available. A separate recommendation for early referral was not seen as necessary.

- The bundle has been developed purely as a guide for clinical care during the ED stay. Recommending a stroke unit model of care goes beyond ED clinical care.

The developers of this resource strongly advocate for the stroke unit model of care and feel that, although this recommendation was not appropriate for inclusion in this resource, all hospitals treating stroke patients should consider a stroke unit model of care in line with available resources, as detailed in the NSF Acute stroke services framework 2008.[3]

The developers feel that this resource can be used in those hospitals with acute stroke units for the period that the patient is in the ED. Attendance in the ED by stroke unit staff does not preclude completion of any bundle components.

Thrombolysis

Thrombolysis is an important aspect of acute stroke management. Systematic reviews demonstrate a net benefit for patients treated within three hours of stroke with intravenous recombinant tissue plasminogen activator (rt-PA, the only thrombolytic agent approved for use in Australia) in reducing the odds of death or dependency.[1]

Thrombolysis is a time dependent intervention requiring rapid and efficient processes both in pre-hospital and hyperacute hospital settings.

Thrombolysis has not been included in the care bundle because it is currently not recommended for routine use in hospitals without dedicated and organised stroke care or stroke units.[1,9,10] Inclusion of thrombolysis as a component of the bundle would not be in line with the care bundle approach, which is to develop a resource that can be implemented in all situations.

Early referral to the best available stroke expertise (i.e. a stroke unit, where available) should follow on from identification of a possible stroke via the first bundle component, 'Rapid initial stroke screen'. This should result in eligible patients being thrombolysed where the treatment is available.

Thrombolysis for acute stroke is an evidence-based recommendation outlined in the NSF *Clinical guidelines for acute stroke management*[1] and, like stroke unit care, should therefore be considered by all hospitals. Exclusion from the care bundle does not imply that the intervention is not endorsed or should not be administered, just that it is currently not appropriate for inclusion in the bundle.

Table 1:   Abbreviations for included **guidelines** (See Appendix B for full reference list)

Abbreviation	Definition
AHA/ASA	American Heart Association/American Stroke Association Stroke Council: Guidelines for the early management of adults with ischemic stroke[11]
ESO	European Stroke Organisation: Guidelines for the management of ischemic stroke and transient ischemic attack 2008[12]
RNAO	Registered Nurses Association of Ontario/Heart and Stroke Foundation of Ontario: Nursing best practice guideline: Stroke assessment across the continuum of care[13]
ICSI	Institute of Clinical Systems Improvement: Diagnosis and initial treatment of ischemic stroke (7th ed.)[14]
CSN	Canadian Stroke Network/Heart and Stroke Foundation of Canada: Canadian best practice recommendations for stroke care (updated 2008)[10]
NICE	National Institute for Health and Clinical Excellence/National Collaborating Centre for Chronic Conditions: Stroke: national clinical guideline for diagnosis and initial management of acute stroke and transient ischemic attack[9]
NSF	National Stroke Foundation: Clinical guidelines for acute stroke management[1]
SIGN	Scottish Intercollegiate Guidelines Network: Management of patients with stroke or TIA: assessment, investigation, immediate management and secondary prevention. A national clinical guideline[15]
SIGN-D	Scottish Intercollegiate Guidelines Network: Management of patients with stroke: Identification and management of dysphagia. A national clinical guideline[16]
AHRQ	Agency for Healthcare Research and Quality: Acute stroke: Evaluation and treatment[17]

Part 2: Care Bundle

All people presenting to emergency departments with stroke-like symptoms should receive:

✔ Rapid initial stroke screen

✔ ABCD^2 assessment when TIA suspected

   A   Age: ≥ 60 years (1 point)

   B   Blood pressure: ≥ 140/90mmHg (1 point)

   C   Clinical features: unilateral weakness (2 points),
       speech impairment without weakness (1 point)

   D   Duration: > 60 mins (2 points), 10-59 mins (1 point)

   D   Diabetes (1 point)

   Tool interpretation[1]

   >4 = HIGH risk;   ≤4 = LOW risk   Maximum score = 7

✔ Urgent* CT or MRI

✔ Nil by mouth until bedside swallow screen

   (within 24 hours) for stroke

✔ Aspirin as soon as possible**, if haemorrhage excluded

   150-300mg one-time loading unless contraindicated

✔ Physiological monitoring and management:

   • **Neurological status**
     Regular monitoring to establish baseline and identify change

   • **Blood glucose**
     Cautious treatment of markedly elevated blood glucose levels; early, intensive
     maintenance of euglycaemia is not recommended. Avoid hypoglycaemia

   • **Blood pressure**
     Cautious lowering by no more than 10-20% if extremely high ≥ 220/120; monitor
     for neurological deterioration. Avoid hypotension

   • **Hydration status**
     Maintain euvolemia

   * 'Urgent' is considered as soon as possible, but certainly less than 24 hrs[1]
   ** 'As soon as possible' is considered within 48 hrs[1]

Please note: This care bundle represents key components of stroke and TIA care that are essential to evidence-based stroke care. This is not a complete list of all care components that will be required. Other interventions will be necessary within the continuum of care.

Rapid initial stroke screen

NSF[1] recommendation: ED staff should use a validated stroke screen tool to assist in rapid accurate assessment for all people with suspected stroke (Grade C; Level II)

Rationale

The diagnostic accuracy of ED staff is increased by the use of a validated stroke recognition tool and training in that tool.[9,18] Rapid and accurate diagnosis leads to earlier and more appropriate referrals to available stroke expertise[18], i.e. a stroke unit or a physician experienced in stroke care. This in turn should lead to timely treatment and better outcomes.[19]

Results from the 2009 NSF *National stroke audit acute services organisational survey report*[2] also found that half of hospitals surveyed did not have emergency department triage protocols for stroke.

This audit also found that even in hospitals surveyed with stroke units, a third of stroke patients were receiving care on other wards.

Resource Implications

- Available tools should be assessed and the preferred tool selected for use in the initial assessment in ED. The recommended tool is the Recognition of Stroke in the Emergency Room scale (ROSIER).[18] See Appendix G for a copy of the ROSIER scale.
- The selected tool should be implemented into standard practice as part of the initial assessment in ED of all suspected stroke patients.
- ED staff responsible for initial assessment should be trained in the use of the selected tool as evidence indicates that training improves the accuracy of diagnosis.[9,14,20]
- Any locally used tool should prompt rapid referral to available stroke expertise (i.e. acute stroke response team).

Audit Measure

☑ Indication that agreed stroke screen tool was used at agreed time (i.e. triage or initial assessment).

Guideline Summary

Along with the NSF[1], the AHA/ASA[11], NICE[9] and SIGN[15] also recommend the use of a validated stroke screen tool for rapid initial assessment of suspected stroke and TIA patients. In addition, the ESO[12], ICSI[14] and RNAO[13] guidelines recommend that these patients be rapidly assessed, but do not specifically recommend the use of a validated stroke screen tool.

Assessment and initial treatment for stroke should be performed as a priority in the ED. The clinical assessment is the cornerstone of this process.[11]

An effective and efficient medical assessment is essential to the early identification of stroke as well as the exclusion of stroke mimics.[1,11] A validated stroke screen tool has been shown to increase diagnostic accuracy and immediate diagnosis improves speed of access to treatment.[9,15] Such a tool should be used in conjunction with the standard clinical examination for all stroke patients.

There are a number of validated stroke screening tools currently in use in Australia and internationally, including the:

- Cincinnati Prehospital Stroke Scale (CPSS)[21]

- Face Arm Speech Test (FAST)[22]

- Los Angeles Prehospital Stroke Screen (LAPSS)[23]

- Melbourne Ambulance Stroke Screen (MASS)[24]

- National Institutes of Health Stroke Scale (NIHSS)[25]

- Recognition of Stroke in the Emergency Room (ROSIER)[18]

NICE[9] suggests that whilst a simple assessment, such as FAST, is necessary for pre-hospital assessment, a more detailed assessment tool, such as ROSIER, is required in the ED to exclude stroke mimics.

The ROSIER scale (Appendix G) is the only tool that has been validated specifically for use in the ED following triage.[18] When used by medical or ED staff, it has been shown to identify stroke and stroke mimics more accurately than CPSS, FAST or LAPSS.[9,15] NSF[1], NICE[9] and SIGN[15] recommend using the ROSIER scale for initial assessment in the ED, as it is the only scale that has been adequately studied in the ED.

It should be noted that CPSS, FAST, LAPSS and MASS have been developed and validated only in the pre-hospital setting, i.e. for paramedics. However these tools may be useful in triage if the patient did not present via ambulance. NIHSS was originally designed to assess differences in interventions in clinical trials, although it has increasingly been used in patient care as an initial assessment tool.[26]

A small number of studies have found that emergency medical staff have a high diagnostic accuracy (approximately 90% sensitivity). However 20-30% of patients are incorrectly diagnosed with stroke or TIA, indicating a high sensitivity, but lower specificity.[1]

Studies have shown that education and training of ED staff results in improvements in the accuracy of diagnosis[9] and processes of care.[1] ED clinical staff should be educated in the importance of stroke symptom recognition[14], stroke mimics[13] and the appropriate triage measures to take if stroke or TIA is suspected.[14]

ABCD[2] assessment when TIA suspected

NSF[1] recommendation: All patients with suspected TIA should have a full assessment that includes assessment of stroke risk using the ABCD[2] tool at initial point of health care contact (Grade B; Level II)

Rationale

TIA and minor stroke patients are at high risk of subsequent stroke[15], with up to 10% suffering a stroke within the following 48 hours (2.5-5% at 2 days; 5-10% at 30 days; 10-20% at 90 days).[12] Efficiency and accuracy of TIA diagnosis and management in the ED is important in reducing the incidence of subsequent stroke.[10,27] The ABCD[2] assessment tool can provide stratification information to guide management decisions.

