STROKE FOUNDATION OF NEW ZEALAND INC

Reducing Risks, Improving Outcomes

National Acute Stroke Services Audit 2009

ISBN (print): 978-0-9582619-7-5
ISBN (electronic): 978-0-9582619-8-2

This report can be downloaded from
www.stroke.org.nz

Stroke Foundation of New Zealand
Level 1, Thorndon Rise,
95-99 Molesworth St
P O Box 12482
Wellington
Telephone: 0800 787 653
Email: strokenz@stroke.org.nz

Designed by Element Design

Suggested citation
Stroke Foundation of New Zealand.
National Acute Stroke Services Audit 2009.
2010. Stroke Foundation of New Zealand.
Wellington, New Zealand

About the Stroke Foundation of New Zealand

Established in 1981, the Stroke Foundation of New Zealand is a not-for-profit organization working to reduce the incidence of stroke and improve outcomes after stroke.

The Foundation's primary purposes are to:
- Save lives
- Improve outcomes
- Enhance life after stroke for the community affected by stroke.

The Foundation seeks to achieve these by:
- Educating the public about risk factors and signs of stroke and promoting healthy lifestyles.
- Working with health service providers to improve access to, and delivery of, the highest quality stroke services.
- Providing community based support and information services.

Contents

LIST OF TABLES

LIST OF FIGURES

APPENDICES

REFERENCES

About this report

REPORT PREPARATION

This report is based on work undertaken by the team writing on behalf of the Australian National Stroke Foundation and the National Stroke Audit Collaborative (listed in Appendix A). The framework and content afforded by their work is acknowledged by the New Zealand writing team (listed alphabetically below).

P Alan Barber
Consultant Neurologist and Director of Stroke Service, Auckland City Hospital; Neurological Foundation of New Zealand Professor of Clinical Neurology, Auckland University; Honorary Medical Advisor, Stroke Foundation of New Zealand (Northern Region).

John Fink
Consultant Neurologist and Co-director of Stroke Services at Christchurch Hospital; Honorary Medical Director, Stroke Foundation of New Zealand.

Shelley Jones (coordinating writer)
Audit Coordinator, Stroke Foundation of New Zealand.

Mark Vivian
Chief Executive Officer, Stroke Foundation of New Zealand.

Kevin Voges (statistical analysis)
Associate Professor and Head of Department of Management, College of Business and Economics, Canterbury University.

ACKNOWLEDGEMENTS

The 2009 National Acute Stroke Services Audit was made possible by funding from the New Zealand Ministry of Health.

The web based data collection tool was developed by Netsolving Ltd (Australia).

The Australian organisations supporting an ongoing audit programme are the National Stroke Foundation, National Stroke Audit Collaborative and National Advisory Committee. The Stroke Foundation of New Zealand was pleased to partner with them.

Within DHBs, 76 people in clinical and coordinating roles undertook the audit, and were supported by managers and advisors who facilitated their involvement. Without their participation, the audit would not have been possible.

Glossary/Definitions

ADL
Activities of daily living. The basic elements of personal care.

ASSF category/DHB classification
There are four categories of hospital level stroke service (A-D) given in the *Australian Acute Stroke Services Framework* (NSF 2008). For the purposes of this audit and report, New Zealand DHB categories (A/large DHB, B/medium DHB, C/small DHB) relate to population served and the predicted number of stroke admissions per year, based on Health Roundtable figures (www.healthroundtable.org).

Auditors
Those staff members in participating DHBs who completed the Organisational Survey and Clinical Audit (of patient records) on behalf of their organisation.

CT
Computerized tomography is a method of scanning the brain of people suspected of having a stroke.

DHB
District Health Board.

DVT
Deep vein thrombosis. A clot of blood in the deep veins of the leg, arm or abdomen.

FTE
Full time equivalent describes the number of hours or days worked per week with 1.0 being full time work and 0.2 being one day a week.

ICD10
The International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) is a coding of diseases and signs, symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases, as classified by the World Health Organization.

IDUC
Indwelling urinary catheter.

IQR
Inter quartile range is the range between 25th and 75th percentile which is equivalent to the middle half of all values.

Known N
Known N is the number of eligible cases for any indicator that is being measured. It excludes from the denominator cases that do not qualify to be analysed, e.g. the Known N for analysis of treatment with antithrombotic medication would include ischaemic stroke patients only.

New Zealand guideline for management of stroke
The New Zealand stroke care guideline, *Life after stroke. New Zealand guideline for management of stroke* (Baskett and McNaughton 2003) was published by the Stroke Foundation of New Zealand. An updated New Zealand guideline is being developed for publication in late 2010.

MDT
Multidisciplinary team consists of medical, nursing and allied health practitioners

MOH
Ministry of Health, New Zealand.

MRI
Magnetic resonance imaging is a method of scanning the brain in suspected stroke patients.

mRS
Modified Rankin Score. A global disability scale that records a patient's functional ability with a score that ranges between 0 and 6 (0 = no symptoms, 6 = death).

NSF
National Stroke Foundation (Australia). The NSF is a not-for-profit organisation which works with the public, government, health professionals, patients, carers and stroke survivors to reduce the impact of stroke on the Australian community.

OT
Occupational therapist.

Oxford Classification
The Oxford Community Stroke Project (OSCP) classification, also known as the Oxford classification, for acute ischaemic stroke relies primarily on the initial symptoms. Based on the extent of the symptoms, the stroke episode is classified as total anterior circulation infarct (TACI), partial anterior circulation infarct (PACI), lacunar infarct (LACI) or posterior circulation infarct (POCI). These four entities predict the extent of the stroke, the area of the brain affected, the underlying cause, and the prognosis.

Participants
The participating DHBs are referred to as participants in the 2009 National Acute Stroke Services Audit.

People with stroke
Preference is to use the term 'people with stroke' in general, and 'patient' for hospitalised period. Note that cited Australian material uses the term 'stroke survivor'.

Primary and secondary prevention
Primary prevention is the prevention of a disease before it occurs; secondary prevention is the prevention of recurrences or exacerbations of a disease that already has been diagnosed.

SFNZ
Stroke Foundation of New Zealand.

SLT
Speech language therapist.

Statistical discharge
Statistical discharge may occur when patient care transfers from an acute service to a rehabilitation service while remaining within the same hospital or ward. The patient is then administratively discharged (and readmitted) solely for contractual or statistical purposes without need for a formal clinical discharge (and readmission) to occur at that point in their care.

Stroke Unit
Factors determining 'stroke unit' status as defined for the audit were combined in the statistical analysis. In New Zealand, the 'organised stroke services' concept was promulgated in *Life after stroke. New Zealand guideline for management of stroke* (Baskett and McNaughton 2003) and is presented in Appendix D. The co-location of stroke beds without other features of stroke service organisation does not warrant categorisation as stroke unit.

SUTC
Stroke Unit Trialists' Collaboration. A specialty group within the Cochrane Collaboration.

TIA
Transient ischaemic attack is where all the symptoms of a stroke disappear within a 24 hours of onset.

Thrombolysis
Refers to the process where the intravenous drug recombinant tissue plasminogen activator (rt-PA) is used to break up a blood clot.

Executive summary

The findings of the 2009 National Acute Stroke Services Audit provide a stocktake of acute stroke services in New Zealand District Health Boards (DHBs), and a benchmark against which to compare subsequent improvement and development of services. This audit concentrates solely on the provision of acute stroke services, and does not cover stroke rehabilitation services or hospital care beyond seven days of stroke onset. A national audit of stroke rehabilitation services is planned.

The National Acute Stroke Services Audit comprises two parts: an Organisational Survey of structural and process elements of stroke service provision; and a Clinical Audit involving retrospective review via patient record of up to 40 consecutive stroke patients admitted, treated and discharged from acute care in individual DHBs between 1 June 2008 and 31 December 2008. The presentation of findings from both parts in this integrated report means that organisational intentions related to the provision of service to people with acute stroke can be compared with the care documented in patient records as actually delivered. However, an important caution is that 'documented care' may not reflect care received, and an important conclusion is that documentation itself is a priority area for improvement.

All 21 DHBs provide acute stroke care, and all participated in the Organisational Survey. The Clinical Audit provided a cohort of 832 records from all but one small DHB, and the sample can therefore be considered representative of the patient experience of acute stroke care in New Zealand:

- More than half the audited stroke patients were aged over 77 years; 48% were male and 52% female
- Ethnicity was recorded as Maori for 13% and Pacific for 3%
- Most of the audited patients had been independent prior to their stroke (66%, mRS<=2) and 90% lived at home
- Three quarters of the audited patients were diagnosed with an ischaemic stroke
- Half of the audited patients had multiple pre-existing stroke risk factors at the time of admission.

ORGANISED STROKE SERVICE PROVISION

A recent review of evidence determined that '...absolute benefits of organised inpatient (stroke unit) care appear to be sufficiently large to justify the reorganisation of services' (SUTC 2007):

> Organised stroke unit care is a form of care provided in hospital by nurses, doctors and therapists who specialise in looking after stroke patients and work as a co-ordinated team. This review of 31 trials, involving 6936 participants, showed that patients who receive this care are more likely to survive their stroke, return home and become independent in looking after themselves. A variety of different types of stroke unit have been developed. The best results appear to come from those which are based in a dedicated ward.

Life after stroke. New Zealand guideline for management of stroke (Baskett and McNaughton 2003) recommended levels of organisation for DHBs according to the population serviced and the number of expected strokes and stroke admissions per year. In large, medium and small DHBs, people with stroke should receive care from a coordinated multidisciplinary team (MDT) which includes (or consults with) a designated stroke clinician and which utilises written protocols and has a regular staff education programme about stroke. Specialised stroke units (geographically either separate or designated within a general unit) integrating acute and rehabilitation care were recommended for large DHBs and a defined area (i.e. separate or designated) within a general unit for acute care in medium DHBs.

The definition of stroke unit for audit purposes is 'a discrete ward or beds within a ward with a dedicated specialized multidisciplinary team'.

The Organizational Survey found that there are eight stroke units in the 21 DHBs, fewer than would be expected across 13 large and medium DHBs. Auditors reported a total of 83 dedicated beds in stroke units. Of 6,194 acute stroke patients admitted in 2008, 82% were admitted to large and medium DHBs and 36% to DHBs with stroke units. Of the 128 audited patients who were thrombolysed in the year prior to survey, almost all had been admitted to large DHBs or DHBs with stroke units.

On the day of survey, there were 176 acute stroke patients in New Zealand, of whom 39% were in stroke units. In comparison, 51% of acute stroke patients in participating Australian hospitals were in stroke units on the day of survey. Even in DHBs with stroke units, only 64% of acute stroke patients were actually in the stroke unit on the day of survey, suggesting ongoing problems with stroke unit access even where provided. The level of stroke unit care in New Zealand is low by international comparison: 74% in the United Kingdom (Royal College of Physicians of London 2008), >80% in Scandinavian countries (Kaste *et al* 2006).

In the Organisational Survey, 75% of DHBs with stroke units reported that the usual first admission ward for people with stroke was the stroke unit. However, Clinical Audit findings were that only 52% of people with stroke admitted to DHBs with a stroke unit actually receive stroke unit care at any point during their admission. This compares poorly with the situation in Australia, where 74% of stroke patients admitted to hospitals with a stroke unit spend time in the stroke unit.

EARLY RECOGNITION, DIAGNOSIS AND TREATMENT OF STROKE

Thrombolytic therapy with intravenous recombinant tissue plasminogen activator (rt-PA) given within 4.5 hours of stroke symptom onset is proven to reduce the combined endpoint of death and disability for ischaemic stroke (Wardlaw *et al* 2009). Despite differences in rates of stroke unit care between New Zealand (39%) and Australia (51%), only 3% of stroke patients in both countries were treated with rt-PA.

The great majority of the New Zealand population (>80%) now live in catchment areas where DHBs offer acute stroke thrombolysis. Improvement in time of presentation to hospital after stroke onset is an urgent priority and substantial improvement in the performance of these thrombolysis services is required.

The main barriers to early delivery of thrombolytic therapy (Nazir, Petre and Dewey 2009) are discussed in relation to audit findings below:

- Difficulties in patient recognition of stroke symptoms and delay in seeking appropriate emergency help.
- Delays in reaching hospital by ambulance. While 75% of audited patients with acute stroke arrived by ambulance, only one third of patients with a known time of symptom onset actually reached hospital within three hours and only 38% reached hospital within four hours. Only 10% of DHBs reported arrangements with ambulance services.
- Triaging priorities in emergency departments (EDs). Less than half of DHBs reporting that their ED had protocols for acute stroke care.
- Delays in obtaining urgent imaging. All DHBs have onsite CT brain scanning and 24 hour access to CT. Most DHBs have onsite MRI and most can provide access within 24 hours when this is required. Further, 88% of all audited patients received brain imaging within 24 hours. However, while all DHBs have onsite ultrasound carotid Doppler and two-thirds can provide access within 24 hours, only 22% of audited patients had carotid imaging studies while still in hospital, compared to 50% of all Australian audited patients.

People with transient ischaemic attack (TIA) are at a higher risk of completed stroke than the general population, and rapid assessment and management should be undertaken:

- Adherence to the 2008 *New Zealand guideline for the assessment and management of people with recent transient ischaemic attack* (TIA) (Gommans, Barber and Fink 2008)

may be reflected in the use of stratification tools. Just over 80% of DHBs used a stroke risk stratification tool to guide management decisions in patients with TIA. This compares favourably with Australia, where just under 40% of Australian hospitals use such tools. However, 33% of DHBs still need to establish a documented pathway for assessing people presenting with TIA. It is not clear that the frequency of outpatient clinics – where provided - is sufficient to meet the standards for time to assessment in the New Zealand TIA guideline.

COMPREHENSIVE ASSESSMENT BY MULTIDISCIPLINARY TEAM

Comprehensive assessment and management of acute stroke patients cannot be provided without appropriate staffing, staff training, and communication systems between MDT members:

- New Zealand MDTs are more likely to have neurologists and specialist nurses as members than Australian teams. However, the level of neurologist involvement is substantially lower in New Zealand than Australia.
- DHBs with stroke units are more likely to have protocols in place for referral to physiotherapist, speech language therapist (SLT), occupational therapist (OT), dietitian, social worker than those without stroke units.
- Full time equivalents (FTEs) per 10-bed stroke unit are less in New Zealand than Australia for advanced medical trainees, clinical psychologists, dietitians, neurologists and social workers.
- DHBs with stroke units were more likely to have access to a programme of continuing education, but rates of provision of onsite or offsite training appear low in medium and small DHBs.
- Almost all DHBs report using integrated patient records.
- Multidisciplinary teams in all DHBs meet regularly and those MDTs in DHBs with stroke units meet more frequently than those without stroke units. MDTs in New Zealand meet more frequently than those in Australia.
- Most DHBs reported using agreed assessment protocols for common impairments after stroke, but less than two thirds had protocols for management of hydration and mood.

Early assessment is important to early rehabilitation and prevention of complications. Most audited patients received appropriate assessments, but these assessments were frequently delayed.

- The rates of physiotherapy, occupational therapy and social work assessment for eligible patients is similar in New Zealand and Australia. There are lower assessment rates in New Zealand by SLTs and dietitians.
- Prompt dysphagia screening is considered a fundamental component of stroke care. Rates of documented swallow screening during admission and before food, drink or oral medications are given appear unacceptably low and must be addressed with urgency.
- Delay to physiotherapy, occupational therapy, speech language therapy and dietitian assessments is longer in DHBs without stroke units. These assessments tend to be undertaken later in New Zealand than in Australia. The implication is that rehabilitation processes start later in New Zealand than in Australia, extending length of stay in hospital. It is very likely that New Zealand stroke services would benefit from greater involvement from specialist stroke physicians, social workers, dietitians and clinical psychologists to levels that are more similar to those in Australia.

PREPARING FOR DISCHARGE

Setting goals for treatment, rehabilitation and discharge in conjunction with the patient is considered essential to successful reintegration into the community, yet people with stroke and their families and carers often report that insufficient attention and resources are provided.

- DHBs with stroke units were more likely to report offering family meetings and information on local community care arrangements than DHBs without stroke units. Two-thirds of stroke services in both New Zealand and Australia reported providing family meetings. However, only a fifth (20%) of audited New Zealand patients were actually documented as having a family meeting, compared with just over a quarter (27%) of audited Australian patients.

- It appears that New Zealand DHBs are much more likely to provide stroke specific literature and community-based stroke support groups than Australian services. It is likely that the frequent involvement of Stroke Foundation of New Zealand (SFNZ) field workers accounts for this difference.

- DHBs with stroke units were more likely to report providing routine assessments of further need for rehabilitation and access to early supported discharge. However access to early supported discharge was generally low.

- Only half of DHBs reported routinely providing a discharge care plan and two-thirds did not have protocols for reviewing patients post-discharge. Rates of documentation that a discharge care plan had been provided were lower in audited New Zealand patients (42%) than in Australian patients (53%). There were also lower rates of documentation that patients had received stroke education by discharge in New Zealand (32%) than Australia (43%).

- Documentation of a home visit by an OT was low in both New Zealand and Australian audited patients (13%). Audited patients were more likely to be present at the time of the visit in New Zealand (83%) than in Australia (64%).

- Overall, the rates of use of discharge care plans, and documentary evidence of patient education at discharge, carer training and carer need assessment are low and appear as areas for improvement.