The 2009 NSF *National stroke audit acute services organisational survey report*[2] found that less than half of hospitals surveyed had a defined pathway for assessing TIA patients and only 39% were using a risk stratification tool.

Resource Implications

- ABCD[2] should be implemented into standard practice in the selected area of ED (e.g. triage or treatment area).
- ED staff responsible for assessment should be trained in the use of ABCD[2].

Audit Measure

☑ Indication that ABCD[2] assessment was undertaken at the initial assessment (for all TIA patients only).

Guideline Summary

The NSF[1], SIGN[15], NICE[9] and ICSI[14] guidelines all recommend the use of the ABCD[2] tool for suspected TIA patients. The CSN guideline[10] recommends the use of a standardised stratification tool but does not recommend the ABCD[2] tool.

As there are strong similarities between minor ischaemic stroke and TIA, it follows that initial assessment and management should be the same.[1]

Recent data has shown a higher and earlier risk of subsequent stroke for TIA patients than previously thought (2.5-5% at 2 days; 5-10% at 30 days; 10-20% at 90 days[12]). Approximately half of the early risk is seen within the first 48 hours, necessitating early initial assessment and management in order to prevent further events.[1] Streamlined systems that definitively diagnose TIA and initiate secondary treatment within 24-48 hours are associated with reduced rates of early death.[14]

Simple risk stratification tools for TIA have been shown to be accurate in identifying patients at high risk of early subsequent stroke who require immediate assessment and management in the ED.[9,14,15] The ABCD[2] tool (Figure 2) has been found to be accurate in identifying TIA patients at high risk of subsequent stroke[1,9,14,15] and is the best, validated tool currently available.[28] ABCD[2] is a simple, efficient way of predicting stroke in TIA patients and is appropriate for use in emergency care.[29]

Included in the tool are the five risk factors that have been identified for early stroke after TIA:

- age (≥ 60 years)

- high blood pressure (≥ 140 systolic or ≥ 90 diastolic)

- motor or speech symptoms

- longer symptom duration (> 10 min)

- diabetes mellitus.

Recommendations for hospital admission following TIA have historically been vague and practice varied.[28] The ABCD[2] score can be used as a decision tool to determine the course of treatment of TIA patients.

NSF[1] recommends that TIA patients with an ABCD[2] score of 5 or greater be designated as high risk, be admitted (or, where available, referred to a TIA clinic for urgent assessment) to facilitate rapid assessment, including urgent head imaging (as soon as possible, but certainly within 24 hours), and be treated as for acute stroke.

All TIA patients with an ABCD[2] score of 4 or less are designated as low risk and should have a CT brain scan and carotid ultrasound (where indicated) as soon as possible, that is, within 48 to 72 hours. Low risk TIA patients should be referred to a general practitioner, private specialist or TIA clinic for ongoing management.[1]

NICE[9] and ICSI[14] designate high risk patients as having an ABCD[2] score of 4 or greater, as derived from Johnston et al[28], and recommend they be immediately identified, assessed and secondary prevention be initiated. NICE[9] considers secondary prevention to include antiplatelet agents, blood pressure management, anticoagulation in selected patients and management of dyslipidaemia including statins.

In strict accordance with Johnston et al[28], SIGN has designated ABCD[2] scores of 0-3 as low risk; 4-5 as moderate risk; and 6-7 as high risk.

ICSI recommends that hospitalisation, or expedited outpatient assessment, be considered for recent (within 24-48 hours) and crescendo TIAs. ICSI[14] does not recommend that patients be selected for hospitalisation solely on their ABCD[2] score, although accepts that this may happen in practice.

ABCD[2] Tool[28]

A   Age: ≥ 60 years (1 point)

B   Blood pressure: ≥ 140/90mmHg (1 point)

C   Clinical features: unilateral weakness (2 points),

speech impairment without weakness (1 point)

D   Duration: > 60 mins (2 points), 10-59 mins (1 point)

D   Diabetes (1 point)

Tool interpretation[1]

>4 = HIGH risk;   ≤4 = LOW risk   Maximum score = 7

Urgent CT or MRI

NSF[1] recommendations: All patients with suspected stroke should have an urgent* brain CT or MRI (Grade A; Level I)

TIA patients classified as high risk (ABCD^2 > 4) should have an urgent* CT brain. Patients classified as low risk (ABCD^2 < 5) should have a CT brain and carotid ultrasound (where indicated) as soon as possible** (Grade B; Level I & III-3)

* 'urgent' is considered as soon as possible, but certainly less than 24 hours
** 'as soon as possible' is considered within 48-72 hours

Rationale

Clinicians disagree on the clinical diagnosis of stroke (versus stroke mimic) in about 20% of patients. Brain imaging is required to distinguish ischaemic stroke from intracranial haemorrhage and stroke mimics and should be performed immediately so that treatment can start promptly.[12,15]

One systematic review reported that the most cost effective strategy in acute stroke is for all patients to undergo 'immediate' imaging, as opposed to 'within 48 hours'.[9,10,12,15]

The 2009 NSF *National stroke audit acute services organisational survey report*[2] found that one third of rural hospitals surveyed that managed acute stroke patients had no access to CT.

Resource Implications

- Initial assessment should be performed using agreed tools by the most appropriate ED staff member, i.e. the clinician most experienced in stroke, to determine diagnostic needs and urgency.
- Local protocols should be developed for prioritising stroke and high risk TIA for rapid access to brain imaging services (imaging and reporting).
- An organised system of stroke care should be developed to ensure timely access to brain imaging services (imaging and reporting) if not available at the presenting hospital.

Audit Measure

☑ CT or MRI conducted within 24 hours of presentation (time of registration or triage, whichever comes first chronologically)

Guideline Summary

In addition to the NSF[1], the following guidelines also have a similar recommendation for an urgent initial brain CT or MRI for all suspected stroke: ESO[12], NICE[9], CSN[10], AHA/ASA[11], ICSI[14] and SIGN.[15]

Imaging modalities

The primary purpose of initial brain imaging is to exclude intracranial haemorrhage (ICH)[12,14,15] and non-vascular stroke mimics[12], although it may also provide information on

the ischaemic penumbra[12] and on early ischaemic changes in the brain such as mass effect from oedema, middle cerebral artery embolic material, other vascular lesions and prior cerebral infarctions.[10]

According to the AHA/ASA[11], ESO[12], CSN[10], SIGN[15] and ICSI[14], CT (without contrast enhancement) is the modality of choice for the initial brain scan. The AHA/ASA[11] states that, in most instances, a CT is the most practical initial brain imaging test and will provide enough information to make decisions about emergency management.

The CSN[10] states that although an MRI may provide more information in some cases, it is generally not recommended for the initial scan. It also states that emergency treatment of stroke should not be delayed in order to obtain multimodal imaging studies, even though they may provide additional information. If MRI is used for the initial scan, it should include diffusion-weighted sequences to detect ischaemia and gradient echo and FLAIR sequences for haemorrhage.[11]

Studies have shown that MRI is more sensitive than CT for early ischaemic changes[1,12,15], and is as sensitive for acute haemorrhagic changes.[1,11] It has also been shown to have a potential diagnostic advantage over CT in non-thrombolysis situations due to improved ability to identify acute, small cortical, small deep, and posterior fossa infarcts[15]; to distinguish acute from chronic ischaemia; and to identify subclinical satellite ischaemic lesions that provide information on stroke mechanism.[11] CT is sensitive to ICH in the acute phase, but not after 8-10 days.[1] Thus, to confirm diagnosis and differentiate ICH from haemorrhagic stroke, MRI may be preferred over CT in some presentations.[1,12,15]

Despite this, limited availability, contraindications and longer imaging time currently limits the routine application of MRI. For these reasons, CT is predicted to remain the first choice for imaging in the foreseeable future.[1,15]

Physicians' ability to reliably and reproducibly recognise early CT changes has been shown to be variable.[15] It is recommended that the greatest possible level of radiological expertise is employed to interpret images. Protocols should also be in place so that this occurs without delay.[11,14]

Time

NSF[1] recommends an 'urgent' scan, where 'urgent' is considered as soon as possible but certainly less than 24 hours, for acute stroke and high risk TIA. NICE[9] recommends immediate brain imaging within a maximum of 24 hours after symptom onset for all acute stroke patients without indications. This is in accordance with the understanding that immediate scanning in some patients will result in immediate changes in clinical management.[9] The CSN[10], ESO[12] and SIGN[15] state that initial brain imaging should be conducted immediately, but do not specify a maximum timeframe.[10,12] The CSN does, however, recommend that those TIA patients 'classified at *highest* risk of recurrent stroke [emphasis added]' undergo brain imaging within 24 hours.[10]

NICE[9] recommends that imaging is conducted within one hour of presentation if any of the following apply: indications for thrombolysis or early anticoagulation treatment; on anticoagulant; known bleeding tendency; depressed level of consciousness; progressive/fluctuating symptoms; papilloedema, neck stiffness or fever; or severe headache at symptom onset.

Wardlaw et al[30] found that out of 13 strategies assessed, the least costly and most effective strategy was for all patients to undergo immediate imaging.[1,9,10,15] NICE[9] recognises that while this approach is the most cost effective, it may be difficult to implement in all cases because of scanning availability.

Nil by mouth until bedside swallow screen (within 24 hours) for stroke

NSF[1] recommendations: All patients should be screened for swallowing deficits before being given food, drink or oral medications. Screening should be undertaken by personnel specifically trained in swallow screening (Grade C, Level I)

Patients should be screened within 24 hours of admission (Grade ✔)

Patients who fail the swallowing screen should be referred to a speech pathologist for a comprehensive assessment (Grade ✔)

Rationale

Dysphagia occurs in 27-55% of people with new onset strokes. Only about 50% of those affected recover normal swallowing ability by six months after onset.[10]

Dysphagia is associated with an increased risk of complications, such as aspiration, aspiration pneumonia, dehydration and malnutrition.[15,16] Early bedside screening is required to prevent these complications.[15] A failed bedside screen should always be followed by a complete assessment by a speech pathologist prior to any oral ingestion.[10]

In the 2007 NSF *National stroke audit clinical report acute services*[31], only half of the stroke patients included had a documented swallow screen before being given food or drink.

Resource Implications

- Bedside screening tools should be assessed and the preferred tool selected or developed for use in ED.
- Appropriate ED staff are trained to perform the selected bedside swallow screen.
- Initial bedside screening to be performed by a trained health practitioner for all newly admitted stroke patients.

Audit Measure

☑ Maintained nil by mouth prior to bedside swallow screen.

☑ Bedside swallow screen conducted within 24 hours of presentation (time of registration or triage, whichever is earliest).

Guideline Summary

Along with the NSF[1], the ESO[12], CSN[10], NICE[9], AHA/ASA[11], ICSI[14], RNAO[13], SIGN[15] and SIGN-D[16] guidelines all recommend an early bedside swallow screen for stroke patients, with the patient maintained as nil by mouth until screened.

TIA patients are not specifically mentioned in the guidelines in relation to bedside swallow screening, although standard practice does not usually require screening for TIA patients.

Reported incidence of dysphagia varies between 27-55% of people with new onset stroke (depending on the definition, and timing and method of evaluation)[1,10,13,16], but is commonly quoted at around 40%.[9] Of this percentage, approximately half do not recover a normal swallow at six months after onset.[10,13]

Patients with brain stem infarcts, multiple strokes, major hemispheric lesions and depressed consciousness are at higher risk of aspiration.[11,12]

Patients with dysphagia have an increased risk of the following complications: aspiration, aspiration pneumonia, dehydration and malnutrition.[1,10,11,13,16] Bacterial pneumonia, which is mainly caused by aspiration, is one of the most important complications in stroke patients.[12] Dysphagia is also associated with poorer outcomes, specifically higher incidence of death, disability, chest infection, and longer length of stay.[9,11,13,16]

Studies have found that implementation of and adherence to a formal dysphagia screening, referral and assessment protocol reduces the incidence of pneumonia, improves the process of care and patient outcomes.[1,16] Evidence suggests that a protocol for screening, diagnosis and treatment may yield dramatic reductions in pneumonia rates, feeding tube dependency and length of hospital stay.[10]

Screening tools

A simple bedside swallow screen, using a simple, valid, reliable tool, should be conducted on admission, or as soon as possible following admission (within 24 hours), for all acute stroke patients. This screening will identify possible dysphagic patients who should then be referred for a complete examination by a speech pathologist.[1,10,12,13,16]

Although a bedside swallow screen is useful for determining early feeding management, it may result in a false positive and/or false negative due to the variable sensitivity and specificity of the screening tool used.[9] *It is therefore essential that all patients who fail an initial bedside screen be kept nil by mouth and be referred for a complete examination by a speech pathologist. All patients, regardless of whether they pass or fail the initial bedside screen, should be monitored during their stay in the ED for symptoms of swallowing difficulties.*[10]

Numerous variations of a number of screening tools are available, although currently available data, including three systematic reviews, are not able to conclusively recommend one tool over another.[1,10]

Bedside screening generally involves observation of the patient's level of alertness to participate in the screening process, and an oromotor evaluation of the patient's oral motor function, oral sensation, and presence of a cough. This may be followed by a water swallow test, administered using a preset protocol along with monitoring for signs of impaired swallowing. Coughing during and up to one minute following test completion and/or 'wet' or hoarse voice are suggestive of an abnormal swallow.[10]

Studies have shown that a 50ml water swallow test (administered in 10ml aliquots) followed directly by an oxygen saturation test has high sensitivity (87-100%).[1]

It should be noted that a bedside swallow screen will not pick up 'silent' aspiration, thought to comprise up to half of all aspirations.[13] This necessitates careful clinical observation even after a patient has 'passed' a swallow screen.[9] An assessment of gag reflex is not a valid screen for dysphagia and should only be used as part of a more detailed assessment.[1,11,13,16]

Bedside swallow screens have been designed for use by non-specialist staff who should be trained by a specialist in the tool prior to use.[9,13,16] Any ED clinician (nurse or physician) can be trained in the screening tool. Staff should be selected according to resources, in order to maximize coverage in the ED of trained personnel. As studies have demonstrated inter-rater variability with these tools, consistent application and interpretation of the chosen tool should be ensured via a set protocol.[10,13,16]

Aspects to consider for the nil by mouth patient:

• Non-oral feeding does not prevent the aspiration of saliva.[9]

• Removal of food and drink requires immediate replacement of fluids to avoid dehydration, either intravenously, subcutaneously or via an enteral route (nasogastric tube or percutaneous endoscopic gastronomy).[1,9]

• Nil by mouth has an adverse psychological effect on patients.[9]

Aspirin as soon as possible if haemorrhage excluded

NSF[1] recommendation: Aspirin (150-300mg) should be given as soon as possible after the onset of stroke symptoms (i.e. within 48 hours) if CT/MRI excludes haemorrhage (Grade A; Level I)

Rationale

Acute phase (< 48 hours) aspirin therapy improves outcomes and reduces the risk of early recurrent ischaemic stroke.[15] Long-term aspirin therapy reduces the risk of ischaemic stroke, myocardial infarction and vascular death. There are no data from randomised controlled trials to support the use of other antiplatelet regimes in acute stroke patients.[10,15]

Resource Implications

- Protocols in place for timely access to diagnostic services (neuroimaging).
- Protocols in place for prompt post-imaging assessment by the most experienced clinician to determine appropriateness for aspirin therapy.

Audit Measure

☑ Aspirin administered within 48 hours of presentation (time of registration or triage, whichever is earliest), unless contraindicated, for all ischaemic stroke patients

Guideline Summary

The NSF[1] recommends 150-300mg of aspirin be given as soon as possible after the onset of stroke symptoms (i.e. within 48 hours) if CT/MRI scan excludes haemorrhage. The ESO[12], CSN[10], NICE[9], AHA/ASA[11], ICSI[14] and SIGN[15] similarly recommend an early initial dose of aspirin unless contraindicated (e.g. ICH, allergy or genuine intolerance, thrombolysis candidate).

As for stroke, antiplatelet therapy should be commenced in TIA patients as soon as haemorrhage has been excluded.[1]

All included guidelines recommend a similar dose of aspirin within a similar timeframe:

- NICE[9] recommends 300mg within 24 hours
- ESO[12] recommends a one-time loading dose of 160-325mg within 48 hours
- CSN[10] recommends at least 160mg immediately as a one-time loading dose
- AHA/ASA[11] recommends 325mg within 24 to 48 hours
- ICSI[14] recommends 160-325mg promptly
- SIGN[15] recommends 300mg within 48 hours.

Aspirin is the only oral antiplatelet agent that has been evaluated for treatment of acute ischaemic stroke (AIS)[9,11,15], and only doses of 160-300mg have been evaluated for treatment at the acute stage.[9,10]

Two large trials, which contribute 98% of data for the most recent Cochrane review of antiplatelet therapy in acute stroke (n=41,399)[12,32], found that 160-300mg of aspirin daily commenced within 48 hours of symptom onset was associated with improved outcomes in AIS patients.[15] With treatment, there was a significant decrease in death or dependency at the end of follow up. Treatment also increased the odds of patients making a full recovery.[1,9,10,15] It is not clear whether aspirin limits the neurological consequences of the AIS itself.[11]

Administration of aspirin within 24 hours of use of a thrombolytic agent is not recommended.[10,11,14,33]

Little evidence exists comparing the different methods of aspirin delivery.[9] The most clinically appropriate route should be selected from those available. Dysphagic patients may receive aspirin via enteral tube.[9,10,14,15]

Again, little evidence also exists for the management of aspirin-intolerant patients. Other antiplatelet agents, such as clopidogrel, may be considered for patients who are truly allergic, although they have not been evaluated in AIS.[10-12,14] Consensus from the NICE[9] guideline developers is that patients who are not truly allergic to aspirin should be administered aspirin along with a proton pump inhibitor, e.g. omeprazole, where appropriate.