- The documented rates of the use of secondary prevention medications in audited patients were similar in DHBs with and without stroke units, and were comparable in New Zealand and Australian audited patients.

PRIORITY AREAS

Table 1: Priority areas by Australian and New Zealand totals and DHB stroke unit status

	Aust total	NZ total	SU	No SU
% of acute stroke patients in stroke unit on day of survey	**51%**	**39%**		
% of patients receiving stroke unit care	**49%**	**28%**		
Ambulance service protocols for rapid transfer	**21%**	**10%**	25%	0%
ED protocols for rapid triage	**48%**	**43%**	63%	31%
Stroke service offers thrombolysis	**28%**	**67%**	87%	54%
Thrombolysis offered 24 hrs	**77%**	**43%**	57%	29%
Aspirin given within 48 hours (if ischaemic stroke)	**62%**	**21%**	21%	21%
Staff access to continuing stroke education	**42%**	**57%**	87%	38%
IDUC within one week of admission	**26%**	**20%**	20%	21%
Incontinent patients with continence plan	**32%**	**19%**	9%	26%
DVT prophylaxis for patients unable to walk	**68%**	**18%**	19%	17%
Carotid artery imaging while in hospital:	**50%**	**22%**	19%	24%
Assessed by physiotherapy within 48 hrs	**58%**	**41%**	51%	34%
Assessed by occupational therapy within 48 hrs	**37%**	**18%**	24%	13%
Assessed by SLT within 48 hrs	**60%**	**35%**	43%	30%
Swallow screened during admission *	**79%**	**57%**	63%	54%
Assessed by dietitian within 48 hrs **	**26%**	**9%**	9%	9%
Use of a stroke register	**24%**	**43%**	63%	31%

* Includes SLT swallow assessment
** If dysphagia/nutrition/hydration problems.

RECOMMENDATIONS

There are deficiencies in the management of people with stroke in many DHBs. It is clear that there are several DHBs which fall far short of the minimum standards for organized stroke services as defined in Life after stroke: New Zealand guideline for management of stroke (Baskett and McNaughton 2003). Such DHBs should see the correction of these deficiencies as a priority. Minimum standards for organized stroke services will be revised in the updated 2010 guideline.

For District Health Boards

That stroke care teams, including managers responsible for stroke services:

- Review their stroke service provision, appropriate to DHB size, against the recommendations given in *Life after stroke. New Zealand guideline for management of stroke* (Baskett and McNaughton 2003), and the revised guideline to be released in late 2010.
- Review their DHBs stroke service provision against the key messages and results given in this report to identify areas where they are doing well and where they need to improve.
- Formulate and implement plans to address gaps in relation to organisation and provision of services.
- Participate in a national audit of acute services in 2011 to enable ascertainment of the standard of service or improvement where required.

For the Stroke Foundation

That the Stroke Foundation:

- Seeks funding to partner with the National Stroke Foundation (Australia) to offer DHBs the opportunity to participate in a national audit of acute services in 2011, thus enabling a clear indication of progress in the provision of services to people with stroke.
- Facilitate the utilisation of recognised protocols by supporting the development of clinical networks; and by sourcing a 'bank' of protocols (e.g. best practice examples of formal arrangements with local ambulance services and protocols for rapid triage in ED), suited to small, medium and large DHBs, and making these available on the Stroke Foundation website for DHBs to adopt and adapt.

For the Ministry of Health

That the Ministry of Health:

- Targets implementation of the 2010 New Zealand stroke guideline to priority areas identified in the 2009 National Acute Stroke Services Audit
- Funds the Stroke Foundation to offer DHBs the opportunity to participate in a national audit of acute services in 2011.

Chapter 1

Introduction

KEY MESSAGES:

Evidence-based stroke care reduces death and disability.

Feedback from audit can influence and change clinical practice.

STROKE IN NEW ZEALAND

In 2009 there were approximately 6,000 first ever and 2,000 recurrent strokes in New Zealand. More than 90% of people with stroke in New Zealand were admitted to hospital (Tobias *et al* 2007). Stroke is New Zealand's third biggest killer after all cancers combined and heart disease. Stroke is the greatest cause of long term adult disability. The annual lifetime costs of stroke in New Zealand were estimated for 2007 at $450 million (Brown 2009).

The Diabetes and Cardiovascular Disease Quality Improvement Plan 2008 (QIP) identifies the improvement of stroke services as a priority. However, the QIP also recognizes that 'Comparable national data for stroke, stroke services and stroke outcome are sparse relative to such data for coronary heart disease and diabetes' (MOH 2007:40). This lack of data means that DHBs are hampered in evaluating and benchmarking their service provision for stroke.

EVIDENCE-BASED STROKE CARE

Organised stroke unit care is a form of care provided in hospital by MDTs of clinicians who specialise in looking after stroke patients and work together as a co-ordinated team. A review of 31 trials involving 6936 participants, showed that patients who receive care in a stroke unit are more likely to survive their stroke, return home and become independent than those cared for in a general ward. While a variety of different types of stroke unit have been developed, the best results appear to come from those which are based in a dedicated ward. The review concluded that the absolute benefits of organised inpatient (stroke unit) care appear to be sufficiently large to justify the reorganisation of services (SUTC 2007).

Evidence-based stroke care has been proven to reduce death and disability. For example, aspirin within 48 hours of ischaemic stroke and rt-PA within 4.5 hours of stroke onset is associated with significantly improved outcomes (Sandercock *et al* 2008, The ATLANTIS ECASS and NINDS rt-PA Study Group Investigators 2004).

However, evidence-based care does not always occur in clinical practice. It has been reported that 30 to 40% of patients do not receive treatments proven to be effective. In addition, 20 to 25% of patients receive unnecessary or potentially harmful treatments (Grimshaw and Eccles 2004).

Audit is one of many strategies used in programmes to improve the delivery of evidence-based care. It is a process of assessment that can be used to motivate or guide behaviour change. International experience has shown that audit can be effectively used to influence and change clinical practice (Jamtvedt *et al* 2006, Irwin *et al* 2005, Cadhilac *et al* 2008, Schwamm *et al* 2009).

THE 2009 NATIONAL ACUTE STROKE SERVICES AUDIT

The 2009 National Acute Stroke Services Audit (2009 Audit) was an initiative of the Stroke Foundation of New Zealand (SFNZ), in collaboration with the Australian National Stroke Foundation (NSF). The 2009 Audit determined what resources are available to support the delivery of evidence-based care and examined conformance of clinical practice with evidence-based best practice recommendations. It was expected that the findings would provide a useful national benchmark in the ongoing development and review of acute stroke care delivery. Ideally the exercise is repeated biennially to provide longitudinal data on clinical performance, and alternates between audit of acute and post-acute services.

The New Zealand Ministry of Health supported the 2009 Audit, and contracted SFNZ to undertake it in DHBs from 1 April to 30 June 2009.

Thus the 2009 Audit aimed to:

1. Characterise the nature of acute stroke services in New Zealand.
2. Identify resources available to support the delivery of evidence-based care.
3. Identify priority areas where focused strategies linked with resource provision may facilitate evidence-based stroke care.
4. Monitor how well recommendations in current stroke guidelines available to New Zealand stroke services are being implemented.
5. Enable DHBs to benchmark against similar DHBs nationally.
6. Provide data to form the basis of a cycle of ongoing quality improvement.
7. Foster a culture of audit and feedback.

The 2009 Audit comprised two components:

- An **Organisational Survey** of stroke services in DHBs across New Zealand. The survey examined the resources required to deliver evidence-based stroke care such as stroke units, imaging (including CT), and MDT meetings. The self-reported data was provided by a nominated member of the DHB auditing team. The Organisational Survey questions are found in Appendix B.

- A **Clinical Audit** involving retrospective review of up to 40 consecutive cases admitted to participating District Health Boards during a defined timeframe. The Clinical Audit examined process of care such as diagnostic procedures (CT, MRI and carotid ultrasound), early interventions (such as rt-PA and aspirin) and the way in which the evidence-based recommendations are delivered. Timing of the delivery of aspects of care is also considered. The Clinical Audit questions are found in Appendix C.

THE 2009 NATIONAL ACUTE STROKE SERVICES REPORT

Findings in the Organisational Survey and Clinical Audit are integrated in this national report, along with discussion and recommendations. Thus, areas of excellence or need identified in the Clinical Audit are informed by the description of resource organisation and availability obtained from the Organisational Survey.

The process of audit and feedback supports informed decision-making directed to improving care delivered to stroke patients. Audit and feedback are a crucial part of guidelines implementation and core components in a cycle of continuous quality improvement. Audit findings may also be used to inform planning at a local, regional or national level to improve outcomes associated with stroke.

USING THE REPORT TO REVIEW SERVICES

The Report has been designed to support discussion within clinical teams. In addition to the national report, each DHB is supplied with a confidential report giving their own data (in the table column headed 'Your DHB') alongside national data. There is a prompt for team discussion of implications in each section: 'What the key messages and/or findings [in this section] mean for our DHB's stroke service...'. A sample page is given in Appendix 5.

[a] Note that *Life after Stroke. New Zealand guideline for management of stroke* (Baskett and McNaughton 2003) will be superseded by updated clinical guidelines for stroke management to be published by SFNZ in late 2010. For the purposes of the 2009 Audit and Report, the 2007 *National Clinical Guidelines for Acute Stroke Management* published by the National Stroke Foundation (Australia) are most commonly referenced.

Chapter 2

Audit Approach

Collaboration with National Stroke Foundation

KEY MESSAGES:

Evidence-based stroke care reduces death and disability.

Feedback from audit can influence and change clinical practice.

Australia's National Stroke Foundation (NSF) first ran a national audit of acute stroke services in 2007, in which five New Zealand DHBs participated. The NSF audit programme alternates audit of acute and rehabilitation services, and repetition of the acute stroke services audit in 2009 was seen by SFNZ as an opportunity to identify strengths and weaknesses in the provision of stroke care by DHBs. This collaboration offered significant efficiencies for New Zealand participation, and a locally-based Audit Coordinator worked closely with the NSF audit programme team.

The National Stroke Audit Acute Services Organisational Survey Report (NSF 2009b) reports on participation in the Organisational Survey by 206 Australian hospitals, and the National Stroke Audit Acute Services Clinical Audit Report (NSF 2009a) on the Clinical Audit of 3307 patient records (excluding reliability cases) by 96 Australian hospitals.

Methods

DEVELOPMENT OF ORGANISATIONAL SURVEY AND CLINICAL AUDIT QUESTIONS

Questions for the 2009 Audit were reviewed using the 2007 National Stroke Audit indicator set and *Clinical Guidelines for Acute Stroke Management* (NSF 2007a). This review was undertaken by the Australian National Advisory Committee, which included New Zealand representation (Appendix A gives Committee membership). Some new indicators were introduced, and some existing indicators were also modified in order to clarify terminology and increase epidemiological soundness. Auditor feedback in 2007 relating to clinical relevance and meaningfulness prompted provision of extra response options, enhancing validity and reliability.

To reflect the New Zealand situation and terminology for ethnicity, discharge destination and medication names, adjustments were made to the handbooks and on-line audit tool (via 'Help' options) by the Audit Coordinator in consultation with SFNZ Medical Advisors.

The questions as they appeared for New Zealand auditors for the Organisational Survey and Clinical Audit components are presented in Appendices B and C respectively.

INVITATION TO DHBS TO PARTICIPATE

The Chief Executive of SFNZ wrote to all 21 DHB Chief Executives in early 2009, inviting participation in a national audit of acute stroke services.

Senior medical, nursing, allied health and operational management staff had been identified and were copied in to this correspondence, as they were understood to have a key part to play in the conduct of the audit. A summary of what participation in the Audit would entail was included as a set of Frequently Asked Questions, and access to the web-based data entry tool (webtool) was provided to enable potential auditors a preview.

RECRUITMENT OF AUDITORS AND SET UP

Early responses were received from about half of the 21 DHBs and followup by the Audit Coordinator saw 20 DHBs commit to participating in both the Organisational Survey and Clinical Audit. One small DHB elected to participate in only the Organisational Survey. Expected benefits of staff development and service improvement were outlined in the initial invitation, and the demand on staff time was recognised in a reimbursement offered by SFNZ for involvement.

A key person at each DHB was asked to liaise with Medical Records personnel to ensure the timely availability of sufficient patient records meeting the criteria for auditing. Case inclusion/exclusion criteria (including ICD 10 codes) were supplied.

There were 76 people directly involved in data collection in the Organisational Survey and Clinical Audit, primarily from medical (57%), nursing (48%) and allied health professions (10%), with a few from quality and planning roles (14%). Note that percentages sum to more than 100%, as audit teams typically had two or three members. In some DHBs nurse advisers and service managers were also closely involved in supporting the audit teams.

Audit teams were requested to take various responsibilities amongst themselves:

- a senior person to take responsibility for data quality in the Organisational Survey
- 40 patient records were to be audited in the Clinical Audit
- availability as a contact person for any enquiry through the data analysis stage.

The majority of Organisational Surveys were completed by audit team members with a medical background (60%). In the Clinical Audit, the majority of patient records were audited by team members with a nursing background (72%), and the balance by those with a medical (20%), allied health (8%) or quality (<1%) backgrounds.

TRAINING

Auditors were organised in DHB teams for training as close as possible to when they would begin auditing. An hour of on-line training was provided via teleconference by the NSF National Audit Program Manager and Audit Project Officer. Use of the screening log, and the operational functions of the web-based data entry tool were covered. Training also reinforced that responses could be recorded only where there was documented evidence for process of care indicators. At the completion of the training session, auditors were supplied with a data dictionary which included rationales for all questions, and definitions and help-notes about the data required. Auditors were able to post case specific queries on-line with the Australian audit team, and to call or email them as well as the New Zealand based Audit Coordinator.

DATA COLLECTION

Data collection occurred as auditors and patient records were available, in the period April to August 2009.

All 21 DHBs provide acute stroke care, and all participated in the Organisational Survey. Twenty DHBs participated in the Clinical Audit in which patients must have been admitted, treated and discharged from acute care between 1 June 2008 and 31 December 2008. The Clinical Audit is held to be nationally representative of acute stroke care as all but one small DHB participated in the Clinical Audit.

Sixteen (67%) DHBs provided 40 or more cases for the audit. The minimum number of cases audited by any one DHB was 29 and the maximum 59. Case numbers were smaller than expected in smaller DHBs, where there were fewer patients admitted during the period defined for the Clinical Audit. Case numbers were higher than expected in those DHBs where acute admissions from more than one hospital were included for the DHB, or when auditors decided to audit total admissions for the audit time period. The average numbers of cases from the three DHB categories (see Figure 1) were: large [n=40], medium [n=46], and small [n=40].

A confidential screening log was used to ensure audit of patient records of the first 40 consecutive acute stroke admissions met diagnostic inclusion criteria. Patients must have been admitted, treated and discharged from acute care between 1 June 2008 and 31 December 2008.

Security and confidentiality were maintained by assigning DHBs with a site code and password, each of which had to be entered in order to access the webtool.

The webtool allowed auditors to enter and monitor data via a standard internet connection. The webtool included specific help notes for the interpretation of each question asked. Help was available through the NSF project team and the New Zealand Audit Coordinator at all stages of data entry.

The webtool was capable of significant administrative functions which facilitated monitoring by the project team, and enabled consultation with auditors where data was inconsistent or incorrect.

DATA VERIFICATION

Programmed data logic checks were used at two levels:

1. Those written into the webtool programme which ensured consistency in responses between primary questions and their subcategories.

2. Prior to analysis, data was subjected to a comprehensive logic check programme run by staff at the National Stroke Research Institute (NSRI) in Melbourne, Australia. This enabled cross-referencing between a DHB's Organisational Survey and Clinical Audit data.

Additionally, each DHB had received a copy of their raw data in an Excel spreadsheet to check and make any correction necessary before the final analyses were undertaken.

DATA ANALYSIS

Data analysis was undertaken by the Public Health Division at the National Stroke Research Institute (NSRI). To ensure confidentiality, DHB data sets were de-identified prior to transmission for analysis, with a site identification number allowing re-identification by NSF, to enable the provision of individual site reports.

The data were analysed using PASW Statistics Version 18.0. The data were exported from the web-based database as an Excel spreadsheet and transferred into PASW.

Organisational Survey response data were then recoded into variable definitions recording Yes=1, No=0, and Unknown=9. Variables were derived from the data for DHB category and stroke unit status.

Variable definitions used for recoding Clinical Audit response data included 'no, but', 'not applicable', 'not recorded', '*Not documented*', 'unknown' and 'no access to therapist'.

Some Clinical Audit questions enabled development of derived variables, which allow for more accurate reporting by removing potential for responder bias. For example, a derived variable was created for DVT prophylaxis and included treatment with either TED stockings or heparin.

Adherence to processes of care was generally calculated on the entire sample. In some instances, eligibility criteria for processes of care were specified. For example, adherence to the process of care relating to the use of antithrombotic agents on discharge was calculated only for patients diagnosed with ischaemic stroke. When reporting adherence to care, 'Known N' refers to all eligible patients for whom data were reported, and excludes missing data. For processes of care where eligibility criteria were specified, a note is made in the rationale or in the table title. The median (50th percentile) and interquartile (25th and 75th percentiles) ranges were reported for skewed data from questions, such as the time to assessment and length of stay.