Physiological monitoring and management

- neurological status
- blood glucose
- blood pressure
- hydration status

NSF[1] recommendations: Patients should have their neurological status (including Glasgow Coma Scale) and vital signs including pulse, blood pressure, temperature, oxygen saturation, glucose, and respiratory pattern monitored and documented regularly during the acute phase, the frequency of such observations being determined by the patient's status (Grade C; Level II & III-2)

Patients with hyperglycaemia should have their blood glucose level monitored and appropriate glycaemic therapy instituted to ensure euglycaemia, especially if the patient is diabetic. Hypoglycaemia should be avoided (Grade ✔)

Intensive, early maintenance of euglycaemia is currently not recommended (Grade B; Level II)

If extremely high blood pressure (BP > 220/120) exists, instituting or increasing antihypertensive therapy may be started, but blood pressure should be cautiously reduced (by no more than 10-20%) and the patient observed for neurological deterioration (Grade ✔)

Close monitoring of hydration status and appropriate fluid supplementation should be used to treat or prevent dehydration (Grade B; Level I)

Rationale

Monitoring and management of vital signs is routinely conducted for all ED patients in order to identify adverse physiological events that may require early intervention.[15]

These particular four elements have been included because they require special attention in acute stroke patients.

Neurological status: The severity of the initial neurological defect has been found to be the single most important variable in determining the rate and degree of recovery.[13] Monitoring of neurological status during the acute phase also helps to identify deterioration which can lead to earlier intervention.[13]

Blood glucose: Hyperglycaemia at the time of acute stroke is associated with poorer clinical outcomes[1], infarct progression, greater mortality and reduced functional recovery.[9-15] Hypoglycaemia may cause focal neurological deficits[11] that can be reversed by treatment.[10-12]

Blood pressure: Both hyper and hypotension in the first 24 hours of acute stroke have been found to negatively affect outcomes, although evidence regarding specific therapies is lacking.[15]

Hydration status: Suboptimal fluid intake leads to negative outcomes.[15] This is particularly problematic in patients with dysphagia. Dehydration is linked to cerebral hypoperfusion[34] and increased ischaemic penumbra* size.[35]

Resource Implications

- Clinicians to be trained in assessment and monitoring requirements of neurological status, blood pressure, blood glucose and hydration status in acute stroke.
- Definition and dissemination of information on best practices for stroke patients in the ED for blood pressure, blood glucose and hydration monitoring and management.
- Protocols developed for routine monitoring of stroke patients within ED.

Audit Measure

☑ Evidence that neurological status, blood glucose, blood pressure and fluid status were measured during initial assessment and indication of ongoing monitoring and management as required

Guideline Summary – Neurological Status

Along with the NSF[1], ESO[12], ICSI[14] and RNAO[13] also recommend for an initial neurological assessment, followed by regular monitoring.

Studies have found that neurological monitoring in the first two days following stroke enhances the benefits of conventional stroke unit care.[1]

An initial exam must be performed to assess whether the presentation is consistent with stroke, estimate the severity of the deficit and establish baseline data.[14] The single most important variable that influences the rate and degree of recovery following stroke is the severity of the initial deficit.[13] Prompt early assessment can also influence patient outcomes.[13]

Regular monitoring through the acute phase provides a standardised method of detecting neurological change.[13] This should result in early intervention in the event of a change in neurological status, which can influence patient outcomes.[13] There is little direct evidence to indicate how intensively monitoring should be carried out for non-thrombolysis patients, but it is common practice to have a minimum of four-hourly observations for the first 72 hours after stroke.[12]

The frequency of subsequent neurological assessments should be determined by the patient's status and whether a problem is identified.[1]

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* Ischaemic penumbra is the cerebral area peripheral to the area of ischaemia where metabolism is active but blood flow is diminished.

Neurological scales

ESO[12] and RNAO[13] recommend using a validated neurological assessment tool, such as the Glasgow Coma Scale (GCS), the Canadian Neurological Scale (CNS) or the National Institutes of Health Stroke Scale (NIHSS), to ensure reliable assessment and documentation of a patient's status. The selection of a tool will be dependent on patient needs, organisational resources, and educational support available.[13]

NSF[1] recommends the use of the GCS as a minimum.

ICSI[14] recommends using the NIHSS for the initial assessment by physician or nursing staff in order to establish a baseline evaluation and then after resuscitation or treatment to assess change. NIHSS is recommended as it is rapid (5-8 minutes), covers all key aspects, is validated and has both inter-rater and intra-rater reliability. ICSI[14] does not recommend the full NIHSS be conducted for subsequent, regular neurological checks as this is often not feasible and not a good use of time.

RNAO[13] states that at a minimum, the assessment tool used should include:

• level of consciousness

• orientation

• motor

• pupils

• speech/language

• vital signs (TPR, BP, SpO2)

• blood glucose.

Examples of the three validated tools mentioned (GCS, CNS and NIHSS) are available in Appendix F.

Guideline Summary – Blood glucose

The NSF[1] recommends monitoring of stroke patients' blood glucose and appropriate management of hyperglycaemia during the acute phase. The ESO[12], CSN[10], NICE[9], AHA/ASA[11], ICSI[14], AHRQ[17], RNAO[13] and SIGN[15] documents also have similar recommendations.

Hyperglycaemia

Hyperglycaemia after stroke is commonly found in one third of patients, although reported prevalence varies between 8-83%, depending on cohort and definition.[1,11]

Several large clinical studies have shown hyperglycaemia directly after stroke to be associated with poorer clinical outcomes[1], infarct progression, greater mortality and reduced functional recovery.[9-15]

It is unclear as to what extent post-stroke hyperglycaemia is a 'normal' physiological response, or whether hyperglycaemia per se increases cerebral damage in the acute phase and is an independent predictor of poor outcome.[10,14] It is speculated that hyperglycaemia may be a result of physiological stress, especially in non-diabetic patients.[11,13,14] Hyperglycaemia is also a marker of more severe stroke; therefore poorer outcomes in these patients may be a result of stroke severity, and not a direct result of hyperglycaemia only.[11]

There is evidence to suggest that hyperglycaemia following stroke is associated with impaired glucose metabolism.[10,15] Glucose intolerance following stroke is found in approximately 25% of patients and is linked to higher stroke recurrence[1], while previously unrecognised diabetes mellitus and glucose intolerance preceding stroke is thought to exist in up to 42% of stroke patients.[10]

Observational data indicates that hyperglycaemia fluctuates in the first 72 hours in non-diabetic and diabetic patients, even with current best practice.[1] Gray et al (2004)[36], in AHA/ASA[11] and AHRQ[17], found that plasma glucose levels also spontaneously decline in many patients.

Early identification of hyperglycaemia in AIS is recommended.[1,13,14]

While the need for close monitoring is clear, current evidence does not point towards a specific management strategy for treating hyperglycaemia in acute stroke.[12] There is little evidence to support early, aggressive control of blood glucose in patients with mild to moderately elevated glucose levels[15], however general consensus across the included guidelines suggests that cautious treatment of patients with markedly elevated blood glucose is reasonable.[1,10,11,14]

The NSF[1] does not recommend a specific level at which to initiate therapy, but suggests monitoring and therapy as appropriate to maintain euglycaemia, although does not recommend early, intensive maintenance of euglycaemia. Similarly, the CSN[10] recommends that blood glucose be monitored regularly and treatment with glucose-lowering agents be instigated if patient has markedly elevated glucose levels.

NICE[9] and AHA/ASA[11] consider mild to moderately elevated blood glucose to be between a median of 7-9 mmol/L, and cautious treatment in patients with glucose levels above 11 mmol/L to be reasonable. ESO[12] recommends treatment of patients with glucose levels above 10 mmol/L with insulin titration. RNAO[13] recommends that glucose levels above 8.3 mmol/L be referred to a physician for further management.

The NICE guideline development group reached consensus that where possible, patients should be treated to maintain blood glucose between 4-11 mmol/L following stroke.[9]

ICSI[14] states that until there is evidence regarding the appropriateness of more aggressive treatment, usual management of hyperglycaemia (blood glucose > 8 mmol/L) with gentle dosing of subcutaneous insulin, avoiding hypoglycaemia, should be followed in a timely manner. SIGN[15] does not recommend the routine use of insulin regimens aimed at lowering blood glucose levels in patients with moderate hyperglycaemia.

ESO[12] states that the use of intravenous saline and avoidance of glucose solutions in the first 24 hours following stroke appears to reduce blood glucose levels.

Close monitoring of blood glucose with adjustment to insulin dose is required to maintain euglycaemia and avoid hypoglycaemia[1,11,14], although SIGN[15] does not recommend the routine use of insulin regimens in patients with moderate hyperglycaemia. Simultaneous administration of glucose and potassium may also be appropriate.[11]

Hypoglycaemia

Hypoglycaemia can cause focal neurological deficits that mimic AIS. Hypoglycaemia may also lead to brain injury.[11] For these reasons, prompt initial measurement and correction are important for patients diagnosed with stroke. Symptoms of hypoglycaemia can be reversed by administration of glucose.[10-12] The goal of this treatment is euglycaemia; hyperglycaemia should be avoided.[11]

Guideline Summary – Blood pressure

As well as the NSF[1], the following guidelines have a similar recommendation for regular monitoring and cautious management of high blood pressure after stroke: ESO[12]; NICE[9]; AHA/ASA[11]; ICSI[14]; and RNAO[13]. SIGN[15] recommends an active monitoring protocol should include frequent observation of blood pressure, although routine active management is not recommended.

Blood pressure (BP) abnormalities, especially hypertension, are common after stroke; in the 1997 International Stroke Trial, as reported in NICE[9], 54% of patients had systolic blood pressure (SBP) greater than 160 mmHg. BP changes may occur as a result of disturbed cardiovascular autonomic regulation, with changes in absolute BP levels and BP variability both possible. Hypertension may also indicate hypertensive encephalopathy or an increase in the risk of primary ICH.[13] Many hypertensive patients also have pre-existing hypertension that may or may not have been treated prior to the stroke.[9,11]

Both hyper and hypotension in the first 24 hours after stroke are associated with poor outcome[1,9,12,14], and poor short and long term prognosis.[11] Hypertension may also be associated with oedema and haemorrhage.[9] According to AHA/ASA[11], for every 10 mmHg increase above 180 mmHg, the risk of neurological deterioration increases by 40% and the risk of poor outcome increases by 23%. A study in AHA/ASA[11] found that an elevated baseline mean arterial BP was not independently associated with poor outcomes, but elevations in mean BP over the first days after stroke were. The same study found that an elevated pulse pressure was also associated with poor outcomes after three months.

In most hypertensive stroke patients, BP spontaneously reduces over the first 4-10 days after stroke.[9,11] This can be hastened by moving the patient to a quieter room, controlling their pain, allowing the patient to rest, or allowing them to empty their bladder.[11]

Hypotension is not as common in acute stroke and may result in extension of an ischaemic stroke and increased likelihood of a poor outcome. The underlying cause of hypotension should be sought and treated as it may be the result of a large cerebral infarct, cardiac failure, ischaemia, hypovolaemia or sepsis.[11,12,14] Patients with stroke may have depleted blood volume, in which case, correction of hypovolemia and optimisation of cardiac output are important priorities during the first hours after stroke.[11]

BP should be taken as part of the initial assessment[13] and general measures introduced to monitor and manage changes in the acute phase.[1,14]

Although strong evidence exists for lowering of BP for secondary prevention, acute BP therapy (during the first 48 hours) for both hypo and hypertension remains controversial[12] with treatment in both situations found to negatively affect outcomes.[1] There are concerns that lowering BP acutely in those patients with hypertension may have a deleterious effect by reducing cerebral flow and impairing penumbral viability, thus affecting outcome.[9] It may also be the case that the effects of lowering or elevating BP may have different effects in different stroke subtypes.[9]

Due to the limited number of studies on acute BP therapy for stroke, it remains unclear which agent should be used and whether lowering or increasing BP improves patient outcomes.[1,9,11,12,15] No specific recommendations can be made until more evidence becomes available.[9]

Close monitoring of BP, with or without therapy, is recommended.[1,15,33]

In the absence of clear data, consensus decisions were reached by a number of the included guidelines that cautious BP lowering therapy should be initiated or increased in response to severe hypertension. The point at which BP lowering therapy should be initiated varied between guidelines:

- NSF[1], AHA/ASA[11], ESO[12] and ICSI[14] recommend SBP > 220 mmHg, or diastolic blood pressure (DBP) > 120 mmHg or mean arterial pressure (MAP) > 130 mmHg (ICSI only)

- NICE[9] recommends SBP > 200 mmHg

Outside of organ dysfunction, BP should not be lowered rapidly as evidence indicates that this may be harmful.[11,12] NSF[1] recommends a decrease of no more than 10-20%. AHA/ASA[11] recommends a decrease of 15-25% with the first 24 hours. ICSI[14] recommends that, where BP lowering treatment is required in the acute phase, hypertensive agents with a short duration of action and minimal effect on cerebral blood flow are preferred. Agents that tend to cause a precipitous drop in BP should be avoided.[14]

When deciding on management, it is important to take into account the patient's acute presentation and whether or not there is a previous history of hypertension. Young patients without a previous history of hypertension may be less tolerant of elevated BP, while specific comorbidities may require more aggressive antihypertensive therapy.[11,14]

NSF[1] and ICSI[14] recommend that existing antihypertensive drugs be continued, unless the patient has symptomatic postural hypotension or other reason to withhold treatment.

Guideline Summary – Hydration level

Along with NSF[1], the ESO[12], NICE[9], SIGN[15], AHA/ASA[11], ICSI[14], and RNAO[13] guidelines have similar recommendations or statements for close monitoring of hydration levels and use of fluid supplementation to treat or prevent dehydration.

Dehydration is common in stroke patients on admission[12,15] due not only to swallowing impairments[11] but also loss of appetite, motor and sensory or visual impairment, reduced awareness, communication difficulties, depression and cognitive impairment.[1,9,13]

Suboptimal fluid intake and early dehydration are associated with slower recovery and poor outcomes following stroke.[12] These include increased complications, including deep vein thrombosis, and increased mortality.[1,11,12] Dysphagic patients are particularly at risk.[1]

RNAO[13] recommends that a nutrition and hydration screen be conducted within 48 hours of admission and then repeated after any changes in neurological or medical status. A fluid chart should be started to monitor fluid levels and help manage dehydration.

In ischaemic stroke, haemorrheological[†] disturbances may be a factor in limiting cerebral blood flow. Dehydration associated with haemoconcentration may also impair cerebral blood flow, as well as increasing thrombus formation and recurrent embolisation in cardiogenic stroke.[14] It should be noted that specialist fluid replacement therapy with haemodilution has not been shown to improve stroke outcomes.[12]

For non-dysphagic patients simple strategies have been shown to increase fluid intake including offering preferred fluids and providing supervision during meals.[1]

For those patients with dysphagia, initial fluid intake should be increased via IV or enteral routes.[1,9,12] Currently there is no clear evidence to indicate that one option is more beneficial than the other.[1,12] ESO[12] and ICSI[14] recommend treatment with isotonic fluids for maintenance of euvolemia and avoidance of dehydration, i.e. 0.9% normal saline at a rate of 75-125 ml/hr or 2-3 L/day, adjusted for febrile patients.[14] Hypotonic fluids should not be used as they promote brain swelling.[14]

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† Haemorrheology is the study of the deformation and flow behaviours of blood and its elements, i.e. plasma, erythrocytes, white blood cells, and blood platelets.

Part 3: Implementation

The following section is an outline of the steps that can be taken to implement the care bundle in your ED.

This section has been adapted from the NICS 'Stop the Clot' implementation guide.[37]

According to Lewin-Schein change theory[38], successful change involves three progressive steps:

1. Becoming motivated to change
2. Changing what needs to be changed
3. Making the change permanent

This approach lends itself to implementing the bundle.

These steps have been set out in chronological order. This is not intended to be a rigid structure and in practice you may conduct a number of steps together.

Please contact NICS if you require further information on evidence implementation, or refer to one of the resources listed at the end of this section.

Step 1: Becoming motivated to change

Conduct a baseline audit

The first step to implementing the bundle is assessing current practice in your organisation's ED. The results of a baseline audit will show how well your organisation's ED is doing with regard to the bundle elements and acute stroke care in general.

A baseline audit will:

• provide a snapshot of current practice to compare with post-implementation audit results

• identify the components that need improvement

• help convince staff that action needs to be taken (see next step 'create a sense of urgency').

Baseline data may also indicate that your ED does not need this resource if data shows that all bundle components are completed for all stroke and TIA patients.

A simple audit tool, available in Appendix C, has been developed for this and subsequent audits. Prior to starting your baseline audit you should develop a minimum standard of chart documentation for each bundle component that will constitute a 'yes' response.

Helpful tips:

• Ensure that you approach and explain the audit carefully to other staff. Staff will generally accept a baseline audit more readily if it is presented as a 'low key issue' that is about verification of quality care (and improved outcomes for patients) rather than a fault-finding mission.[39]

• Keep the audit to a manageable size. A baseline audit should be slightly larger than subsequent regular audits, but neither should be onerous.

• Involve a variety of staff in the audit.

• Make use of electronic data where available. This will minimise the amount of work involved and improve consistency over time.

• It may not be necessary to obtain ethics approval as audits can be classified as a quality assurance activity. It is important to get clear guidance on this matter locally.

Form a project team

You will need to form a project team to guide and action the implementation of the bundle.

Ensuring the right team members are involved is vital to successful and sustainable implementation. Team members should be selected based on capability, leadership and determination to see the implementation through.[40]

Each team member should be chosen for a reason and the team should be organised to have maximum influence over the ED as a whole, i.e. experience or skills in previous similar projects, natural leaders/champions, and management/senior positions.

The following roles should be included on the team:

• a *clinical champion*, who can speak with authority on clinical matters and is able to motivate others

• an *executive sponsor*, who has sufficient influence and authority to garner the necessary resources

• a *team coordinator*, who is responsible for overseeing, guiding and carrying out the bundle implementation on a day-to-day basis.[37]

Helpful tips:

• An effective team should usually be between three and eight people, depending on the size of your organisation.

• Include people with as wide a range of relevant disciplines, experience and seniority levels as possible: nurses, pharmacists, physicians, allied health professionals, imaging staff, people with quality improvement experience, junior staff, management, and administrative and finance staff.

• Include natural leaders and people who are passionate about change.

• Involve hospital clinical audit/effectiveness departments to support the process.

• Try to inform and obtain commitment from all departments and disciplines involved. You may wish to use the 'Rationale' sections of each bundle component when giving reasons to your organisation's executive on why stroke care in the ED is a priority issue.

Raise awareness and create a sense of urgency

"Motivation for change must be generated before change can occur."[38]

This is the most important part of the unfreezing stage of the implementation process. If you wish to introduce changes to the way an existing process is conducted, a clear, consistent and persuasive case is needed for why it is necessary *now*. This step is aimed at developing that case and also developing a motivation for change amongst the majority of staff involved.

This should not be a 'sky-is-falling' tactic, but instead should create an environment in which staff are aware of their current practice and are saying 'we must do something to improve our patient care'.

The results of the baseline audit are a useful tool in creating this sense of urgency and readiness to change amongst staff.

Once a real desire to make some changes exists, it is necessary to start planning the implementation of the bundle itself.