CATEGORIES FOR ANALYSIS: ORGANISATION SURVEY

All organisational data from DHBs were aggregated to provide national estimates. Results are provided according to DHB categories and stroke unit status (with stroke unit or with no stroke unit). The median (50th percentile) and interquartile (25th and 75th percentile) ranges were reported for continuous data from questions such as the number of strokes admitted each year and the number of patients thrombolysed in last 12 months.

CATEGORIES FOR ANALYSIS: CLINICAL AUDIT

All clinical data were aggregated to provide national estimates and variables were summarised according to DHB category.

Limitations

The collaboration between NSF and SFNZ in the audit enables comparison of the processes of care between the two countries, but two important complications arise.

The first is related to the recency of available guidelines in each country. The webtool is based on the Australian *Clinical Guidelines for Acute Stroke Management* (NSF 2007a). These guidelines are being updated in 2010, meaning that the services and practice audited at an earlier point is shortly to be overtaken by new standards. The most recent New Zealand reference for practice is *Life after stroke. New Zealand guideline for management of stroke* (Baskett and McNaughton 2003). With the support of MOH, the New Zealand guideline is also being updated in 2010 in a collaboration between SFNZ, NSF and New Zealand Guidelines Group (NZGG). However, clinicians in New Zealand stroke services have referenced other more recent international guidelines to ensure best practice and quality of service. As *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) has been an important reference for New Zealand clinicians, this report cites recommendations from that document where they inform audit questions.

While adjustments were made in data collection and analysis for differences between health systems and service provision, some important aspects of clinical practice differ between Australia and New Zealand, and direct comparisons cannot always be made, however this is specifically noted in reporting.

A second important complication is that Australian audit participants are individual hospitals, whereas New Zealand participants are DHBs (some of which have more than one hospital admitting stroke patients). In other words, because New Zealand DHBs are composite participants, on some measures, they appear to perform better than Australian participants. This effect is noted in the discussion where it applies.

Finally, retrospective data collection from patient records, particularly in the Clinical Audit, must rely only on the documented notes, which may not fully reflect the care given.

Chapter 3

Organisation of acute stroke services in New Zealand

(Organisational Survey findings)

DHB participation and categorisation

All 21 DHBs provide acute stroke care, and all participated in the Organizational Survey. Each DHB team of auditors was requested to identify one member to take responsibility for data quality in the Organizational Survey, and it was suggested this be a senior person who would be able to give accurate details of service provision.

DHBs were split into three groups of large, medium or small (Figure 1) on the basis of population served and the predicted number of stroke admissions per year, based on Health Roundtable figures (www.healthroundtable.org). Individual DHB reports advise the DHB of their category. DHB categories will be referred to as large/medium/small in the discussion.

Note that some DHBs have more than one hospital. For example, Northland DHB has a base hospital and three other smaller hospitals. In such cases, where data was collected separately by hospital it was aggregated to allow comparison with DHBs of similar size.

Figure 1: Categorisation of DHBs for audit data analysis

DHB category/size	Description
A/large	Population catchment >200,000
	Predicted annual stroke admissions >300
B/medium	Population catchment 120,000 - 200,000
	Predicted annual stroke admissions 150 - 300
C/small	Population catchment < 120,000
	Predicted annual stroke admissions <150

DHBs are identified as A/large, B/medium and C/small in the data tables because available Australian data is presented in A, B and C hospital categories determined by the Australian Stroke Services Framework (NSF 2008). In summary (NSF 2009b, p.8):

> Category A: Hospitals with access to onsite CT within 24 hours, and annual acute stroke admissions of ≥200 if in urban area and ≥120 if in rural area.
>
> Category B: Hospitals with access to onsite CT within 24 hours, and annual acute stroke admissions of 100–199 if in urban area and 80–119 if in rural area.
>
> Category C: Hospitals with access to CT within 24 hours (onsite/offsite), and annual acute stroke admissions of <100 if in urban area and <80 if in rural area.

While all New Zealand DHBs are able to access CT within 24 hours (Table 7), comparison of categories for audit participants (New Zealand DHBs and Australian hospitals) is approximate and not exact. No New Zealand DHBs correspond to Category D of the ASSF framework, which are very small rural and remote Australian hospitals unable to access CT within 24 hours.

Organisation of Services: Stroke Admissions and Service Provision

Stroke units and access

RATIONALE

Stroke unit care is the single most important recommendation for acute stroke management and should be a high priority for clinicians and administrators. Such care significantly reduces death and disability after stroke compared with conventional care in general wards (SUTC 2007).

For the purposes of the 2009 Audit, stroke units were defined as 'discrete wards or beds within a ward with a dedicated specialized multidisciplinary team', which could include

1. Acute (intensive) stroke units – which admit patients acutely but discharge early (usually within 7 days) either home or to a rehabilitation service.

2. Integrated/comprehensive stroke units – which admit patients acutely and provide all of the rehabilitation.

Participants were asked to report if the DHB had a stroke unit and to describe the type of stroke unit and number of beds in it.

While the provision of care in stroke units is increasing, stroke units may not have the capacity to admit all of the people with stroke presenting to their DHB. Access to stroke unit care is therefore an important question, i.e. what proportion of patients actually receives care on the stroke unit.

Participants were asked to provide information about the number of stroke patients in the stroke unit, compared to the number of patients with acute stroke present in the hospital on the day the survey was completed. This data was used to estimate the proportion of patients accessing the stroke unit as an indication of the capacity of stroke units.

Participants were also to report on the number of acute stroke admissions to their DHB in the previous year, i.e. 2008.

KEY MESSAGES:

6,194 acute stroke patients were admitted in 2008: 82% of these to 13 large and medium DHBs and 36% to DHBs with stroke units.

There are eight stroke units with 83 dedicated beds.

On the day of survey, there were 176 acute stroke patients in DHBs, 39% of whom were in stroke units, compared with 51% of Australian stroke patients.

FINDINGS

There were seven large, six medium and eight small DHBs [Table 2]. Of the 6,194 stroke patients admitted in 2008, 3,862 were admitted to large DHBs, 1,347 to medium DHBs, and 985 to small DHBs [Table 2].

As defined in this audit, there are eight stroke units across 21 DHBs. Large DHBs were more likely to have an acute stroke unit, medium DHBs more likely to have an integrated stroke unit, and small DHBs have neither. Nationally, just over a third (36%) of stroke patients were admitted to stroke units (44% in large and 38% in medium DHBs) [Table 2].

Life after stroke. New Zealand guideline for management of stroke (Baskett and McNaughton 2003) recommended that 'All people admitted to hospital with stroke should expect to be managed in an area of the hospital designated for people with stroke (i.e. a stroke unit)' (p. 24), and discussed appropriate service organization according to hospital size and number of stroke admissions. While large and medium DHBs were recommended to have a separate stroke unit or designated area within a general unit, only five of seven large DHBs and three of six medium DHBs had stroke units as defined in the audit [Table 2]. Total dedicated stroke unit beds number 83. One large and one medium DHB had co-located stroke beds, but did not identify as stroke units.

On the day auditors completed the Organizational Survey, there were 176 acute stroke patients in DHBs, 39% of whom were in stroke units, compared with 51% of Australian stroke patients [Table 2]. In other words, over 60% of acute stroke patients in DHBs with stroke units were receiving care on other wards [Table 2]. However, these data should be interpreted with caution as there was no verification with hospital admission data. The estimate is for one day of the year only and is not an indication of annual capacity.

Table 2: Characteristics of DHBs and stroke unit access by DHB category and stroke unit status						
	Total N (IQR)	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
Number of DHBs	**21**	7	6	8	8	13
Median number of hospital beds *(IQR)*	**250 *(143–450)***	670 *(518–750)*	303 *(250–366)*	132 *(96–166)*	518 *(308–685)*	189 *(131–350)*
DHBs with ICU	**21**	7	6	8	8	13
DHBs with onsite neurosurgery	**5**	4	1	0	4	1
DHBs with stroke unit	**8**	5	3	0	8	-
Acute stroke unit	**5**	4	1	0	5	-
Integrated stroke unit	**3**	1	2	0	3	-
Median number of stroke unit beds *(IQR)*	**11 *(5–15)***	12 *(10–15)*	6 *(5–10)*	- -	11 *(5-15)*	- -
Median number stroke admissions last year	**258**	500	256	100	401	116
Total number stroke admissions last year	**6,194**	3,862	1,347	985	3,493	2,701
% of stroke patients admitted to stroke unit last year (estimated)	**36%**	44%	38%	0%	63%	0%
Total number of stroke patients on day of survey	**176**	121	36	19	107	69
% of stroke patients in stroke unit on day of survey	**NZ 39%** **Aust 51%**	45%	39%	0%	64%	0%

(Australian datum from NSF 2009b, p. 18, Table 18)

Mobile stroke teams

RATIONALE

Clinical guidelines recommend that mobile stroke teams should only be developed if part of a formal randomised controlled trial to establish an evidence-base. This is because mobile stroke teams are generally no more effective than care on a general ward and are inferior to care on a stroke unit (Langhorne *et al* 2005). Despite the evidence, mobile stroke teams are being used as an alternative to, or to supplement inadequate capacity of stroke units.

Participants were asked to indicate whether they had a mobile stroke team. Comparison with those that do and do not have a stroke unit makes it possible to determine if these are provided to supplement, or to be a substitute for stroke unit care.

FINDINGS

Six DHBs (24%) reported using a mobile stroke team. Of these, three large DHBs with stroke units appear to use mobile stroke teams to provide specialist care for patients that are unable to access the stroke unit and three DHBs are using mobile stroke teams in the absence of a stroke unit.

KEY MESSAGES:

75% of DHBs with stroke units reported that the stroke unit was the most likely first admission ward for people with stroke.

Ward of admission

RATIONALE

Early patient assessment and rehabilitation is a key contributor to the positive outcomes associated with stroke unit care. Immediate access to a stroke unit ensures that the patient is seen early, receives the appropriate investigations and treatments, and is cared for by the specialized MDT.

Participants were asked to indicate the most likely first ward of admission to determine if patients are being admitted directly to the stroke unit.

FINDINGS

Large DHBs were more likely to admit patients into stroke units or medical assessment units, and small DHBs more likely to admit patients into general medical wards (Chi-square = 18.9, df = 4, $p < 0.01$). Of those DHBs with a stroke unit, 75% reported that the stroke unit was the most likely admission ward for people with stroke and 25% reported that patients were first admitted into a medical assessment unit [Table 3]. In DHBs without a stroke unit, 85% of patients were first admitted into a general medical ward and 15% into a medical assessment unit [Table 3].

Table 3: Most likely ward of admission by DHB category and stroke unit status

		Total (N=21)	A/large (N=7)	B/medium (N=6)	C/small (N=8)	SU (N=8)	No SU (N=13)
Stroke Unit	**NZ**	**29%**	43%	50%	0%	75%	NA
	Aust	**27%**	81%	39%	1%	81%	NA
General Medical	**NZ**	**52%**	0%	50%	100%	0%	85%
	Aust	**54%**	13%	42%	81%	13%	75%
Medical Assessment Unit	**NZ**	**19%**	57%	0%	0%	25%	15%
	Aust	**11%**	4%	16%	6%	4%	14%

(Australian data from NSF 2009b, p. 21, Tables 6 and 7. Australian percentages sum to 100% when Neurology Ward (1%), Geriatric Ward (1%) and Other (6%) are added)

KEY MESSAGES:

DHBs not using a stroke register – more than half – may find a register helps identify areas for improvements in stroke care.

Increasing access to telehealth clinical support, particularly in smaller DHBs, may improve various aspects of clinical care such as the provision of thrombolytic therapy.

Stroke register and access to telehealth facilities

RATIONALE

A stroke register assists in the audit process by allowing DHBs to easily access data on the numbers and various aspects of management of people with stroke going through the hospital during any given time period.

Telehealth facilities may play an important part in the delivery of stroke care, particularly in rural centres. They may be used to access ongoing professional development and enable rural practitioners to access clinical expertise from urban centres. Moreover, such technology can be used to assist in diagnosis with teleradiology, or enable an urban-based practitioner to review a patient in a rural setting with the local provider.

Participants were asked if they kept a stroke register and whether they had access to telehealth facilities for clinical and professional support.

FINDINGS

Fewer than half of DHBs used stroke registers although almost three quarters of large DHBs did so [Table 4]. Not using a stroke register represents a missed opportunity to identify deficiencies in the provision of stroke care.

Access to telehealth clinical support was even across DHBs and similar to Australia [Table 4]. Increasing access to telehealth clinical support, particularly in smaller DHBs, may improve various aspects of clinical care such as the provision of thrombolytic therapy.

Table 4: Other features impacting on stroke services by DHB category and stroke unit status

	Aust total	NZ total (N=21)	A/large (N=7)	B/medium (N=6)	C/small (N=8)	SU (N=8)	No SU (N=13)
Using stroke register	**24%**	**43%**	71%	33%	25%	63%	31%
Access to telehealth clinical support	**60%**	**62%**	57%	67%	63%	50%	69%
Access to telehealth professional development	**77%**	**71%**	57%	83%	75%	50%	85%

(Australian data from NSF 2009b, p. 20, Table 5 – ASSF and stroke unit figures not available)

KEY MESSAGES:

33% of DHBs still need to establish a documented pathway for assessing people presenting with TIA.

Adherence to the New Zealand Guideline for TIA may be reflected in the high use of stroke risk stratification tools and provision of TIA clinics.

It is not clear that the frequency of outpatient clinics – where provided – is sufficient to meet the standards for time to assessment in the New Zealand TIA guideline.

Neurovascular/TIA services

RATIONALE

The aim of assessment of a patient with suspected transient ischaemic attack (TIA) is to confirm the diagnosis, identify and treat the cause, and guide relevant secondary prevention to prevent recurrent events or stroke.

The 2008 *New Zealand guideline for the assessment and management of people with recent transient ischaemic attack* (TIA) recommends reorganization of services to facilitate prompt assessment of TIA patients and assessment within 24 hours for those TIA patients at very high risk of stroke. This is because early intervention may reduce the risk of a stroke following TIA by up to 80 percent (Gommans, Barber and Fink 2008).

Participants were asked to describe the pathways for managing TIA in their DHBs; for example, whether a stroke risk stratification tool is used to guide in the decision to admit a person with TIA, and to identify if they provided TIA outpatient clinics.

FINDINGS

Small DHBs were less likely to assess people presenting with TIA by means of a documented pathway, and less likely to provide TIA outpatient clinics [Table 5].

Just over 80% of DHBs used a stroke risk stratification tool to guide the decision to admit TIA patients, compared to just under 40% of Australian hospitals [Table 5]. The greater use of stratification tools in New Zealand may reflect better awareness of TIA management and adherence to the 2008 New Zealand TIA guideline. However, in DHBs providing an outpatients TIA clinic, it is not clear that the frequency of the clinics is sufficient to meet the standards for time to assessment in the New Zealand TIA guideline.

Table 5: Neurovascular/TIA services by DHB category and stroke unit status

		Total (N=21)	A/large (N=7)	B/medium (N=6)	C/small (N=8)	SU (N=8)	No SU (N=13)
Documented pathway for assessing TIA presentions	NZ	**67%**	71%	83%	50%	75%	62%
	Aust	**42%**	-	-	-	76%	25%
'Admit all' TIA policy *	NZ	**5%**	0%	17%	0%	13%	0%
	Aust	**30%**	-	-	-	24%	33%
Using a stratification tool to guide decision to admit	NZ	**81%**	100%	66%	75%	88%	77%
	Aust	**39%**	-	-	-	79%	16%
Outpatient TIA clinic	NZ	**43%**	57%	50%	25%	50%	39%
	Aust	**19%**	-	-	-	48%	3%
Median frequency of clinic days per week (IQR)	NZ	**2** ***(1-5)***	5 *(3-6)*	1 *(1-2)*	- *(1-5) **	5 *(3-6)*	1 *(1-2)*
	Aust	**3** ***(1–5)***	- -	- -	- -	2 *(1–5)*	1 *(1–1)*

* Only one DHB stated they had an 'admit all' policy
** Only two DHBs provided a clinic – range rather than IQR shown
(Australian data from NSF 2009b, p. 21, Tables 6 and 7 – ASSF figures not available)

KEY MESSAGES:

The lack of arrangements with ambulance services and emergency departments must be addressed urgently if the rate of actual thrombolysis treatment is to increase from current very low levels.

Organisation of Care: Systems for Stroke Assessment and Management

Pre-hospital and emergency department care

RATIONALE

There is growing evidence that early stroke management can reduce damage to the brain and minimise the effects of stroke. Early recognition of stroke and the subsequent response by individuals and the health system is therefore integral to optimal health outcomes.

Participants were asked if they had arrangements (over and above regular arrangements) with the local ambulance provider or protocols for use in the emergency department (ED) to enable rapid assessment and triage of people presenting with stroke.

FINDINGS

While many DHBs now report that they offer acute stroke thrombolysis, only a few large DHBs have arrangements in place with ambulance services. Large DHBs are more likely than medium or smaller DHBs to have a protocol for rapid triage in ED, but overall, less than half of DHBs reported having emergency department protocols for stroke. [Table 6].