Helpful tips:

• Disseminate the results of the baseline audit using a number of approaches – e.g. newsletters, staff meetings, meetings with management, screen savers, dedicated staff presentations.

• Create an identifiable logo or design for the bundle so that new information and resources associated with the bundle are immediately recognisable.

Step 2: Changing what needs to be changed

Identify barriers

Your baseline audit will provide information on the nature and extent of any bundle components that are not being completed. Identifying these gaps is an important initial step, but identifying why these gaps exist is also essential if you are to close them. Factors preventing best evidence from being applied are known as barriers.

Each site will have unique barriers to implementing the bundle, therefore identifying and addressing these barriers on a site-by-site basis is the most effective way of completing this step.

Barriers to change can occur at all levels and it is important to consider each level when conducting this step in your organisation.

Please see Appendix I for a table of potential barriers, organised by level of health care, to get you started.

There are a number of ways to identify barriers in your hospital. Direct feedback from staff can be obtained through brainstorming, focus groups, and one-on-one interviews. These techniques can provide information on barriers facing individual clinicians.

Identifying barriers at systems level is often more complex. One way of identifying such barriers is to create a workflow diagram for stroke and TIA patients in your ED and analyse how the processes involved in this diagram are organised and performed. This is known as process mapping.

Helpful tips:

- Engage with frontline, nursing and junior medical staff.
- Remember that systems issues and individual factors are both critical.

Develop a project plan

Developing and following a project or action plan provides a clear direction for change for the project team and other staff. It focuses efforts on this change and provides an unambiguous approach to testing the change. A concise view of what improvements the bundle is designed to help staff achieve is required, so that staff can clearly identify the gap between the current situation and what is being proposed.

When developing the plan, the team should keep in mind the findings of the baseline audit and the barriers identified in the previous steps. These findings should inform decisions about which areas to focus the plan on and the specific interventions used.

A summary of specific interventions matched to identified barriers is provided below.

Identified barriers	Specific interventions
Lack of knowledge	Interactive education seminars, decision aids
Perception/reality mismatch	Audit and feedback, Reminders
Lack of motivation	Incentives/sanctions, Leadership
Beliefs/attitudes	Peer influence, Opinion leaders
Systems of care	Process redesign

NICS 2008[37]

The impact of the plan on workflow also needs to be considered. A plan that adds an extra burden of work for frontline personnel will be much harder to implement than one that does not. Aim to simplify the system as much as possible and integrate the plan into existing work processes.[37]

The plan should include:

• Goals (key performance indicators) associated with implementation of the bundle. These goals should be agreed to by the staff.

• Strategies to overcome the barriers identified in the previous step.

• How each of the bundle components is to be completed: when, by whom, how, and where it will be recorded. Existing policies and protocols will need to be checked and reviewed. New protocols may need to be developed.

• How the bundle is to be audited: how often, by whom, and how it will be fed back to staff. Appendix C contains an audit tool template.

A template for a plan has been provided in Appendix D to be used as a starting point.

Helpful tips:

• Plan a sustainable change – do not make changes reliant on individuals. Embed changes into routine systems of care.

• Don't get bogged down in the detail; the plan may change over time.

• Design the intervention so that it is easy for staff to do the right thing and hard to make errors or omissions.

• Make sure your plan goes to the hospital executive for sign-off and support.

Implement bundle

Use the action plan produced previously to implement the bundle in your organisation. When doing so it is important to allow some flexibility; remember that your plan may require refinement along the way. It is also important to recognise that change takes time; be realistic about how long this is going to take to complete.

In order to maximise the success of the implementation, the bundle can initially be implemented on a small scale as a test using the Plan, Do, Study, Act (PDSA) cycle.[41] The key to using the PDSA cycle successfully is to focus on small changes over a short time. Making small changes, then learning and altering one's approach is said to break down the inertia of change.[42] Following a small scale implementation of the bundle, changes should be assessed, and approach modified if required. The cycle can then be repeated iteratively until the desired effect is observed. This cycle applies to even the smallest steps in the implementation process. After the process has been optimised, the bundle can then be rolled out across the entire department.

It is not essential to have agreement from everyone at the initial stages of implementation. This can be sought later once initial changes in care have been demonstrated.

Regular meetings of the project team are important during this phase.

Helpful tips:

- Run education seminars for all staff, including associated staff (e.g. allied health etc).
- Provide materials for use in ED (e.g. memory aids, posters).
- Arrange staff training as required (stroke screening tool, $ABCD^2$ tool).
- If possible, ensure all performance measurements are collected in one place, e.g. patient charts, to enable a quick audit process.
- Include steps to incorporate ongoing assessment of the care bundle into your data collection processes.

Monitor progress and evaluate change

An essential part of any quality improvement exercise, care bundles included, is an audit cycle. This is designed to gather information on what changes, both positive and negative, have occurred and why they occurred. This will enable an assessment of the success of implementation activities and help clarify any remaining barriers that have not been addressed.[42]

> *The care bundle concept is able to provide a mechanism for timely measurement to show that clinical guidelines are being followed. While similar to an 'audit cycle', the difference is the speed with which the feedback takes place. In audit, data is analysed retrospectively, but a care bundle is monitored prospectively. Best results are obtained when measurement is incorporated into daily routine.*

NHS 2005[43]

Good data that are reliable, timely and easily understood is critical. A care bundle is designed to provide this via a simple checklist (Appendix C). This approach provides easy and effective information on performance with no time delay and ensures the current standard of care can be fed back to staff quickly and efficiently. This in itself encourages compliance with the system and improvements in care.

It should be noted, though, that as a result of the simplicity of the care bundle audit process and tool itself, the audit data are internally reliable, but are not comparable to results from other hospitals that may have conducted their audits in a different way.

How regularly you audit, and how many patient records you include in each audit will depend on the size of your department and your staff resources. As care bundles are designed to be audited regularly and prospectively, the audit process should be kept simple and quick.

In order to ensure the sustainability and success of this simple audit and feedback process, make monitoring of the clinical processes in the bundle integral to the clinical process itself.

Most well-planned quality improvement activities produce incremental improvements. In the first instance, if you achieve an improvement in bundle completion of around 10-20% you will have done well. Celebrate gains but temper staff expectations so that those involved do not lose motivation.

In addition to the regular prospective audits conducted internally, the National Stroke Audit is conducted every two years by the National Stroke Foundation. Although the NSF audit is not directly linked with this care bundle, it does include a number of the bundle components and will provide hospitals with a long-term, independent appraisal of how the bundle has improved care (or maintained a high level of care). From 2009 the NSF acute stroke audit will include measurement of the following bundle components: urgent CT/MRI, swallow screen prior to oral intake, and aspirin as soon as possible.

Helpful tips:

- Ensure the audit measures are tracked on an ongoing basis (weekly, monthly, or three-monthly, depending on the number of stroke presentations in your ED).

- Maintain a consistent approach to auditing, i.e. same number, same time period, same minimum standards for a 'yes' response as used in the baseline audit. The audit tool template in Appendix C will assist with this.

- Provide time and facilities for staff to generate ideas to improve the delivery of care, e.g. team meetings.

- Feed back audit results to all ED staff on a regular basis, e.g. team meetings.

- Report back to your hospital executive on a regular basis.

- Include progress reports and audit data in relevant regular hospital reports.

- Ensure the regular audits are set up in a way that is sustainable and not reliant on the involvement of the project team.

Step 3: Making the change permanent

Sustain progress

In order to be effective, change needs to be sustained by becoming embedded in routine systems of care. How this is achieved is specific to each organisation and determined by local processes. This is the 'refreezing' stage of the implementation process.

A number of activities can be used to enhance this normalisation process and ensure the changes are sustained:

- Maintain audit and feedback processes. Regular, prospective audits and feedback of results to staff should be incorporated into routine systems of care.

- Identify forums to share successes and learnings with other departments, other sites and different stakeholders, e.g. regional workshops/conferences, hospital newsletters or local papers.

- Use change strategies. Reminders and prompts have been found to be very successful, e.g. sticky notes in patient files, posters, screensavers, and informal reminders by team leaders during meetings.

- Formalise the changes in hospital policy, e.g. introduce the audit measures into formal quality improvement processes.

Part of this step is also modification of the approach if goals (set in the action plan) have not been reached. The level of success can be assessed as part of the previous evaluation step. If further changes are still desired, repeat the PDSA cycle, using the barriers and action plan stages to modify the previous approach. This cycle can be repeated as many times as necessary to achieve the goals.

Helpful tips:

- Ask people for feedback on what they need to make the changes sustainable.

- Include information on the bundle in all clinical staff orientation presentations, especially those for junior staff.

- Ensure audit results are fed into regular clinical department meetings.

- Continue to measure and report on audit results.

- Embed the bundle components in your hospital's regular performance monitoring systems.

- Acknowledge and reward the effort people have put in, regardless of the outcome.

Implementation costs

One of the benefits of a care bundle is the requirement that it be simple and not need extensive resources to implement.

Any practice change will require time for staff training, however the care bundle approach has been designed to minimise education and training requirements.

Specific support will be required for education and training in the stroke screening tool, the $ABCD^2$ tool, and the dysphagia screening protocol for ED staff involved in assessment of stroke patients. This will vary depending on which tools are chosen and how they are implemented.

Support will be required for training in techniques of data collection. Time will need to be allocated for staff to collect clinical data, to reflect on results of measuring clinical processes, and to create new ways of increasing the reliability of the bundle implementation.