Table 6: Processes to facilitate rapid assessment and treatment by DHB category and stroke unit status

		Total (N=21)	**A/large** (N=7)	**B/medium** (N=6)	**C/small** (N=8)	**SU** (N=8)	**No SU** (N=13)
Ambulance arrangements	NZ	**10%**	29%	0%	0%	25%	0%
	Aust	**21%**	44%	21%	12%	43%	11%
ED protocol for rapid triage	NZ	**43%**	71%	33%	25%	63%	31%
	Aust	**48%**	75%	45%	37%	71%	37%
Transfer protocols *	NZ	**29%**	14%	17%	50%	13%	38%
	Aust	**51%**	44%	42%	54%	49%	53%

(Australian data from NSF 2009b, p. 22, Tables 8 and 9).
* An apparent difference in transfer protocols between Australia and New Zealand may be explained by New Zealand audit participation at DHB level, whereas Australian participated at hospital level.

KEY MESSAGES:

Access to CT and MRI for stroke patients is generally good. Rapid availability of carotid ultrasound is a problem for some DHBs.

Diagnostic imaging

RATIONALE

Access to brain imaging within 24 hours computed tomography (CT) has long been considered an important criterion that defines basic management of acute stroke (Wardlaw *et al* 2004). The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommends that all patients with acute stroke should have an urgent CT or MRI. Studies have found that magnetic resonance imaging (MRI) is more sensitive than CT for ischaemic changes and is as sensitive as CT in identifying acute haemorrhagic change (Kidwell *et al* 2004, Chalela *et al* 2007).

In patients with carotid territory symptoms and where large artery disease is suspected, carotid imaging studies should be performed rapidly and the potential for surgery considered.

Participants were asked about access to brain and vascular imaging. Immediate access was defined as access within 24 hours.

FINDINGS

All DHBs have onsite CT and can provide access within 24 hours. All but two small DHBs have onsite MRI and most DHBs can provide access within 24 hours [Table 7]. All DHBs have onsite carotid Doppler ultrasonography, and two-thirds can provide access within 24 hours.

Table 7: Availability of CT, MRI, and Carotid Doppler by DHB category and stroke unit status

			Total (N=21)	**A/large** (N=7)	**B/medium** (N=6)	**C/small** (N=8)	**SU** (N=8)	**No SU** (N=13)
CT	Onsite	NZ	**100%**	100%	100%	100%	100%	100%
		Aust	**77%**	-	-	-	100%	62%
	Access within 24 hrs	NZ	**100%**	100%	100%	100%	100%	100%
		Aust	**82%**	-	-	-	100%	72%
MRI	Onsite	NZ	**95%**	100%	100%	88%	100%	91%
		Aust	**-**	-	-	-	-	-
	Access within 24 hrs	NZ	**78%**	86%	83%	38%	75%	80%
		Aust	**58%**	-	-	-	88%	44%
Carotid ultrasound	Onsite	NZ	**100%**	100%	100%	100%	100%	100%
		Aust	**-**	-	-	-	-	-
	Access within 24 hrs	NZ	**62%**	71%	83%	37%	75%	54%
		Aust	**82%**	-	-	-	100%	74%

(Australian data from NSF 2009b, p. 23, Table 10, Figures 1 and 2 – ASSF figures and some stroke unit status figures not available)

KEY MESSAGES:

The great majority of the New Zealand population (>80%) now live in catchment areas where DHBs offer acute stroke thrombolysis, however thrombolysis rates remain low and substantial improvement in the performance of these thrombolysis services is required.

Availability of thrombolysis

RATIONALE

There is significant benefit associated with the administration of intravenous rt-PA in ischaemic stroke patients within 4.5 hours of symptom onset. (Hacke *et al* 2008) Clinical guidelines recommend intravenous thrombolysis in acute ischaemic stroke should be undertaken in patients satisfying specific inclusion and exclusion criteria. At the time of the audit, most guidelines only recommended stroke thrombolysis within three hours.

Participants were asked to report on whether stroke thrombolysis was offered at their DHB and if so, to estimate how many acute stroke patients had been thrombolysed in the previous year.

FINDINGS

Fourteen DHBs offer thrombolysis, including all large DHBs and all but one of the DHBs with a stroke unit. DHBs with stroke units appear more likely (87%) to offer a thrombolysis service than DHBs without stroke units (54%) although this trend did not reach statistical significance [Table 8].

Two-thirds of DHBs offer thrombolysis compared with just under a third of audited Australian hospitals [Table 8].

128 patients were treated with stroke thrombolysis in the last twelve months, the majority in large DHBs or DHBs with stroke units [Table 9].

Table 8: DHBs offering thrombolysis by DHB category and stroke unit status

		Total (N=21)	A/large (N=7)	B/medium (N=6)	C/small (N=8)	SU (N=8)	No SU (N=13)
Thrombolysis offered *	NZ	**67%**	100%	50%	50%	87%	54%
	Aust	**28%**	77%	29%	11%	65%	9%

(Australian data from NSF 2009b, p. 22, p. 24, Table 11)
* An apparent difference in transfer protocols between Australia and New Zealand may be explained by New Zealand audit participation at DHB level.

Table 9: Processes in DHBs offering thrombolysis by DHB category and stroke unit status

		Total (N=14)	A/large (N=7)	B/medium (N=3)	C/small (N=4)	SU (N=7)	No SU (N=7)
Thrombolysis offered 24 hrs/7 days	NZ	**43%**	43%	33%	50%	57%	29%
	Aust	**77%**	-	-	-	80%	69%
Total number thrombolysed	NZ	**128**	101	14	13	95	33
	Aust	**711**	-	-	-	648	63
Median number thrombolysed last year *(IQR)*	NZ	**7 *(4–14)***	14 *(8–19)*	5 *(4–5)*	2 *(1–6)*	14 *(6–19)*	5 *(2–7)*
	Aust	**8 *(2–15)***	- -	- -	- -	11 *(3–19)*	2 *(0–6)*

(Australian data from NSF 2009b, p. 24, Table 12 – ASSF figures not available)

KEY MESSAGES:

DHBs with stroke units were more likely to provide routine assessments of further need for rehabilitation and access to early supported discharge.

Access to early supported discharge is generally low.

Access to rehabilitation or palliative care

RATIONALE

Access to rehabilitation, either as an inpatient or through early supported discharge, is an important requirement for acute stroke patients (SUTC 2007).

Participants were asked if patients were assessed in conjunction with a rehabilitation team for the need for further inpatient rehabilitation and if they had access to further rehabilitation, including early supported discharge or community-based rehabilitation services. Participants were also asked about access to palliative care for those patients assessed as requiring it.

FINDINGS

DHBs with a stroke unit were more likely to provide routine assessments of further need for rehabilitation for all patients (Chi-square = 8.0, df = 1, $p < 0.01$) [Table 10]. They were also more likely to provide access to early supported discharge than those without a stroke unit, but access to early supported discharge is generally low in both Australia and New Zealand. All DHBs provided access to palliative care [Table 10].

Table 10: Access to rehabilitation or palliative care by DHB category and stroke unit status

		Total (N=21)	**A/large** (N=7)	**B/medium** (N=6)	**C/small** (N=8)	**SU** (N=8)	**No SU** (N=13)
Provide routine assessments for all patients	NZ	**62%**	86%	50%	50%	100%	39%
	Aust	**63%**	88%	82%	52%	85%	52%
Access to early supported discharge teams	NZ	**24%**	29%	17%	25%	37%	15%
	Aust	**16%**	27%	18%	11%	28%	9%
Access to community based rehabilitation	NZ	**81%**	100%	83%	62%	87%	77%
	Aust	**74%**	88%	84%	73%	82%	70%
Ongoing rehabilitation service *	NZ	**100%**	100%	100%	100%	100%	100%

(Australian data from NSF 2009b, p. 25, Tables 13 and 14 – *Australian data not available)

KEY MESSAGES:

Only half of DHBs routinely provided a discharge care plan.

Two-thirds of DHBs did not have protocols for reviewing patients post-discharge.

Discharge arrangements

RATIONALE

A discharge care plan is completed prior to discharge and identifies appropriate management strategies to guide care after the person with stroke returns to the community. Clinical guidelines recommend that care plans should be used and include the development of self-management strategies, provision of equipment and support services, and plans for further outpatient appointments (NSF 2007a). Providing post-discharge support (such as that provided by a stroke support group) is also recommended. People with stroke and their families often report being dissatisfied with the information, support services and therapy available (NSF 2007b).

Participants were asked about the routine use of discharge care plans and post-discharge patient support.

FINDINGS

Only half of the DHBs routinely provided a discharge care plan. Two-thirds did not have protocols for reviewing patients post-discharge. There were no differences between DHB categories and those with or without stroke units with provision of discharge planning and protocols [Table 11].

Large DHBs and those with stroke units are more likely to provide post-discharge contact. Provision of post-discharge contact is less likely to occur in New Zealand (57%) than Australian stroke services (72%) [Table 11].

One possible factor confounding this comparison may be the transfer of patients from acute stroke services to rehabilitation services via 'statistical discharge' without a formal 'discharge from hospital' process at that point in care.

Table 11: Discharge planning processes by DHB category and stroke unit status

	Aust total	NZ total (N=21)	A/large (N=7)	B/medium (N=6)	C/small (N=8)	SU (N=8)	No SU (N=13)
Providing a discharge care plan	58%	**52%**	57%	50%	50%	50%	54%
Protocols for post-discharge review	27%	**29%**	29%	0%	50%	25%	31%
Providing a post-discharge contact	72%	**57%**	71%	50%	50%	62%	54%

(Australian data from NSF 2009b, p. 26, Table 15 – ASSF and stroke unit figures not available)

KEY MESSAGES:

DHBs with stroke units are more likely to offer family meetings and information on local community care arrangements.

Universal availability of stroke literature is commendable. 'Aphasia-friendly' formats need further development.

Communication with patient and family

RATIONALE

Ongoing communication between the stroke team and the family/whanau and/or carer is also a key element of an organised stroke service. Communication is established through formal and informal meetings to discuss assessment results, management plans and to also plan for discharge. Coordinated care helps the patient and their family/whanau and/or carer understand what is happening. The provision of information and education is particularly important for people with stroke and their families/whanau and/or carer, People with stroke report that information and education is an important component of their preparedness to go home, but also that it is not often available in the hospital.

The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- The stroke team should meet regularly with the person with stroke and the family/carer to involve them in management, goal setting and planning for discharge. (Extrapolated from Level I, Grade C)
- All stroke survivors and their families/carers should be provided with timely, up-to-date information in conjunction with opportunities to learn via education from members of the interdisciplinary team and other community service providers. Simple information provision alone is not effective. (Level I, Grade A)

Audit participants were asked to report on the routine use of family meetings with stroke patients and/or their family in the hospital. Participants were also asked to report on the routine provision of information about a number of issues before discharge.

FINDINGS

DHBs with stroke units appear more likely to offer family meetings than those without stroke units. DHBs with stroke units are more likely to provide information on local community care arrangements (Chi-square = 4.9, df = 1, $p < 0.05$) [Table 12].

While family meetings are provided at similar rates in New Zealand and Australia, it appears that New Zealand DHBs are more likely to provide stroke specific literature and community-based stroke support groups than Australian services [Table 12]. The provision of SFNZ field workers likely accounts for this difference, as there is no equivalent nationally provided service in Australia.

All DHBs offer stroke specific literature, but only a third have 'aphasia-friendly' literature available [Table 12].

Table 12: Provision of family meetings and information by DHB category and stroke unit status

		Total (N=21)	A/large (N=7)	B/medium (N=6)	C/small (N=8)	SU (N=8)	No SU (N=13)
Family meetings	NZ	**67%**	86%	67%	50%	87%	54%
	Aust	**68%**	-	-	-	82%	64%
Stroke specific literature	NZ	**100%**	100%	100%	100%	100%	100%
	Aust	**63%**	-	-	-	93%	49%
Local community care arrangements	NZ	**76%**	86%	83%	62%	100%	61%
	Aust	**65%**	-	-	-	72%	62%
Community stroke support groups	NZ	**95%**	100%	100%	87%	100%	92%
	Aust	**50%**	-	-	-	75%	37%
Aphasia-friendly literature available	NZ	**33%**	29%	17%	50%	25%	38%
	Aust	**26%**	-	-	-	40%	20%
Patient versions of guidelines/ standards *	NZ	**62%**	71%	50%	62%	62%	61%
Literature on local voluntary agencies *	NZ	**86%**	100%	83%	75%	87%	85%
Literature on complaints procedure *	NZ	**100%**	100%	100%	100%	100%	100%

(Australian data from NSF 2009b, p. 34, Tables 25 and 26, and p. 35, Figure 4 – ASSF figures and some stroke unit status figures not available)
* Australian data not reported.

KEY MESSAGES:

New Zealand MDTs are more likely to have neurologists, geriatricians and specialist nurses as members than Australian teams.

Involvement of clinical psychologists in the MDT is rare in New Zealand.

Organisation of Workforce: Team Membership, Process and Development

Access to multidisciplinary care

RATIONALE

Multidisciplinary assessment and management are important in early assessment and rehabilitation. Effective care relies on a coordinated approach. The MDT may combine and coordinate the use of medical, nursing and allied health skills.

Participants were asked about their access to various members of the multidisciplinary team. Participants were also asked to identify which medical team usually manages stroke patients.

FINDINGS

There are nine DHBs with a stroke specialist, with the remaining 12 DHBs reporting that acute stroke was managed by the general medical team. DHBs with a stroke unit were more likely to have a stroke specialist in the medical team managing stroke (Chi-square = 5.7, df = 2, $p < 0.10$) [Table 12]. DHBs with stroke units were more likely to have advanced trainees and specialist research nurses (Chi-square = 2.9, df = 1, $p < 0.10$) [Table 14].

Larger DHBs were more likely to have neurologists as part of the MDT (Chi-square = 11.5, df = 3, $p < 0.01$), and half of New Zealand DHBs have neurologists in comparison to a third of participating Australian hospitals [Table 14].

Overall, New Zealand stroke services are more likely than Australian services to have nurses in designated specialist roles related to stroke [Table 14].

There are similar numbers of physiotherapists and OTs in New Zealand and Australian stroke services, but approximately 40% less FTE senior medical officers, dietitians and social workers in New Zealand than Australia [Table 14].

General practitioners (GPs) appear as a higher proportion in the Australian sample [Table 14] because they provide services to smaller rural hospitals, whereas in New Zealand, only small DHBs have GPs as MDT members.

Note that the involvement of clinical psychologists in the MDT is rare in New Zealand.

Table 13: Medical team usually managing acute stroke patients by DHB category and stroke unit status

		Total (N=21)	**A/large** (N=7)	**B/medium** (N=6)	**C/small** (N=8)	**SU** (N=7)	**No SU** (N=2)
Stroke specialist	NZ	**43%**	71%	67%	0%	88%	15%
	Aust	**17%**	60%	13%	1%	51%	0%
Other specialist	NZ	**57%**	29%	33%	100%	12%	85%
	Aust	**54%**	40%	87%	57%	49%	57%

(Australian data from NSF 2009b, p. 27, Table 17; Australian percentages sum to 100% when General Practitioner/visiting medical officers (29%) are added)

Table 14: Access to MDT by DHB category and stroke unit status								
		Aust total	**NZ total (N=21)**	**A/large** (N=7)	**B/medium** (N=6)	**C/small** (N=8)	**SU** (N=8)	**No SU** (N=13)
Medical	Neurologist	**34%**	**52%**	100%	50%	12%	75%	38%
	Geriatician	**38%**	**81%**	86%	100%	62%	87%	77%
	General physician	**59%**	**95%**	86%	100%	100%	87%	100%
	General practitioner	**52%**	**5%**	0%	0%	12%	0%	8%
	Rehabilitation physician	**44%**	**52%**	57%	33%	62%	37%	61%
	Advanced trainee	**22%**	**19%**	43%	17%	0%	37%	8%
Nursing	Clinical nurse specialist *	**32%**	**52%**	57%	50%	50%	62%	46%
	Stroke nurse educator	**11%**	**29%**	57%	17%	12%	50%	15%
	Other nurse educator	**-**	**57%**	43%	67%	62%	50%	61%
	Nurse practitioner	**5%**	**5%**	14%	0%	0%	12%	0%
	Specialist research nurse	**-**	**9%**	29%	0%	0%	25%	0%
	Nursing unit manager **	**85%**	**90%**	86%	83%	100%	100%	85%
Allied Health	Clinical psychologist	**22%**	**9%**	0%	17%	12%	0%	15%
	Dietitian	**89%**	**100%**	100%	100%	100%	100%	100%
	Occupational therapist	**90%**	**100%**	100%	100%	100%	100%	100%
	Physiotherapist	**96%**	**100%**	100%	100%	100%	100%	100%
	Social worker	**85%**	**100%**	100%	100%	100%	100%	100%
	Speech language therapist	**92%**	**100%**	100%	100%	100%	100%	100%

* Clinical nurse consultant or clinical nurse specialist
** Nursing Unit Manager – NZ equivalent is a Registered Nurse in charge of a ward or unit with the title of 'Clinical Nurse Manager' or 'Charge Nurse Manager'.
(Australian data from NSF 2009b, p. 27, Table 16 – ASSF and stroke unit figures not available)

KEY MESSAGES:

DHBs with stroke units are more likely to have protocols in place for referral to physiotherapists, SLTs, OTs, dietitians, social workers than those without stroke units.