Implementation resources

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Appendices

Appendix A: NICS Stroke Clinical Reference Group

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Reference Group Clinical Lead
Emergency Physician, The Angliss Hospital VIC

Ms Kelly Couglan
Acute Stroke Nurse, Box Hill Hospital VIC
replaced in July 2008 by

> **Ms Bronwyn Coulton**
> Acute Stroke Nurse, Box Hill Hospital VIC

Ms Sonia Denisenko
Program Manager, Stroke Clinical Network, Department of Human Services VIC
replaced in July 2008 by

> **Ms Adele Mollo**
> Stroke Clinical Network Facilitator/Acting Program Manager, Stroke Clinical Network,
> Department of Human Services VIC

Mr Patrick Groot
Stroke Liaison Project Worker, South West Healthcare VIC

Mr Paul Jennings
Manager Clinical Effectiveness and Research, Ambulance Victoria
replaced in March 2009 by

> **Mr Bill Barger**
> Manager Clinical Standards, Ambulance Victoria

Dr Andrew Lee
Consultant Neurologist and Senior Stroke Research Consultant, Flinders Medical Centre SA
Consultant Neurologist, The Repatriation General Hospital SA

Dr Simon Leslie
Medical Director of Emergency, Shellharbour Hospital NSW

Mr Mark Longworth
State Manager, Stroke Services Network NSW

Ms Bree McGillivray
Clinical Nurse Specialist ED, The Northern Hospital, VIC
Paramedic, Ambulance Victoria

Appendix B: Guideline shortlist and inclusion criteria

The guideline inclusion criteria are based on those used by the U.S. National Guidelines Clearinghouse. These criteria establish a level of rigour in the selection of the included guidelines.

Guideline inclusion criteria:

1. The guideline contains systematically developed statements that include recommendations, strategies, or information that assists physicians and/or other health care practitioners and patients to make decisions about appropriate health care for specific clinical circumstances.

2. The guideline was produced under the auspices of medical specialty associations, relevant professional societies, public or private organisations, government agencies at the Federal, State, or local level, or health care organisations.

3. Corroborating documentation can be produced and verified that a systematic literature search and review of existing scientific evidence published in peer reviewed journals was performed during the guideline development.

4. The full text guideline is freely available and accessible on the internet, in the English language. The guideline is current and the most recent version produced. Documented evidence can be produced or verified that the guideline was developed, reviewed, or revised within the last five years (2004-2008).

Included guidelines:

Adams HP, del Zoppo G, Alberts MJ, Bhatt DL, Brass L, Furlan A, et al. Guidelines for the early management of adults with ischemic stroke: a guideline from the American Heart Association/American Stroke Association Stroke Council, Clinical Cardiology Council, Cardiovascular Radiology [trunc]. Stroke 2007 May;38(5):1655-711.

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Sharma M, Clark H, Armour T, Stotts G, Cote R, Hill MD et al. Acute stroke: evaluation and treatment. Evidence Report/Technology Assessment No. 127 (Prepared by the University of Ottawa Evidence-based Practice Center under Contract No. 290-02-0021). AHRQ Publication No. 05-E023-2. Rockville (MD): Agency for Healthcare Research and Quality; 2005.

Appendix C: Audit tool template

Conducting an audit:

- Bundle audit data are to be obtained by prospective (ongoing) chart audits. Possible data sources include the medical record (ED documentation, medication record, radiology documentation, speech pathology documentation), radiology database, and speech pathology database.

- How often you audit the bundle in your ED, how many records you collect in each audit, and the time period of each audit is up to you and dependent on resources, but it should be representative of the total stroke and TIA admissions. As a guide 10-20%, or a minimum of 15-20, of all stroke and TIA patients is reasonable, whichever number is greater. Smaller EDs may need to use a bigger percentage, or audit over a longer period, to gain meaningful results. Obviously, the bigger the sample size, the more reliable the data. A slightly bigger sample size for the initial, baseline audit is also recommended.

- Completion of the bundle requires that none of the elements were audited as no ('N'). However, certain components can be audited as 'not applicable' (NA) or 'contraindicated' (CI), without that particular record being audited as incomplete.

- The audit process may vary considerably between institutions due to the nature of a care bundle. This means that care bundle audit data are not comparative between institutions. This does not mean that the results from your ED are unreliable. As long as all audits in your ED are conducted consistently, the data collected should be indicative of current practice in your ED.

- To conduct audits consistently, agreement will need to be reached on how records will be pulled from the records system, and what constitutes completion of each bundle component (a 'Y' response). This may vary slightly between institutions, depending on variables such as documentation standards and language differences.

- Your audit data can be used to demonstrate level of bundle completion, areas of the bundle where specific gaps in evidence-based practice may exist, and broad trends in bundle completion (and evidence-based practice) in your ED over the course of a number of audits.

Steps to conduct your bundle audit:

1. Decide on the frequency, time period, and number of records you need for each audit.

2. Alter the audit tool according to number of records selected (add or remove rows), and order in which components will be accessed during the audit (alter the order of columns).

3. Obtain the selected number of records with a stroke or TIA ED discharge diagnosis from the selected time period.

4. Fill in the audit tool using records, according to agreed process.

5. Conduct analysis as required.

6. Feed back audit results, data analysis and any conclusions to your team and broader ED staff via agreed channels.

Audit Form – NHMRC NICS Stroke and TIA Care Bundle

Project lead...

Audit period........ / .... / .... to .... / .... / ....

| Date | Patient ID | Assessment | | Urgent CT/MRI | Nil oral prior to BSS | Immediate aspirin, following CT | Physiological Monitoring | | | | ED LOS | ED Discharge Diagnosis | Bundle Completed |
| | | Stroke Screen | ABCD² for TIA | | | | Neuro | BP | Blood Glucose | Hydration | Hrs | Stroke /TIA | |
		Y / N	Y (or NA) / N	Y / N	Y (or NA) / N	Y (or CI) / N	Y / N	Y / N	Y / N	Y / N	Hrs	Stroke /TIA	Y / N
	# pts	#Y	# (Y + NA)	#Y	# (Y + NA)	# (Y + CI)	#Y	#Y	#Y	#Y	Median LOS	# Stroke #TIA	% complete

Feedback on this audit tool would be appreciated. Please forward comments to emergencycare@nhmrc.gov.au

Appendix D: Project plan template

PROJECT BACKGROUND	
Program Title:	National Institute of Clinical Studies (NICS) Acute Stroke and TIA Care Bundle
Program Aim:	To improve the assessment and management of acute stroke and TIA in the emergency department
Program Background:	In consultation with the NICS Emergency Care Community of Practice (EC CoP), stroke management in the emergency department (ED) has been identified as a clinical priority area. There are approximately 60,000 new and recurrent strokes in Australia each year. Around half of these people are over the age of 75 and as the population ages the number of strokes per year will increase. Stroke costs the Australian economy an estimated $2.14 billion per year. Effective early stroke treatment aims to promote maximum recovery and prevent costly complications and subsequent strokes. Given the ED setting and the varied requirements of acute stroke management, the care bundle approach was selected as an appropriate format for an ED evidence-implementation tool. The NICS stroke care bundle is based on evidence-based recommendations from the National Stroke Foundation (NSF) Clinical Guidelines for Acute Stroke.
Program Benefits:	Implementation of the care bundle will result in: • Accurate assessment of stroke care in the ED, via audit process. • Evidence based care consistent with national guideline recommendations. • Timely and accurate assessment of stroke and TIA in the ED. • Timely and appropriate clinical management of stroke and TIA in the ED.
Program Objectives:	1. Conduct a baseline audit to assess the current standard of acute stroke and TIA care. 2. Educate all staff on acute stroke assessment and management. 3. Complete all care bundle components for all stroke and TIA patients.

SCOPE OF THE PROJECT IN YOUR HEALTH SERVICE	
Insert organisation name here:	
Organisational Context	*Why is the project important for your emergency department? E.g. To improve outcomes in acute stroke and TIA patients, to narrow demonstrated evidence-practice gaps.*

This project will include:	**This project will not include:**
e.g. which clinical units will you involve?	*e.g. which units are not involved?*

Project Deliverables:	*What will you be delivering at the end of the implementation process? NOTE: these are the products you will have at the end of the process, e.g. an orientation program, improved awareness levels etc.*
Success Criteria:	*How will you measure the success of the implementation of the care bundle? NOTE: the success criteria must be specific and measurable.*
Resources:	*What are the resources required to undertake the project? NOTE: it is important to be fair and reasonable. Consider: people, space to meet and access to a computer and internet, etc.*
Linkages:	*Are there opportunities for this program to gain leverage or support from other groups? For example: quality improvement processes or programs, risk management programs.*
Project Assumptions:	*Project assumptions are circumstances and events that need to occur for the project to be successful but are outside the total control of the project team. They are listed as assumptions if there is a HIGH probability that they will in fact happen.*
Project Constraints:	*Project constraints are aspects about the project that cannot be changed and are limiting in nature. Constraints generally surround four major areas: scope, cost, schedule (time), and quality.* *Factors that are pre-determined that affect the project: imposed dates, dependence on other committees.* *Examples here can be specific. NOTE: only include time and money if they can be quantified.* *Scope: If the project scope is expanded, it is expected that the project schedule must also expand to accommodate the increased workload.* *Resources: If the project is constrained by access to resources, including skills, people and infrastructure or equipment.*

COMMUNICATION PLAN
Who is important to make this project successful?

Stakeholder	Position	What are their information needs?	How & when are you going to let them know?