Referral to allied health

RATIONALE

Early assessment and management is facilitated where there are processes for referral to allied health. Participants were asked to identify if they had protocols for referral to allied health.

FINDINGS

DHBs with a stroke unit were more likely to report having a protocol for referral to physiotherapists, SLTs, OTs, dietitians, social workers (Chi square 4.0, df = 1, $p < 0.05$) [Table 15], and all DHBs with stroke units had protocols for referral to these disciplines.

Notwithstanding that the involvement of clinical psychologists in the MDT is rare in New Zealand, DHBs without a stroke unit were more likely to have a protocol for referral to a psychologist (Chi-square = 3.0, df = 1, $p < 0.10$) [Table 15].

Table 15: Protocols for referral to MDT by DHB category and stroke unit status

	Aust total	NZ total (N=21)	A/large (N=7)	B/medium (N=6)	C/small (N=8)	SU (N=8)	No SU (N=13)
Physiotherapist	**76%**	**76%**	86%	83%	62%	100%	61%
Speech language therapist	**77%**	**86%**	100%	83%	75%	100%	77%
Occupational therapist	**75%**	**76%**	86%	83%	62%	100%	61%
Dietitian	**72%**	**76%**	86%	83%	62%	100%	61%
Psychologist	**32%**	**19%**	14%	17%	25%	0%	31%
Social worker	**66%**	**76%**	86%	83%	62%	100%	61%

(Australian data from NSF 2009b, p. 28, Figure 3 – ASSF and stroke unit figures not available)

KEY MESSAGES:

It is very likely that New Zealand stroke services would benefit from greater involvement from specialist stroke physicians, social workers, dietitians and clinical psychologists to levels that are more similar to those in Australia.

Composition of stroke unit team

RATIONALE

A key characteristic of stroke unit care is that it is provided by a multidisciplinary team. This team includes specialists from a range of disciplines: medical, nursing and allied health. The availability of services provided by the MDT is important not only for prompt assessment but also to ensure immediate access to rehabilitation.

Participants at DHBs with stroke units were asked to provide an estimate of the number of FTEs (the number of hours or days worked per week) for each discipline on the unit. These data were multiplied by 10 to derive a median for a 10 bed unit for each discipline.

FINDINGS

As units increase in size, they gain economies of scale and there may be lower relative FTEs for some disciplines in larger units. Some units responding to the survey may have been under resourced. However, the findings provide some insight into staffing currently provided on stroke units across Australia and New Zealand. Data presented here are not provided as an indication of what FTE may be required to run a stroke unit.

Nurse FTE data appeared to be reported with considerable variation in interpretation of the question (in both Australia and New Zealand), and the finding for New Zealand of a mean FTE of 12.4 for nursing for a 10 bed stroke unit should be considered with caution. (No equivalent Australian figure is available).

Overall, FTE per 10-bed stroke unit is less in New Zealand than Australia for advanced medical trainees, clinical psychologists, dietitians, neurologists and social workers.

New Zealand MDTs are more likely to have some neurologist involvement than Australian MDTs [Tables 13, 14]. However, while 52% of DHBs report having access to neurologists as part of the MDT, neurologists have a substantially lower level of involvement in New Zealand than Australia [Table 16].

Table 16: Composition of stroke unit team and median FTE for 10 bed stroke unit

Discipline	Median FTE for 10 bed SU	
	Australia	NZ
Advanced medical trainee	0.6	0.0
Clinical psychology	0.1	0.0
Dietitians	0.5	0.3
General physician	0.3	0.5
Geriatrician	0.3	0.3
Neurology	1.2	0.3
Occupational therapy	0.8	0.9
Physiotherapy	1.0	1.2
Rehabilitation physician	0.2	0.0
Social work	0.7	0.4
Speech pathology	0.7	0.7

(Australian data from NSF 2009b, p. 29, Table 18)

KEY MESSAGES:

Almost all DHBs use integrated patient records.

Stroke units are associated with improved team communication.

It appears that MDTs in New Zealand meet more frequently than those in Australia.

Team communication

RATIONALE

Communication between the members of the stroke team is a fundamental element of an organised stroke service. Data from trials included in a stroke unit meta-analysis found that organised stroke units were characterised by formal weekly meetings of the MDT along with one or more informal meetings (Langhorne and Pollock 2002).

Integrated patient records facilitate communication between the members of the MDT. Clinical pathways (also known as care pathways or critical pathways) are recommended in the *Clinical Guidelines for Acute Stroke Management* (NSF 2007a). These are defined as a plan of care which aims to promote organised and efficient multidisciplinary stroke management based on the best available evidence and guidelines. Care pathways are one way of promoting organised and efficient patient care and hence improve outcomes (Kwan and Sandercock 2004, Kwan 2007). However, the definition, structure and detail contained within the pathway may vary between settings.

Participants were asked if they used integrated patient records and if they held regular team meetings at their hospitals. They were asked to describe the frequency of these meetings and to identify the clinicians who routinely attended the team meetings.

Participants were also asked if they used clinical pathways routinely at their centre.

FINDINGS

All but one DHB's MDT uses an integrated patient record, and MDTs in all DHBs meet regularly [Table 17].

The MDTs in DHBs with stroke units meet twice as often (approximately twice a week) as those in DHBs without stroke units (approximately once a week), and overall, it appears that New Zealand teams meet twice as often as Australian teams [Table 17].

Other than clinical psychologists who are rarely members of MDTs in New Zealand, it appears that there is a wider representation of MDT members at team meetings in New Zealand than Australia [Table 18]. DHBs with stroke units were more likely to have SLTs attend team meetings (Chi-square = 5.2, df = 1, $p < 0.01$). Doctors appeared more likely to attend MDT meetings in DHBs with stroke units (p=0.067 Fisher exact test). Team meeting attendance by specialisation and/or seniority of medical and nursing team members is not known.

Overall, half of DHBs routinely use care pathways for managing stroke and it appears that small DHBs are more likely to do so. Stroke unit status appears to make no difference to the routine use of care pathways [Table 17].

Table 17: Multidisciplinary collaboration by DHB category and stroke unit status

		Total (N=21)	**A/large** (N=7)	**B/medium** (N=6)	**C/small** (N=8)	**SU** (N=8)	**No SU** (N=13)
Contributing to a single set of records	NZ	**95%**	100%	100%	87%	100%	92%
	Aust	**93%**	100%	95%	92%	100%	90%
Regular team meetings	NZ	**100%**	100%	100%	100%	100%	100%
	Aust	**70%**	94%	71%	71%	96%	58%
Frequency of team meetings per month *(Median IQR)*	NZ	**8.0 *(4.0-10.5)***	8.0 *(4.0-9.0)*	8.0 *(4.0-20.0)*	6.0 *(4.0-8.0)*	8.5 *(5.0-18.0)*	4.0 *(4.0-8.0)*
	Aust	**4.0 *(4.0-4.0)***	-	-	-	-	-
Using care pathways	NZ	**48%**	43%	33%	62%	50%	46%
	Aust	**53%**	75%	43%	43%	75%	42%

(Australian data from NSF 2009b, pp. 30- 31, Tables 19 and 20)

Table 18: Regular attendees of team meetings by DHB category and stroke unit status							
		Total (N=21)	**A/large** (N=7)	**B/medium** (N=6)	**C/small** (N=8)	**SU** (N=8)	**No SU** (N=13)
Doctor	NZ	**71%**	86%	67%	62%	87%	61%
	Aust	**51%**	90%	68%	36%	87%	34%
Occupational therapist	NZ	**100%**	100%	100%	100%	100%	100%
	Aust	**67%**	94%	82%	67%	96%	54%
Nurse	NZ	**100%**	100%	100%	100%	100%	100%
	Aust	**67%**	88%	82%	68%	91%	56%
Dietitian	NZ	**57%**	57%	33%	75%	62%	54%
	Aust	**53%**	77%	66%	52%	78%	41%
Social worker	NZ	**90%**	86%	83%	100%	87%	92%
	Aust	**61%**	90%	74%	59%	88%	48%
Psychologist	NZ	**0%**	0%	0%	0%	0%	0%
	Aust	**7%**	15%	8%	5%	12%	4%
Speech language therapist	NZ	**71%**	100%	67%	50%	100%	54%
	Aust	**60%**	90%	76%	55%	93%	44%
Physiotherapist	NZ	**100%**	100%	100%	100%	100%	100%
	Aust	**68%**	92%	82%	68%	94%	56%
Other *	NZ	**48%**	57%	17%	62%	25%	61%

(Australian data from NSF 2009b, p. 31, Table 21, *Australian data not available)

KEY MESSAGES:

Assessment of mood and hydration can be improved: agreed assessment protocols for these common and important problems were used in less than two thirds of DHBs.

Assessment protocols

RATIONALE

Comprehensive assessment of the patient requires input from all members of the stroke team. It enables goal-setting and planning for management based on identification of deficits and changes in function and independence. While there is some evidence to suggest a structured assessment helps identify particular problems (Wikander *et al* 1998), there is little direct evidence to guide inclusion and timing of assessments. It is recommended that all assessments occur as soon as possible after admission with the stroke team working together so as not to burden the patient with duplicated questions.

Participants were asked if they had protocols for standardised assessment of common impairments after stroke, a 'yes' response indicating that the protocol was in use.

FINDINGS

DHBs report using locally agreed assessment protocols with little difference according to size or stroke unit status, other than DHBs with stroke units being more likely to use them for assessing motor impairment (Chi-square = 3.0, df = 21 $p < 0.10$) [Table 19]. Protocols for assessing hydration and mood were used in less than two thirds of DHBs.

Table 19: Locally agreed assessment protocols for common impairments by DHB category and stroke unit status

		Total (N=21)	A/large (N=7)	B/medium (N=6)	C/small (N=8)	SU (N=8)	No SU (N=13)
Consciousness level	NZ	**90%**	100%	83%	87%	100%	85%
	Aust	**84%**	-	-	-	97%	78%
Motor impairment	NZ	**81%**	100%	83%	62%	100%	69%
	Aust	**69%**	-	-	-	91%	58%
Visual impairment	NZ	**52%**	71%	50%	37%	62%	46%
	Aust	**57%**	-	-	-	81%	46%
Sensory impairment	NZ	**71%**	86%	67%	62%	75%	69%
	Aust	**59%**	-	-	-	81%	48%
Executive function	NZ	**71%**	71%	67%	75%	75%	69%
	Aust	**54%**	-	-	-	79%	41%
Activities of daily living	NZ	**81%**	100%	67%	75%	87%	77%
	Aust	**69%**	-	-	-	93%	57%
Mood	NZ	**48%**	57%	50%	37%	50%	46%
	Aust	**37%**	-	-	-	41%	35%
Dysphagia	NZ	**90%**	100%	83%	87%	100%	85%
	Aust	**75%**	-	-	-	96%	64%
Incontinence of urine	NZ	**62%**	71%	67%	50%	75%	54%
	Aust	**53%**	-	-	-	72%	43%
Incontinence of faeces	NZ	**57%**	71%	50%	50%	62%	54%
	Aust	**51%**	-	-	-	72%	41%
Nutrition	NZ	**76%**	71%	67%	87%	75%	77%
	Aust	**70%**	-	-	-	88%	62%
Hydration	NZ	**57%**	57%	50%	62%	50%	61%
	Aust	**55%**	-	-	-	74%	46%
Communication	NZ	**81%**	100%	67%	75%	87%	77%
	Aust	**64%**	-	-	-	88%	52%

(Australian data from NSF 2009b, p. 32, Table 22 – ASSF figures not available)

KEY MESSAGES:

DHBs with stroke units were more likely to have access to a programme of continuing education.

Rates of provision of onsite or offsite training appear low in medium and small DHBs.

Continuing education and research

RATIONALE

Education and research are important factors in creating an evidence-based stroke service. Access to ongoing professional development is a core characteristic of effective stroke unit care allowing the members of the MDT to continue to develop their specialised skills in stroke care.

Participants were asked to report on their access to ongoing education for staff, as well as their participation in research and research trials.

FINDINGS

DHBs with stroke units were more likely to have access to a programme of continuing education (Chi-square = 4.9, df = 1, $p < 0.05$), and provide onsite training (Chi-square = 4.9, df = 1, $p < 0.05$) [Table 20].

Rates of provision of onsite or offsite training appear low in medium and small DHBs.

Nine DHBs reported involvement in stroke research (encompassing acute, rehabilitation, prevention and other studies). Of the 23 studies underway, 12 were being undertaken in four large DHBs, five in two medium DHBs and six in three small DHBs.

Table 20: Staff development and research participation by DHB category and stroke unit status

		Total (N=21)	**A/large** (N=7)	**B/medium** (N=6)	**C/small** (N=8)	**SU** (N=8)	**No SU** (N=13)
Staff access to a programme of continuing education	NZ	**57%**	86%	50%	37%	87%	38%
	Aust	**42%**	83%	61%	21%	85%	20%
Provision of onsite staff training	NZ	**57%**	86%	50%	37%	87%	38%
	Aust	**39%**	81%	58%	18%	84%	17%
Provision of offsite staff training	NZ	**19%**	43%	17%	0%	25%	15%
	Aust	**24%**	44%	42%	11%	51%	10%

(Australian data from NSF 2009b, p. 33, Tables 23 and 24)

Chapter 4

Acute stroke care delivery in New Zealand

(Clinical Audit findings)

Characteristics of patients

KEY MESSAGES:

A total of 832 patient records were included in the Clinical Audit.

There were 400 (48%) males and 432 (52%) females.

More than half the audited stroke patients were aged over 75 years.

Ethnicity was recorded as Maori for 13% and Pacific for 3%.

83% of patients had an ischaemic stroke.

The 20 DHBs participating in the Clinical Audit audited a total of 938 patient records from 832 patients. Of the 938 patient records, 106 records were audited independently by a second auditor for reliability purposes.

Audited patients were derived equally from each DHB category (large: 33%, medium 33%, small 34%). Only one small DHB did not participate in the Clinical Audit and the findings are therefore held to be representative of care delivered to stroke patients in New Zealand.

Patient demographics

Of the 832 patients included in the audit:

- 400 (48%) were male and 432 (52%) were female
- 13% were Maori and 3% were Pacific
- 22% of patients were under 65 years of age at the time of their stroke [Table 21]
- median age at stroke onset was 77 with an interquartile range of 67 to 84 [Table 21].
- 28% of patients received care in a hospital with a stroke unit [Table 28].

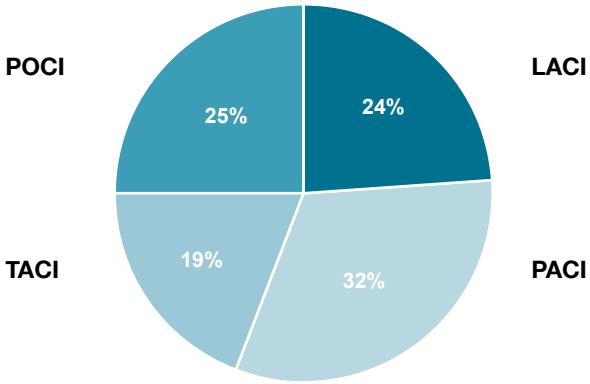
Stroke type was confirmed with imaging in 88% of the audited patients. Of those patients with confirmed stroke type 83% had experienced an ischaemic stroke and 17% had an intracerebral haemorrhage. Ischaemic stroke type where documented (Known N=401) is given in Figure 2 according to the Oxford classification.

Table 21: Patient age at stroke onset

	Aust total (N=3,307)	**NZ total** (N=832)
<65	780 (24%)	185 (22%)
65-74	684 (21%)	182 (22%)
75-84	1130 (34%)	283 (34%)
>85	713 (22%)	182 (22%)
Median (IQR)	77 (66-84)	77 (67-84)

(Australian data supplied by Audit Manager, National Audit Program, NSF)

Figure 2: Oxford classification of ischaemic stroke sub-type



KEY MESSAGES:

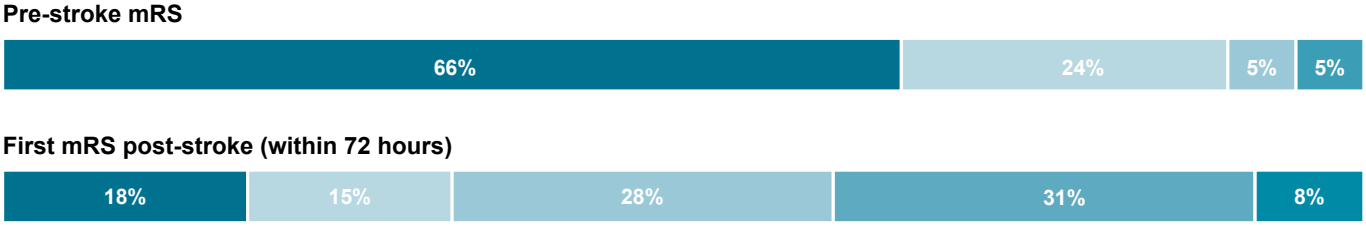
Prior to their stroke, most of the audited patients had been independent (66%, mRS<=2), and lived at home (90%).

Functional status pre- and post-stroke

The modified Rankin Scale (mRS) is a widely used tool for the assessment of the degree of disability or dependence in daily activities after stroke. Pre- and post-stroke assessments are given below.

Most patients (90%) lived at home prior to their stroke.

Figure 3: Functional status pre- and post-stroke as per modified Rankin Scale



Modified Rankin Scale

0 No symptoms at all
1 No significant disability despite symptoms; able to carry out all usual duties and activities
2 Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance
3 Moderate disability; requiring some help, but able to walk without assistance
4 Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5 Severe disability; bedridden, incontinent and requiring constant nursing care and attention
6 Death

KEY MESSAGES:

Half of the audited patients had multiple pre-existing risk factors for stroke on admission.

Prevalence of risk factors

Of those audited patients where pre-morbid factors for stroke were documented, 9% had no risk factors, 18% had one risk factor, 23% had two risk factors, and 50% had multiple risk factors [Table 22].

Table 22: Pre-morbid risk factors by DHB category and stroke unit status

	Aust total (N=3,307)	NZ total (N=832)	A/large (N=277)	B/medium (N=273)	C/small (N=282)	SU (N=336)	No SU (N=496)
Previous stroke / TIA							
Clinical history documented	2,808	685	203	232	250	261	424
Patients with risk factor	1,030 (37%)	308 (45%)	83 (41%)	116 (50%)	109 (44%)	118 (45%)	190 (45%)
Atrial fibrillation							
Clinical history documented	2,673	682	198	243	241	256	426
Patients with risk factor	839 (31%)	272 (40%)	94 (47%)	78 (32%)	100 (41%)	99 (39%)	173 (41%)
Hypertension							
Clinical history documented	3,023	747	238	254	255	296	451
Patients with risk factor	2,173 (72%)	536 (72%)	167 (70%)	184 (72%)	185 (72%)	214 (72%)	322 (71%)
Hypercholesterolaemia							
Clinical history documented	2,671	606	173	219	214	228	378
Patients with risk factor	1,197 (45%)	244 (40%)	83 (48%)	80 (36%)	81 (38%)	89 (39%)	155 (41%)
Current / past smoker							
Clinical history documented	2,570	666	210	232	224	256	410
Patients with risk factor	1,124 (44%)	320 (48%)	101 (48%)	108 (47%)	111 (50%)	126 (49%)	194 (47%)
Ischaemic heart disease							
Clinical history documented	2,703	678	190	243	245	252	426
Patients with risk factor	822 (30%)	232 (34%)	64 (34%)	83 (34%)	85 (35%)	82 (32%)	150 (35%)
Diabetes							
Clinical history documented	2,793	696	212	238	246	278	418
Patients with risk factor	764 (27%)	158 (23%)	60 (28%)	56 (23%)	42 (17%)	78 (28%)	80 (19%)
High alcohol consumption							
Clinical history documented	2,255	547	150	208	189	205	342
Patients with risk factor	291 (13%)	58 (11%)	16 (11%)	24 (11%)	18 (9%)	28 (14%)	30 (9%)
Rheumatic or other valvular heart disease							
Clinical history documented	2,307	572	146	223	203	208	364
Patients with risk factor	195 (8%)	71 (12%)	32 (22%)	13 (6%)	26 (13%)	25 (12%)	46 (13%)
Recent myocardial infarction (within six months)							
Clinical history documented	2,577	656	175	237	244	239	417
Patients with risk factor	142 (6%)	40 (6%)	19 (11%)	7 (3%)	14 (6%)	15 (6%)	25 (6%)

(Australian data from NSF 2009a, p. 16, Table 3 – ASSF and stroke unit figures not available)

KEY MESSAGES:

Improvements in thomboembolic prophylaxis for patients with AF has the potential to prevent a substantial number of strokes in New Zealand.

While uptake of antihypertensive medications appears high, there is no data regarding the effectiveness of treatment taken in maintaining normotension.

Use of preventative medication

Auditors were asked to record medications related to risk factors reported on admission.

Audited patients were documented as receiving medications for atrial fibrillation, hypertension and hypercholesterolaemia prior to their admission [Table 23].

Table 23: Primary prevention (prior to admission) by DHB category and stroke unit status

	Aust total (N=3,307)	NZ total (N=832)	A/large (N=277)	B/medium (N=273)	C/small (N=282)	SU (N=336)	No SU (N=496)
Atrial fibrillation							
N Patients with risk factor	839	272	94	78	100	99	173
Patients medicated *	235 (28%)	66 (32%)	24 (32%)	19 (34%)	23 (29%)	25 (32%)	41 (31%)
Hypertension							
N Patients with risk factor	2,173	536	167	184	185	214	322
Patients medicated *	1,768 (81%)	463 (87%)	139 (84%)	162 (88%)	162 (89%)	179 (85%)	284 (89%)
Hypercholesterolaemia							
N Patients with risk factor	1,197	244	83	80	81	89	155
Patients medicated *	868 (73%)	171 (71%)	51 (62%)	65 (83%)	55 (69%)	61 (71%)	110 (71%)

(Australian data from NSF 2009a, p. 17, Table 4 – ASSF and stroke unit figures not available)
* Percentages calculated on N patients with risk factor minus missing cases for N patients medicated

Table 24: Secondary prevention (prior to admission) if previous stroke/TIA by DHB category and stroke unit status

	Aust total (N=1,030)	NZ total (N=308)	A/large (N=83)	B/medium (N=116)	C/small (N=109)	SU (N=118)	No SU (N=190)
Antithrombotic							
Medication history documented	988	304	82	115	107	116	188
Patients medicated	765 (77%)	242 (80%)	70 (85%)	86 (75%)	86 (80%)	99 (85%)	143 (76%)
Anticoagulant (if atrial fibrillation)							
Medication history documented	320	96	33	28	35	40	56
Patients medicated	112 (35%)	32 (33%)	12 (36%)	10 (36%)	10 (29%)	15 (37%)	17 (30%)
Antihypertensive							
Medication history documented	985	302	81	115	106	115	187
Patients medicated	732 (74%)	234 (77%)	57 (70%)	87 (76%)	90 (85%)	91 (79%)	143 (76%)
Lipid-lowering							
Medication history documented	966	300	80	114	106	114	186
Patients medicated	484 (50%)	153 (51%)	42 (52%)	63 (55%)	48 (45%)	64 (56%)	89 (48%)

(Australian data from National Stroke Foundation 2009b, p. 17, Table 5 – ASSF and stroke unit figures not available)

Impairments on admission

Auditors were asked if some of the most common impairments following stroke were documented as being present on admission.

Table 25: Impairments on admission

	Australia		New Zealand	
	Assessment documented (N=3307)	Impairment present (n=%)	Assessment documented (N=832)	Impairment present (n=%)
Arm deficit	3177 (96%)	2266 (71%)	797 (96%)	565 (71%)
Unable to walk independently *	3225 (97%)	2212 (69%)	820 (99%)	532 (65%)
Speech/communication deficit	3096 (94%)	2070 (67%)	779 (94%)	509 (65%)
Dysphagia	2880 (87%)	1351 (47%)	698 (84%)	291 (42%)
Visual deficit	2536 (77%)	881 (35%)	621 (75%)	256 (41%)
Sensory deficit	2729 (82%)	1313 (48%)	658 (79%)	273 (41%)
Incontinent of urine in first 72hrs	3131 (95%)	1338 (43%)	757 (91%)	298 (39%)
Perceptive deficit	2290 (69%)	802 (35%)	564 (68%)	207 (37%)
Cognitive deficit	2734 (83%)	1234 (45%)	621 (75%)	226 (36%)
Hydration problems	2644 (80%)	619 (23%)	706 (85%)	179 (25%)
Mood impairment	1866 (56%)	458 (25%)	488 (59%)	110 (23%)
Nutrition problems	2592 (78%)	595 (23%)	675 (81%)	105 (16%)

(Australian data from NSF 2009a, p. 17, Table 6 - % derived from Table 6).
* Without any assistance

Conformance with evidence-based recommendations

The webtool used in the Clinical Audit is based on the Australian *Clinical Guidelines for Acute Stroke Management* (NSF 2007a). Although these guidelines are being updated for 2010 publication, at the time the audited care was being delivered, they were a relevant and important reference for New Zealand clinicians, who would have looked for more recent sources for direction in clinical management than the recommendations offered in *Life after stroke. New Zealand guideline for management of stroke* (Baskett and McNaughton 2003).

This section therefore cites recommendations from *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) where they inform audit questions.

ANALYSIS OF TIME DEPENDENT PROCESSES OF CARE

Some of the clinical interventions outlined in the *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) are recommended to occur within a defined time-frame. The date and time of clinical interventions may not always be documented. Analysis of time dependent interventions included all patients eligible for the intervention. If dates and times were known, these were used to calculate whether a process of care occurred within a defined time period.

Where times were missing, but a date was available this information was used to include as many eligible patients as possible (same day used if the intervention was required within 24 hours or the next day if the intervention was required within 48 hours). In instances where both dates and times were missing, it was assumed that the intervention did not occur within the defined time-frame. Footnotes to tables have been used to identify results where this method has been used.

KEY MESSAGES:

38% of patients presenting at hospital from the community arrived within the therapeutic window for thrombolytic therapy.

However, improvement in time of presentation to hospital after stroke onset is an urgent priority, particularly as DHB catchments where stroke thrombolysis is available now cover >80% of New Zealanders.

Pre-hospital care

RATIONALE

Growing evidence that early management can reduce damage to the brain and minimise the effects of stroke means that prompt arrival to hospital is a critical factor. The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- *Stroke patients should be given a high priority grouping by ambulance services (Level III-2, Grade C).*

FINDINGS

Recorded mode of arrival and time of presentation as reported by auditors were used to calculate proportions of patients arriving by ambulance, and time window for arrival.

Mode of arrival

The mode of arrival was known for 93% of patients. Most (69%) presented by ambulance from the community and a just over a fifth by private transport. A greater proportion (80%) of Australian patients presenting as an emergency from the community (NSF 2009a, p. 19) arrived by ambulance than did New Zealand patients (59%) [Table 26].

Time of arrival

The proportion of patients presenting within a certain time window was calculated in those patients where date and time of stroke onset was known. Auditors recorded '*Not documented*' where the time of stroke onset or arrival to emergency was not recorded or where patients woke with stroke symptoms.

Overall, a third of patients presenting at hospital from the community arrived within three hours of stroke onset [Table 27]. DHBs without a stroke unit were more likely to have patients arrive at hospital within three hours of stroke onset (Chi-square = 2.9, df = 1, $p < 0.10$) [Table 27].

Table 26: Mode of arrival from community by DHB category and stroke unit status

	NZ total (N=832)	A/large (N=277)	B/medium (N=273)	C/small (N=282)	SU (N=228)	No SU (N=599) *
By ambulance (emergency)	494 (59%)	152 (55%)	183 (67%)	159 (56%)	150 (66%)	341 (57%)
By ambulance (non-emergency)	84 (10%)	35 (13%)	16 (6%)	33 (12%)	16 (7%)	68 (11%)
By private method (not ambulance)	176 (21%)	48 (17%)	56 (21%)	72 (26%)	41 (18%)	134 (22%)
In-hospital stroke	20 (3%)	9 (3%)	0 (0%)	11 (4%)	1 (0%)	19 (3%)
Not documented	58 (7%)	33 (12%)	18 (6%)	7 (2%)	20 (9%)	37 (6%)

*Known N=599 includes five patients whose method of arrival was unknown or *Not documented*, percentages do not sum to 100%.

Table 27: Time of arrival at hospital from community, by DHB category and stroke unit status

	Aust total (N=2,551)	NZ total (N=772)	A/large (N=253)	B/medium (N=264)	C/small (N=255)	SU (N=314)	No SU (N=458)
Presented within 3 hours of onset *	883 (35%)	258 (33%)	91 (36%)	82 (31%)	85 (33%)	94 (30%)	164 (36%)
Presented within 4.5 hours of onset *	991 (39%)	290 (38%)	106 (42%)	91 (34%)	93 (36%)	113 (36%)	177 (39%)

(Australian data from NSF 2009a, p. 19, Table 7)
* Where times of stroke onset and presentation were known.

KEY MESSAGES:

Fewer people with stroke in New Zealand receive stroke unit care than in Australia.

Because only 52% of people with stroke admitted to DHBs with a stroke unit actually receive stroke unit care, access to a stroke unit requires substantial improvement.

Stroke unit access

RATIONALE

The organisation of hospital services to provide stroke unit care is the single most important recommendation for acute stroke management (SUTC 2007). Stroke unit care is not only associated with reduced levels of death and disability after stroke compared with conventional care in general wards, but also with greater adherence to evidence-based processes of care (SUTC 2007).

FINDINGS

Less than a third of the audited acute stroke patients in New Zealand were treated in a stroke unit (28%) at some point during their admission compared with 49% of patients in Australia [Table 28].

Only 52% of the acute stroke patients admitted to DHBs with a stroke unit actually receive stroke unit care, compared to 74% admitted to Australian hospitals with stroke units [Table 28].

Patients admitted to large DHBs with stroke units were more likely to receive stroke unit care (Chi-square = 7.8, df = 1, $p < 0.01$) [Table 28]. However, even where stroke units were available, a lesser proportion of audited patients in New Zealand were treated in a stroke unit at some point during their admission, compared with Australia [Table 28]. Access to a stroke unit requires substantial improvement, even in DHBs which have one.

Table 28: Received stroke unit care at any point during acute admission by DHB category

	Aust total	NZ total	A/large	B/medium	C/small
All DHBs	(N=3,284)	(N=827)	(N=276)	(N=273)	(N=278)
	1,621 (49%)	228 (28%)	135 (49%)	93 (34%)	0 (0%)
Stroke unit DHBs	(N=2,192)	(N=335)	(N=196)	(N=139)	(N=0)
	1,615 (74%)	175 (52%)	115 (59%)	60 (43%)	-

(Australian data pertains to participating hospitals from NSF 2009a, p. 20, Table 8 – ASSF and stroke unit figures not available)

KEY MESSAGES:

There is a marked discrepancy in the proportion of patients having carotid artery imaging between Australia (50%) and New Zealand (22%).

Early assessment and investigation

Diagnostic imaging

RATIONALE

Brain imaging is required to delineate cerebral ischaemia from haemorrhage in a patient presenting with stroke. Brain imaging also identifies non-vascular causes of a 'stroke-like' syndrome i.e. stroke mimics. Although MRI is more sensitive to ischaemic changes and may be preferred by some clinicians, CT is more commonly available in New Zealand and Australia and has been described as the most cost-effective imaging modality for acute stroke (Wardlaw *et al* 2004).

FINDINGS

Auditors were asked to provide information about the type of imaging performed, and the time and date of imaging. Where imaging was not obtained, they were also asked to report the reasons why; for example, the patient refused or was unable to cooperate, patient was for palliative care only, or the patient had died before the scan could be performed. In patient records where times of stroke onset, arrival to the emergency department and brain imaging were *Not documented* it was assumed that imaging did not occur within the defined timeframe. Patients with contraindications were excluded from analysis.

Auditors were also asked if cardiac and carotid imaging was undertaken during the hospital admission.

Patients in large DHBs were more likely to receive brain imaging during admission (Chi-square = 10.7, df = 2, $p < 0.01$) [Table 29]. Patients in large and small DHBs were more likely to receive brain imaging within twenty-four hours (Chi-square = 45.0, df = 2, $p < 0.001$) [Table 29].

The low rate of use of carotid imaging in New Zealand compared with Australia is an area of potential concern, but the appropriateness of use of this investigation has not been specifically addressed in this audit.

Table 29: Use of brain imaging (CT or MRI) by DHB category and stroke unit status

	Aust total	NZ total	A/large	B/medium	C/small	SU	No SU
Brain imaging during admission	(N=3,247)	(N=832)	(N=277)	(N=273)	(N=282)	(N=336)	(N=496)
	3,229 (99%)	791 (95%)	273 (99%)	255 (93%)	263 (93%)	322 (96%)	469 (95%)
Brain imaging within 24 hours of hospital arrival *	(N=3,247)	(N=724)	(N=249)	(N=244)	(N=231)	(N=303)	(N=421)
	2,946 (91%)	635 (88%)	232 (93%)	186 (76%)	217 (94%)	272 (90%)	363 (86%)

(Australian data from NSF 2009a, p. 21, Table 10 – ASSF and stroke unit figures not available)
* Percentage of patients where time known.

Table 30: Use of ECG and carotid artery imaging while in hospital by DHB category and stroke unit status

	Aust total (N=3,307)	NZ total (N=832)	A/large (N=277)	B/medium (N=273)	C/small (N=282)	SU (N=336)	No SU (N=496)
ECG	3,068 (93%)	774 (93%)	261 (94%)	253 (93%)	260 (92%)	316 (94%)	458 (92%)
Carotid artery imaging	1,654 (50%)	182 (22%)	58 (21%)	57 (21%)	67 (24%)	65 (19%)	117 (24%)

(Australian data from NSF 2009a, p. 21, Table 11 – ASSF and stroke unit figures not available)

KEY MESSAGES:

People presenting to hospital within 3 hours of stroke onset are more likely to receive thrombolysis where a stroke unit is present.

DHBs offering stroke thrombolysis need to examine their processes to improve the low rate of treatment for patients who arrive within 3 hours of stroke onset.

The rate of use of aspirin within 48 hours is very surprisingly and unacceptably low.