PROJECT TEAM ROLES

Executive Sponsor:	*Who fulfils this role and what do they do?* *Role of the Executive Sponsor*
Clinical Leaders:	*Who fulfils this role and what do they do?* *Role of the Clinical Leader*
Project Team Coordinator:	*Who fulfils this role and what do they do?* *Role of the Project Coordinator*
Project Team Members:	*Who fulfils this role and what do they do.?* *Role of Project Team Members*
Key Contacts:	*Project Coordinator* — *Clinical Leader*
Start Date:	**Completion Date:**
Executive Sponsor	**Name:** — **Signature & Date:**

This template is available for download at :
www.nhmrc.gov.au/nics/programs/emergency/stroke_tia.htm

Appendix E: External review process

The NICS Stroke Care Bundle received comment from clinicians from each Australian State and Territory, and a number of international experts, in a two stage external review process.

In the first stage, only the care bundle itself was sent out for comment. Reviewers were supplied with the care bundle, a summary of care bundle theory, and the inclusion and exclusion decisions that had been made by the group. Reviewers were asked to comment on the inclusion and exclusion decisions made by the reference group and the specifics of the included care bundle components. All comments received by the cut-off date were discussed by the reference group on their merits and their applicability to the care bundle approach.

The final care bundle was then agreed by the NICS Stroke Reference Group.

Reviewers involved in the second stage of the process were asked to comment on the final draft of this document. In this stage, reviewers were asked to comment on the applicability of the document in the ED context and the supporting text, but not specifically on what is included in the care bundle itself.

External reviewer list

Ms Brenda Booth
Consumer
Member, Working Aged Group Stroke NSW
Member, NSF Clinical Guidelines for Acute Stroke Management
Expert Working Group

Associate Professor Helen M Dewey
Head of Inpatient Stroke, Austin Hospital VIC

Associate Professor Richard Gerraty
Neurologist, Alfred Hospital and Monash University VIC

Ms Louise James
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Dr Simon Judkins
Deputy Director Emergency Department, Austin Hospital VIC

Assistant Professor Eddy Lang
Department of Family Medicine, McGill University Canada

Dr Yusuf Nagree
Director Clinical Services, Armadale-Bentley Group WA
Deputy Director Emergency Medicine, Fremantle Health Service WA

Dr Kenneth Ooi
Director Emergency Medicine, The Queen Elizabeth Hospital SA

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District Director Emergency Medicine, Sunshine Coast - Wide Bay Health Service District QLD

Mr David Ramsay
Stroke Liaison Manager, Monash Medical Centre, Southern Health VIC

Appendix F: Levels of evidence and recommendation grading

Grading of recommendations[8]

Grade	Description
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution
✓	Recommended best practice based on clinical experience and expert opinion

Designations of levels of evidence according to type of research question[8]

Level	Intervention	Diagnosis	Prognosis	Aetiology	Screening
I	A systematic review of Level II studies	A systematic review of Level II studies	A systematic review of Level II studies	A systematic review of Level II studies	A systematic review of Level II studies
II	A randomised controlled trial	A study of test accuracy with an independent, blinded comparison with a valid reference standard, among consecutive patients with a defined clinical presentation	A prospective cohort study	A prospective cohort study	A randomised controlled trial
III-1	A pseudorandomised controlled trial (i.e. alternate allocation of some other method)	A study of test accuracy with an independent, blinded comparison with a valid reference standard, among consecutive patients with a defined clinical presentation	All or none	All or none	A pseudorandomised controlled trial (i.e. alternate allocation of some other method)
III-2	A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group	A comparison with reference standard that does not meet the criteria required for Level II and III-I	Analysis of prognostic factors amongst untreated control patients in a randomised controlled trial	A retrospective cohort study	A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study
III-3	A comparative study without concurrent controls: • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group	Diagnostic case-control study	A retrospective cohort study	A case-control study	A comparative study without concurrent controls: • Historical control study • Two or more single arm study
IV	Case studies with either post-test or pre-test/post-test outcomes	Study of diagnostic yield (no reference standard)	Case series, or cohort study of patients at different stages of disease	A cross-sectional study	Case studies

Appendix G: ROSIER scale

Recognition of Stroke in the Emergency Room (ROSIER)[18]

Assessment   Date: _____   Time: _____

Symptom onset   Date: _____   Time: _____

GCS   E=___ M=___ V=___   BP= ____ / ____   *BG= _____

*If BG < 3.5 mmol/L, treat urgently and reassess once blood glucose normal

Has there been loss of consciousness or syncope?   Y (-1) ☐   N (0) ☐

Has there been seizure activity?   Y (-1) ☐   N (0) ☐

Is there a NEW ACUTE onset (or on awakening from sleep)

I.	Asymmetric facial weakness	Y (+1) ☐	N (0) ☐
II.	Asymmetric arm weakness	Y (+1) ☐	N (0) ☐
III.	Asymmetric leg weakness	Y (+1) ☐	N (0) ☐
IV.	Speech disturbance	Y (+1) ☐	N (0) ☐
V.	Visual field defect	Y (+1) ☐	N (0) ☐

Total Score   _____ (-2 to +5)

Provisional diagnosis

☐ Stroke   ☐ Non-stroke (specify) _____

Note: Stroke is unlikely, but not completely excluded if total scores are ≤0.

	ROSIER (95% CI)	CPSS (95% CI)	FAST (95% CI)	LAPSS (95% CI)
Sensitivity	93 (89-97)	85 (80-90)	82 (76-88)	59 (52-66)
Specificity	83 (77-89)	79 (73-85)	83 (77-89)	85 (80-90)
Positive Predictive Value	90 (85-95)	88 (83-93)	89 (84-94)	87 (82-92)
Negative Predictive Value	88 (83-93)	75 (68-82)	73 (66-80)	55 (48-62)

Nor et al 2005[8,18]

Appendix H: Validated neurological assessment tools

The following tools, the Canadian Neurological Scale (CNS), the National Institutes of Health Stroke Scale (NIHSS), and the Glasgow Coma Scale (GCS) are provided as examples of validated tools that can be used by nurses or doctors for assessing neurological status.

Glasgow Coma Scale (GCS)[44]

The Glasgow Coma Scale is scored between 3 and 15, 3 being the worst and 15 being the best.

Best Eye Response (E)	Best Verbal Response (V)	Best Motor Response (M)
1. No eye opening	1. No verbal response	1. No motor response
2. Eye opening to pain	2. Incomprehensible sounds	2. Extension to pain
3. Eye opening to verbal command	3. Intelligible but inappropriate words	3. Flexion to pain
4. Eyes open spontaneously	4. Confused	4. Withdrawal from pain
	5. Orientated	5. Localising pain
		6. Obeys commands

Canadian Neurological Scale (CNS)[45-47]

Mentation		Score
Level of Consciousness	Alert	3.0
	Drowsy	1.5
Orientation	Orientated	1.0
	Disorientated/NA	0.0
Speech	Normal	1.0
	Expressive Deficit	0.5
	Receptive Deficit	0.0
Section A1 – No Comprehensive Deficit		
Motor Function	**Weakness**	**Score**
Face	None	0.5
	Present	0.0
Arm: Proximal	None	1.5
	Mild	1.0
	Significant	0.5
	Total	0.0
Arm: Distal	None	1.5
	Mild	1.0
	Significant	0.5
	Total	0.0
Leg: Proximal	None	1.5
	Mild	1.0
	Significant	0.5
	Total	0.0
Leg: Distal	None	1.5
	Mild	1.0
	Significant	0.5
	Total	0.0
Section A2 – Comprehensive Deficit		
Motor Function	**Weakness**	**Score**
Face	Symmetrical	0.5
	Asymmetrical	0.0
Arms	Equal	1.5
	Unequal	0.0
Legs	Equal	1.5
	Unequal	0.0

National Institutes of Health Stroke Scale (NIHSS)

The NIHSS should only be used by trained clinicians.

Please see the NIHSS website for the original version of the scale, along with a number of free training tools: **http://www.nihstrokescale.org/**

Appendix I: Table of potential barriers

Level of Health Care	Potential Barriers	Examples
The innovation itself	• Feasibility • Credibility • Accessibility • Attractiveness • Advantages in practice	Clinical practice guidelines may be perceived as inconvenient or difficult to use (Cabana et al., 1999). Guidelines recommending the elimination of an established clinical practice, such as screening for lung cancer with chest x-rays, may be more difficult to follow than guidelines that recommend adding a new behaviour (Cabana et al., 1999).
Individual professional	• Awareness • Knowledge • Attitude • Motivation to change • Behavioural routines	Clinicians may not agree with a specific guideline or the concept of guidelines in general (Cabana et al., 1999). Clinicians may not have the motivation to change (Cabana et al., 1999) or may not feel competent to provide specific services such as counselling about exercise or diet (Oxman and Flottorp, 1998).
Patient	• Knowledge • Skills • Attitude • Compliance	Patient may expect certain services such as the prescription of antibiotics for upper respiratory infections (Oxman and Flottorp, 1998).
Organisational context	• Care processes • Staff • Capacities • Resources • Structures	Burdensome paperwork or poor communication may inhibit provision of effective care (Oxman and Flottorp, 1998).
Social context	• Opinion of colleagues • Culture of network • Collaboration • Leadership	Local opinion leaders may encourage the use of forms of care that have not been shown to be effective, such as screening for ovarian or prostate cancer (Oxman and Flottorp, 1998).
Economic and political context	• Financial arrangements • Regulations • Policies	Reimbursement systems may promote unnecessary services or discourage best practice (Oxman and Flottorp, 1998).

NICS, 2006[48]

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