Acute medical treatment

RATIONALE

Acute stroke therapies include those aimed at restoring blood flow to the brain with thrombolytic agents, or improving outcomes with early administration of aspirin in ischaemic stroke. The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- *Intravenous rt-PA in acute ischaemic stroke should only be undertaken in patients satisfying specific inclusion and exclusion criteria (Level I, Grade A).*
- *Aspirin (150-300mg) should be given as soon as possible after the onset of stroke symptoms (i.e. within 48 hrs) if CT/MRI scan excludes haemorrhage (Level I, Grade A).*

FINDINGS

Auditors were asked to indicate whether the patient had received thrombolysis or early treatment with aspirin and if so, dates and times of the intervention. It was assumed that the patient had not received the intervention if treatment was *Not documented*. Patients with contraindications were excluded from analysis.

Of the 180 patients with ischaemic stroke presenting as an emergency from the community within three hours of stroke onset, 13 (7%) were treated with thrombolytic agents [Table 31]. Patients presenting within three hours of stroke onset were more likely to receive thrombolysis in DHBs with stroke units compared with DHBs with no SU (13% vs 4%, p=0.04, Fisher exact test). Even in DHBs with stroke units, only a small proportion (13%) of people presenting with stroke within 3 hours of onset currently receive thrombolysis.

Despite differences in rates of stroke unit care between New Zealand (28%) and Australia (49%) [Table 28] there were no differences in rates of treatment with thrombolytic agents [Table 31]. Overall rates of thrombolysis are low in both Australia and New Zealand.

Patients in large DHBs were more likely to receive aspirin (Chi-square = 31.3, df = 2, $p < 0.001$) and receive it within forty-eight hours (Chi-square = 7.9, df = 2, $p < 0.05$) [Table 32]. Patients in DHBs with a stroke unit were more likely to receive aspirin (Chi-square = 28.3, df = 1, $p < 0.001$) [Table 32]. Rates of aspirin use in the acute phase of ischaemic stroke are much lower in New Zealand (21%) than in Australia (62%) [Table 32].

Table 31: Thrombolysis treatment for patients with ischaemic stroke by DHB category and stroke unit status

	Aust total	NZ total	A/large	B/medium	C/small	SU	No SU
(All ischaemic stroke)	(N=2,442)	(N=602)	(N=217)	(N=202)	(N=183)	(N=257)	(N=345)
Patients thrombolysed	82 (3%)	17 (3%)	11 (5%)	2 (1%)	4 (2%)	11 (4%)	6 (2%)
(All ischaemic stroke arrived in 3 hrs)	(N=638)	(N=180)	(N=68)	(N=63)	(N=49)	(N=71)	(N=109)
Patients thrombolysed	63 (10%)	13 (7%)	8 (12%)	2 (3%)	3 (6%)	9 (13%)	4 (4%)

(Australian data from NSF 2009a, p. 22, Table 12 – ASSF and stroke unit figures not available)

Table 32: Hyperacute aspirin treatment for patients with ischaemic stroke by DHB category and stroke unit status *

(Patients with ischaemic stroke *)	**Aust total** (N=2,102)	**NZ total** (N=602)	**A/large** (N=217)	**B/medium** (N=202)	**C/small** (N=183)	**SU** (N=257)	**No SU** (N=345)
Received aspirin	1,484 (71%)	342 (57%)	147 (68%)	121 (60%)	74 (40%)	178 (69%)	164 (47%)
Received aspirin within 48 hours	1,295 (62%)	126 (21%)	57 (26%)	42 (21%)	27 (15%)	55 (21%)	71 (21%)

(Australian data from NSF 2009a, p. 22, Table 13 – ASSF and stroke unit figures not available)
* Known N excludes ischaemic stroke patients with legitimate reasons for not receiving aspirin

KEY MESSAGES:

Prompt dysphagia screening is considered a fundamental component of stroke care. Rates of documented swallow screening during admission and before food, drink or oral medications are given appear unacceptably low and must be addressed with urgency.

Assessment and management of the consequences of stroke

Dysphagia assessment

RATIONALE

Dysphagia is associated with an increased risk of complications, such as aspiration pneumonia, dehydration and malnutrition (Carnaby *et al* 2006). Prompt screening, accurate assessment and early management are therefore needed to prevent complications and promote recovery of functional swallow. The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- *Patients should be screened for swallowing deficits before being given food, drink or oral medications. Screening should be undertaken by personnel specifically trained in swallowing screening (Level I, Grade C).*

FINDINGS

Auditors were asked to report whether there was documented evidence of a swallow screen by a trained health professional before the patient was given food, drink or oral medication. If so, date and time of the screen was reported. Auditors were also asked to identify if a swallow assessment by an SLT was provided to patients who did not receive a swallow screen. An SLT swallow assessment was also classified as a 'swallow screen by a trained health professional'. As it was not possible to determine when this swallowing assessment took place, these patients are not included in the analysis of swallow screen before oral intake. This means the proportion receiving a 'swallow screen before food, drink or oral medication' may be an underestimation of adherence to this indicator.

DHBs with a stroke unit were more likely to swallow screen patients during admission (Chi-square = 6.6, df = 1, $p < 0.05$), and before giving patients food, drink or oral medication (Chi-square = 9.9, df = 1, $p < 0.01$) [Table 33].

Rates of documented dysphagia screening are lower in New Zealand (57%) than Australia (79%) and are low even in stroke units (63%) [Table 33]. Note also that dietitian and SLT assessment within 48 hours is much lower in New Zealand than in Australia [Table 34].

Table 33: Patients receiving swallow screen by trained health professional by DHB category and stroke unit status *

	Aust total (N=3,307)	NZ total (N=832)	A/large (N=277)	B/medium (N=273)	C/small (N=282)	SU (N=336)	No SU (N=496)
Swallow screened during admission *	2,626 (79%)	478 (57%)	170 (61%)	147 (54%)	161 (57%)	211 (63%)	267 (54%)
Swallow screened within 24 hours **	2,124 (64%)	280 (61%)	85 (54%)	99 (70%)	96 (61%)	123 (63%)	157 (61%)
Swallow screened before given food, drink or oral medication #	1,734 (52%)	381 (46%)	136 (49%)	124 (45%)	121 (43%)	176 (52%)	205 (41%)

(Australian data from NSF 2009a, p. 24, Table 15 – ASSF and stroke unit figures not available)
* Includes SLT swallow assessment
** Includes SLT swallow assessment, excludes cases where no time was recorded (N=455)
# Excludes SLT swallow assessment (see discussion of data analysis under findings, above)

KEY MESSAGES

The rates of physiotherapy, OT and social work assessment for eligible patients is similar in New Zealand and Australia, but there are lower assessment rates in New Zealand for SLT and dietitians.

The time to first therapy assessments should be improved to at least match stroke services in Australia.

Multidisciplinary team assessment

RATIONALE

Complete assessment requires the input from all members of the stroke team. It is recommended that all assessments occur as soon as possible after admission (target is assessment within two days of admission) with the stroke team working together so as not to overburden the patient by duplicating questions. The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- *Clinicians should provide timely and efficient assessment of patients with acute stroke. Where possible a multidisciplinary assessment should be undertaken and documented within two days of admission (Consensus opinion).*
- *Those who are at risk of malnutrition, including those with dysphagia, should be referred to a dietitian for assessment and ongoing management (Consensus opinion).*
- *Patients with suspected altered mood (i.e. depression, anxiety, emotional lability) should be assessed by trained personnel using a standardised scale (Level II and III-I, Grade B).*

FINDINGS

Auditors were asked to report whether an assessment was documented and if so, date and time of assessment for a range of disciplines. It was assumed the patient had not received an assessment within the defined time period if times of admission and assessment were *Not documented* in the case notes. Eligibility for assessment was defined using the Clinical Guidelines. For example, criteria for 'assessment by dietitian within 48 hours' included only patients with dysphagia or hydration/nutrition problems on admission. The criterion required for an 'assessment by psychologist' included only patients with mood impairment identified on or during admission.

Patients in large DHBs were more likely to have a physiotherapy assessment within forty-eight hours (Chi-square = 39.5, df = 2, $p < 0.001$), as were those in DHBs with stroke units (Chi-square = 22.3, df = 1, $p < 0.001$). [Table 34].

Patients in large and medium DHBs were more likely to have an occupational therapy assessment within forty-eight hours (Chi-square = 17.2, df = 2, $p < 0.001$), as were those in DHBs with stroke units (Chi-square = 14.4, df = 1, $p < 0.001$) [Table 34].

Patients in large DHBs were more likely to have a speech language therapy assessment within forty-eight hours (Chi-square = 8.0, df = 2, $p < 0.05$). as were those in DHBs with stroke units (Chi-square = 15.0, df = 1, $p < 0.001$) [Table 34].

Patients in large DHBs were more likely to have a social work assessment within forty-eight hours (Chi-square = 31.4, df = 2, $p < 0.001$), as were those in DHBs with stroke units (Chi-square = 29.0, df = 1, $p < 0.001$) [Table 34].

The rates of physiotherapy, occupational therapy and social work assessment for eligible patients is similar in Australia and New Zealand, but there are lower assessment rates in New Zealand for speech language therapy and dietitians. Multidisciplinary teams in New Zealand typically do not have clinical psychologists in their membership. Social work assessments are undertaken at a median of three days in both Australia and New Zealand, however, physiotherapy, occupational therapy, speech language therapy and dietitian assessments tend to be undertaken later in New Zealand than in Australia, which may mean that rehabilitation processes start later in New Zealand than in Australia, extending length of stay in hospital [Table 34].

Table 34: Prompt MDT assessment by DHB category and stroke unit status *							
	Aust total (N=3,307)	**NZ total** (N=832)	**A/large** (N=277)	**B/medium** (N=273)	**C/small** (N=282)	**SU** (N=336)	**No SU** (N=496)
Physiotherapy assessment							
Eligible for assessment	**Aust total**	**NZ total**	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
	3,150	777	264	258	255	320	457
Assessed by therapist	2,741 (87%)	639 (82%)	240 (91%)	205 (79%)	194 (76%)	276 (86%)	363 (79%)
Assessed within 48 hrs	1,818 (58%)	316 (41%)	143 (54%)	104 (40%)	69 (27%)	162 (51%)	154 (34%)
Median days to assessment *(IQR)*	1.3 *(0.9-2.2)*	1.7 *(1.0-2.6)*	1.6 *(1.0-2.1)*	1.5 *(1.0-2.8)*	1.8 *(1.0-2.7)*	1.5 *(1.0-2.1)*	1.8 *(1.0-2.8)*
Occupational therapy assessment							
Eligible for assessment	**Aust total**	**NZ total**	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
	3,112	755	257	255	243	312	443
Assessed by therapist	2,318 (74%)	515 (68%)	197 (77%)	171 (67%)	147 (60%)	223 (71%)	292 (66%)
Assessed within 48 hrs	1,166 (37%)	134 (18%)	53 (21%)	58 (23%)	23 (9%)	75 (24%)	59 (13%)
Median days to assessment *(IQR)*	2.0 *(1.1-3.2)*	2.7 *(1.7-4.0)*	2.7 *(1.7-4.0)*	2.3 *(1.7-3.9)*	3.0 *(1.9-5.3)*	2.2 *(1.5-3.5)*	3.0 *(1.8-4.6)*
Speech language therapy assessment							
Eligible for assessment	**Aust total**	**NZ total**	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
	3,106	733	240	245	248	301	432
Assessed by therapist	2,520 (81%)	447 (61%)	167 (70%)	144 (59%)	136 (55%)	198 (66%)	249 (58%)
Assessed within 48 hrs	1,866 (60%)	259 (35%)	99 (41%)	88 (36%)	72 (29%)	131 (43%)	128 (30%)
Median days to assessment *(IQR)*	1.0 *(0.6-1.9)*	1.2 *(0.9-2.8)*	1.2 *(0.9-2.8)*	1.4 *(0.8-2.9)*	1.2 *(0.8-2.6)*	1.1 *(0.8-2.2)*	1.5 *(0.9-3.0)*
Dietitian assessment							
Eligible for assessment	**Aust total**	**NZ total**	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
	2,896	692	233	220	239	284	408
Assessed by therapist	1,399 (48%)	156 (22%)	76 (33%)	41 (19%)	39 (16%)	66 (23%)	90 (22%)
Assessed within 48 hrs[1]	343 (26%)	27 (9%)	10 (10%)	7 (8%)	10 (8%)	10 (9%)	17 (9%)
Median days to assessment *(IQR)*	2.5 *(1.3-4.2)*	3.0 *(1.9-5.0)*	3.6 *(2.0-6.4)*	3.0 *(2.0-4.0)*	2.7 *(1.2-5.0)*	3.0 *(2.0-5.0)*	3.0 *(1.7-5.1)*
Social work assessment							
Eligible for assessment	**Aust total**	**NZ total**	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
	3,037	743	255	241	247	315	485
Assessed by therapist	1,425 (47%)	331 (44%)	152 (60%)	99 (41%)	80 (32%)	161 (53%)	170 (38%)
Assessed within 48 hrs	-	69 (9%)	43 (17%)	20 (8%)	6 (2%)	49 (16%)	20 (4%)
Assessed within 7 days	26%)	22%)	36%)	23%)	7%)	32%)	15%)
Median days to assessment *(IQR)*	3.0 *(1.7-5.4)*	3.0 *(1.8-5.0)*	2.9 *(1.6-5.1)*	3.7 *(1.9-5.0)*	2.9 *(2.0-6.0)*	2.8 *(1.5-5.0)*	3.8 *(2.2-6.0)*
Psychology assessment							
Eligible for assessment	**Aust total**	**NZ total**	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
	516	478	134	151	193	142	336
Assessed by therapist[2]	16 (3%)	6 (1%)	4 (3%)	1 (1%)	1 (<1%)	2 (1%)	4 (1%)
Median days to assessment *(IQR)*	7.7 *(2.9-22.0)*	*(2.8-7.4 *)*	-	-	-	-	-

(Australian data from NSF 2009a, p. 23, Table 14 – ASSF and stroke unit figures not available)
[1] Known N included only patients with dysphagia or hydration/nutrition problems on admission
[2] Known N included only patients with mood impairment identified on or during admission
* Median (IQR) – For psychology assessment, there were only two valid cases, so range is given

KEY MESSAGES:

MDT communication with patients and their family/whanau/carers should be reviewed by stroke services.

Communication between multidisciplinary team and patient

RATIONALE

Having all team members together to discuss assessment results, treatment plans and goals aids the 'coordinated care' approach and adds to the understanding of the patient of what is happening to them (SUTC 2007). The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- *The stroke team should meet regularly with the person with stroke and the family/ carer to involve them in management, goal setting and planning for discharge (Level I, Grade C).*

FINDINGS

A fifth (20%) of audited patients in New Zealand were documented as having met with the MDT to discuss assessment results, treatment plans and goals, compared with just over a quarter (27%) in Australia [Table 35]. Meetings between MDTs and patients appear infrequent in both New Zealand and Australia, and less likely in New Zealand.

Note however, that two-thirds of DHBs indicated that they offered family meetings, and DHBs with stroke units appeared more likely to offer family meetings than those without stroke units [Table 19]. The Clinical Audit webtool asked auditors if a meeting between the MDT and patient (and/or family/carer) had been documented and if so, to give the date of the first family meeting. It is possible that the rate of family meetings is higher than that documented.

Table 35: Meeting between MDT and patient/family/carer by DHB category and stroke unit status *

	Aust total (N=3,307)	**NZ total** (N=832)	**A/large** (N=277)	**B/medium** (N=273)	**C/small** (N=282)	**SU** (N=336)	**No SU** (N=496)
Assessment results and treatment plans discussed with patient/family/ carer	27%	20%	20%	13%	25%	18%	20%

(Australian data from NSF 2009a, p. 25)

KEY MESSAGES:

Rates of post-stroke complications were similar in New Zealand and Australia.

Prevention and management of complications

Complications during hospital admission

RATIONALE

Monitoring and managing complications after stroke is an important aspect of stroke management. Complications during admission may lead to prolonged illness, delays in participating in rehabilitation, increased length of stay or a worse functional outcome.

FINDINGS

Auditors were asked to record whether complications were recorded in the case notes, but were not required to provide information on the severity of the complications.

DHBs without a stroke unit were more likely to have more patients with stroke progression (Chi-square = 8.5, df = 1, $p < 0.01$) and pulmonary embolism (Chi-square = 2.7, df = 1, $p < 0.10$) [Table 36].

Large DHBs were more likely to have patients experience complications of fever (Chi-square = 6.2, df = 2, $p < 0.05$) [Table 36]. Small DHBs were more likely to have patients experience stroke progression complications during admission (Chi-square = 7.5, df = 2, $p < 0.05$) [Table 36].

Rates of post-stroke complications were similar in New Zealand and Australia.

Table 36: Complications during hospital admission by DHB category and stroke unit status *

	Aust total (N=3,307)	NZ total (N=832)	A/large (N=277)	B/medium (N=273)	C/small (N=282)	SU (N=336)	No SU (N=496)
Fever	476 (14%)	98 (12%)	43 (15%)	30 (11%)	25 (9%)	37 (11%)	61 (12%)
Aspiration pneumonia	327 (10%)	83 (10%)	32 (12%)	31 (11%)	20 (7%)	29 (9%)	54 (11%)
Depression/anxiety	347 (10%)	93 (11%)	34 (12%)	28 (10%)	31 (11%)	38 (11%)	55 (11%)
Stroke progression	345 (10%)	100 (12%)	32 (12%)	23 (8%)	45 (16%)	27 (8%)	73 (15%)
Urinary tract infection	345 (10%)	60 (7%)	18 (6%)	21 (8%)	21 (7%)	20 (6%)	40 (8%)
Falls	229 (7%)	51 (6%)	14 (5%)	19 (7%)	18 (6%)	20 (6%)	31 (6%)
New onset atrial fibrillation	183 (6%)	41 (5%)	12 (4%)	15 (5%)	14 (5%)	15 (4%)	26 (5%)
Malnutrition	169 (5%)	36 (4%)	16 (6%)	9 (3%)	11 (4%)	11 (3%)	25 (5%)
Shoulder pain	157 (5%)	28 (3%)	12 (4%)	8 (3%)	8 (3%)	14 (4%)	14 (3%)
Raised intracranial pressure	118 (4%)	24 (3%)	6 (2%)	7 (3%)	11 (4%)	6 (2%)	18 (4%)
New stroke	140 (4%)	32 (4%)	13 (5%)	7 (3%)	12 (4%)	13 (4%)	19 (4%)
Symptomatic haemorrhagic transformation	86 (3%)	29 (3%)	12 (4%)	10 (4%)	7 (2%)	14 (4%)	15 (3%)
Pressure sores	86 (3%)	14 (2%)	5 (2%)	3 (1%)	6 (2%)	5 (1%)	9 (2%)
Seizures	90 (3%)	27 (3%)	10 (4%)	8 (3%)	9 (3%)	11 (3%)	16 (3%)
Acute myocardial infarction	80 (2%)	19 (2%)	10 (4%)	4 (1%)	5 (2%)	6 (2%)	13 (3%)
Deep Vein Thrombosis (DVT)	25 (1%)	6 (1%)	3 (1%)	0 (0%)	3 (1%)	2 (1%)	4 (1%)
Pulmonary Embolism (PE)	16 (<1%)	4 (<1%)	1 (<1%)	0 (0%)	3 (1%)	0 (0%)	4 (1%)

(Australian data from NSF 2009a, p. 25, Table 16 – ASSF and stroke unit figures not available)

KEY MESSAGES:

Rates of use of DVT prophylaxis of any kind are much lower in New Zealand than in Australia.

Use of DVT prophylaxis must be reviewed in light of recent new evidence which will be reflected in the 2010 New Zealand Stroke Guideline.

DVT prophylaxis

RATIONALE

Deep vein thrombosis (DVT) and the associated complication of pulmonary embolus (PE) are significant risks in the first few weeks post-stroke with PE accounting for 5% of deaths after stroke (Sherman 2006). The Australian *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- *The following interventions may be used with caution for selected people with acute ischaemic stroke at high risk of DVT/PE:*
  - *Low molecular weight heparin or heparin in prophylactic doses.*
  - *Thigh-length antithrombotic stockings.*

It should be noted that DVT/PE prophylaxis guidelines have been controversial. *Life after stroke. New Zealand guideline for management of stroke* (Baskett and McNaughton 2003) recommended aspirin, mobilisation and compression stockings for DVT prophylaxis and recommended avoidance of prophylactic anticoagulants for DVT prophylaxis after stroke unless other methods were contraindicated or there was a previous history of DVT. Recent evidence has shown that compression stockings are ineffective for DVT prophylaxis after stroke (The CLOTS Trial Collaboration 2009), requiring revision of current guidelines.

FINDINGS

For patients who were unable to walk on admission, auditors were asked to report the prophylactic interventions used for thrombotic complications. This included heparin, heparinoid, and TED stockings.

Large DHBs were more likely to provide DVT prophylaxis (Chi-square = 6.8, df = 2, $p < 0.05$) [Table 37]. Rates of use of DVT prophylaxis of any kind are much lower in New Zealand than in Australia [Table 37].

Use of DVT prophylaxis must be reviewed in light of recent new evidence which will be reflected in the 2010 New Zealand Stroke Guideline, although rates of DVT and PE in the first week are very low.

Table 37: Prevention and management of DVT for patients unable to walk on admission by DHB category and stroke unit status *

	Aust total (N=2,212)	NZ total (N=288)	A/large (N=89)	B/medium (N=112)	C/small (N=87)	SU (N=120)	No SU (N=168)
DVT prophylaxis *	1,513 (68%)	52 (18%)	23 (26%)	13 (12%)	16 (18%)	23 (19%)	29 (17%)

(Australian data from NSF 2009a, p. 26, Table 17 – ASSF and stroke unit figures not available)
* Prophylaxis included TEDs and/or heparin

KEY MESSAGES:

Rates of continence management planning are lower in New Zealand than Australia, and the use of IDUCs within a week of admission for patients with urinary incontinence is higher.

Continence management plans must be improved and IDUC use reduced.

Management of continence

RATIONALE

Urinary incontinence is common soon after stroke. Incontinence is associated with complications, such as depression and increased length of stay. It is important to assess and identify issues with continence early.

The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- *Patients with confirmed continence difficulties should have a continence management plan formulated and documented (Level II, Grade B).*
- *The use of indwelling catheter should be avoided as an initial management strategy for patients with urinary incontinence (Consensus Opinion).*

FINDINGS

Auditors were asked to report the use of interventions for management of continence for patients with urinary incontinence.

DHBs without a stroke unit were more likely to have a continence management plan for patients with urinary incontinence (Chi-square = 12.7, df = 1, $p < 0.001$). Small DHBs were more likely to have a continence management plan for patients with urinary incontinence (Chi-square = 36.7, df = 2, $p < 0.001$).

Whilst not recommended by clinical guidelines, the use of an indwelling urinary catheter (IDUC) within one week of admission was reported for 170 (20%) of all 832 audited New Zealand patients, compared with 26% of all audited Australian patients [Table 38]. Some of the reasons for use of an IDUC included incontinence, skin care, fluid retention and fluid monitoring. There is a higher rate of continence management planning for patients with urinary incontinence in Australia than in New Zealand [Table 38].

Table 38: Continence management for patients with urinary incontinence by DHB category and stroke unit status *

	Aust total	NZ total	A/large	B/medium	C/small	SU	No SU
Use of IDUC within one week of admission	(N=3,307)	(N=832)	(N=277)	(N=273)	(N=282)	(N=336)	(N=496)
	26%	20%	23%	16%	22%	20%	21%
Continence management plan *	(N=1,338)	(N=298)	(N=92)	(N=89)	(N=117)	(N=112)	(N=186)
	429 (32%)	58 (19%)	8 (9%)	7 (8%)	43 (37%)	10 (9%)	48 (26%)

(Australian data from NSF 2009a, p. 26, Table 18 – ASSF and stroke unit figures not available)
* For patients with urinary incontinence.

KEY MESSAGES:

Not all patients are given full secondary prevention medical treatment. The audit is not able to determine whether medications have been withheld inappropriately.

Secondary prevention

RATIONALE

A person with stroke has an accumulated risk of subsequent stroke of 43% over 10 years with an annual rate of approximately 4% (Hardie *et al* 2004).

The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- *Every person with stroke should be assessed and informed of their risk factors for a further stroke and possible strategies to modify identified risk factors. All patients after stroke or TIA, whether normotensive (<140/90mm Hg) or hypertensive (>140/90mm Hg), should receive blood pressure lowering therapy, unless contraindicated by symptomatic hypotension (Level I, Grade A).*
- *Long term antiplatelet medication should be prescribed to all people with ischaemic stroke or TIA who are not prescribed anticoagulation therapy (Level I, Grade A).*
- *Anticoagulation therapy for long-term secondary prevention should be used in all people with ischaemic stroke or TIA who have atrial fibrillation, cardioembolic stroke from valvular heart disease, or recent myocardial infarction, unless a contraindication exists (Level I, Grade A).*
- *Therapy with a statin should be used for all patients with ischaemic stroke or TIA (Level II, Grade B).*

FINDINGS

Auditors were asked to record which secondary prevention medications were prescribed on discharge. Only patients discharged from acute care were included. People with contraindications for pharmacological agents were excluded from the analysis.

The rate of secondary prevention medication use is at least as high in DHBs without stroke units as in DHBs with stroke units. Secondary prevention measures at discharge are comparable in New Zealand and Australia. However, not all patients are given full secondary prevention medical treatment. The audit is not able to determine whether medications have been withheld inappropriately.

Table 39: Secondary prevention by DHB category and stroke unit status

	Aust total	NZ total	A/large	B/medium	C/small	SU	No SU
Discharged on antihypertensives	77%	71%	64%	72%	78%	66%	76%
Discharged on lipid lowering treatment if ischaemic stroke	77%	73%	75%	78%	67%	73%	73%
Antithrombotics on discharge if ischaemic stroke	94%	94%	90%	93%	99%	90%	97%

(Australian data from NSF 2009a, p. 5, Table 1 – ASSF and stroke unit figures not available)

KEY MESSAGES:

The rates of use of discharge care plans, and documentary evidence of patient education at discharge, carer training and carer need assessment are low.

Discharge care plans, carer training and carer support are identified as priority areas for improvement.

Planning for discharge

RATIONALE

The *Clinical Guidelines for Acute Stroke Management* (NSF 2007a) recommend:

- *Before discharge all patients should be assessed to determine the need for a home visit prior to discharge from hospital (Consensus opinion).*
- *Relevant members of the interdisciplinary team should provide specific training for carers before the person's discharge home. This should include training, as necessary, in:*
  - *Personal care techniques, communication strategies, physical handling techniques, ongoing prevention and other specific stroke related problems; (Level II, Grade B).*
  - *Safe swallowing and appropriate dietary modifications (Consensus opinion).*
- *Care plans should be used and outline care in the community after discharge, including the development of self management strategies, provision of equipment and support services, and outpatient appointments (Consensus opinion).*
- *The stroke survivor's general practitioner, other primary health professionals and community service providers should be involved in, and informed about, the discharge plans and agreed post-discharge management, as early as possible prior to discharge (Consensus opinion).*

FINDINGS

Auditors were asked to provide information about discharge planning processes as outlined in the clinical guidelines, including home visits, and whether carers had training and needs assessments prior to patient's discharge.

However, as a small proportion of patients (7%) were 'statistically discharged' from acute care [Table 41] findings on discharge planning need to be read with some caution. A statistical discharge may occur without the patient 'leaving the bed' or the unit/ward, and especially where acute and rehabilitation stroke care is integrated, a statistical discharge may not trigger care planning, patient education and carer need assessment in the same way a final discharge might.

Large DHBs were more likely to provide a discharge care plan (Chi-square = 28.2, df = 2, $p < 0.001$),); large and small DHBs were more likely to provide patient education on discharge (Chi-square = 36.2, df = 2, $p < 0.001$); large and medium DHBs were more likely to send a discharge summary to the patient's GP (Chi-square = 26.2, df = 2, $p < 0.001$) [Table 40].

DHBs without stroke units were more likely to provide patient education on discharge (Chi-square = 6.0, df = 1, $p < 0.05$), and more likely to document that carer training had been provided (Chi-square = 11.2, df = 1, $p < 0.01$ [Table 40].

Patients in large DHBs were more likely to have a carer (Chi-square = 20.5, df = 2, $p < 0.001$), and have documented evidence of carer needs being assessed (Chi-square = 6.3, df = 2, $p < 0.05$) [Table 40].

Overall, the provision of discharge care plans and patient education is documented for less than half of New Zealand patients, and appears to occur for a higher proportion of Australian than New Zealand patients [Table 40].

Where required, home visits by an OT were provided equally across DHB size and stroke unit status at 13-14%, a rate comparable with Australia. However, it appears that New Zealand patients were more likely to be present when the OT visited [Table 40].

Overall, it appears that a lower proportion of New Zealand patients have someone to care for them (35%) than do Australian patients (44%), and that carers in New Zealand are less likely to receive training and have their support needs assessed [Table 40]. Discharge care plans, carer training and carer support are identified as priority areas for improvement.

Table 40: Discharge planning by DHB category and stroke unit status							
Use of discharge planning process	**Aust total**	**NZ total**	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
Discharge care plan provided	(N=2,353)	(N=712)	(N=240)	(N=239)	(N=233)	(N=296)	(N=416)
	1,247 (53%)	297 (42%)	131 (55%)	74 (31%)	92 (39%)	117 (39%)	180 (43%)
Received patient education on discharge	(N=2,548)	(N=832)	(N=277)	(N=273)	(N=282)	(N=336)	(N=496)
	1,087 (43%)	268 (32%)	111 (40%)	50 (18%)	107 (38%)	92 (27%)	176 (35%)
Patient's GP sent a discharge summary *	(N=2,715)	(N=808)	(N=268)	(N=267)	(N=273)	(N=329)	(N=479)
	2,338 (86%)	697 (86%)	236 (88%)	248 (93%)	213 (78%)	290 (88%)	407 (85%)
Home visit by OT	**Aust total**	**NZ total**	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
Home visit performed **	(N=1,306)	(N=408)	(N=128)	(N=146)	(N=134)	(N=170)	(N=238)
	173 (13%)	53 (13%)	18 (14%)	17 (12%)	18 (13%)	19 (11%)	34 (14%)
Patient present at home visit	(N=173)	(N=53)	(N=18)	(N=17)	(N=18)	(N=19)	(N=34)
	111 (64%)	44 (83%)	16 (89%)	14 (82%)	14 (78%)	15 (79%)	29 (85%)
Documented evidence of carer needs	**Aust total**	**NZ total**	**A/large**	**B/medium**	**C/small**	**SU**	**No SU**
Patients with carer	(N=1,940)	(N=475)	(N=155)	(N=174)	(N=146)	(N=195)	(N=280)
	861 (44%)	167 (35%)	76 (49%)	45 (26%)	46 (31%)	67 (34%)	100 36%)
Received carer training	(N=614)2	(N=167)	(N=76)	(N=45)	(N=46)	(N=67)	(N=100)
	309 (50%)	63 (38%)	30 (39%)	11 (24%)	22 (48%)	15 (22%)	48 (48%)
Received carer support needs assessment	(N=697)2	(N=167)	(N=76)	(N=45)	(N=46)	(N=67)	(N=100)
	356 (51%)	64 (38%)	36 (47%)	11 (24%)	17 (37%)	26 (39%)	38 (38%)

(Australian data from NSF 2009a, p. 29, Tables 19, 20 and 21 – ASSF and stroke unit figures not available)
* Known N excluded cases where this process was deemed not applicable, e.g. patient being transferred to another hospital for further treatment
** Known N excluded cases where this process was deemed not required for the individual

KEY MESSAGES

Hospital mortality, length of acute hospital stay and discharge destination of patients after acute stroke were similar in New Zealand and Australia.

Patient outcomes

Length of stay

Of the 832 patients audited in New Zealand, 120 (14%) died in hospital [Table 41] and of these 87% died within a week. Of stroke patients admitted to DHBs with stroke units, 12% died in hospital and of those admitted to DHBs without stroke units, 16% died in hospital. The median time to death for audited patients who died in hospital was three days. The median length of stay for audited patients discharged alive from hospital was five days.

In comparison, of the 3,307 patients audited in Australia, 448 (14%) died in hospital, and of these 63% died within a week. The median time to death for audited patients in Australia who died in hospital in was four days. The median length of stay for audited patients in Australia discharged alive from hospital was six days (NSF 2009a, p.30).

Discharge destination and access to rehabilitation service

Auditors were asked if a formal assessment for inpatient rehabilitation by a rehabilitation specialist was recorded in the patient record. They were also asked if the patient accessed further rehabilitation, and if yes, whether it was provided via inpatient, outpatient or community services.

Formal assessment undertaken by a rehabilitation specialist was recorded for 55% of audited New Zealand patients. Note that other assessments for rehabilitation may have been undertaken. Access to rehabilitation was documented for 56% of audited New Zealand patients (at similar rates across DHB size categories), compared with 49% of audited Australian patients. Inpatient rehabilitation was accessed by 68%, community rehabilitation by 24% and outpatient rehabilitation by 8% [Figure 4].

The discharge destination for 40% of 832 audited patients in New Zealand was either their own home or a relative's home [Table 41]. Residential care was the discharge destination for 11% of audited patients [Table 41]. Of the 2359 audited Australian patients discharged from hospital, 40% went home, 14% were discharged to a residential aged care facility and 26% required ongoing inpatient rehabilitation (NSF 2009a, p.26). Only 2% of audited Australian patients discharged from hospital were referred to an outpatient or community based rehabilitation program (NSF 2009a, p.26).

The figure for inpatient rehabilitation in Table 41 should be treated with caution, as those statistically discharged may have been discharged from acute care to inpatient rehabilitation. The statistically discharged percentage includes those cases where auditors were advised to record a statistical discharge to overcome a known problem in the webtool (it did not permit entry of data related to secondary medications on prescribed if the patient was discharged to inpatient rehabilitation). Further, inpatient rehabilitation as a discharge destination is not indicative of whether the patient accessed inpatient rehabilitation before discharge to any destination. The percentages given in Figure 4 for the type of rehabilitation accessed derive from questions directly addressing access to rehabilitation (see Clinical Audit question 5.7 in Appendix C).

Figure 4: Type of rehabilitation service accessed

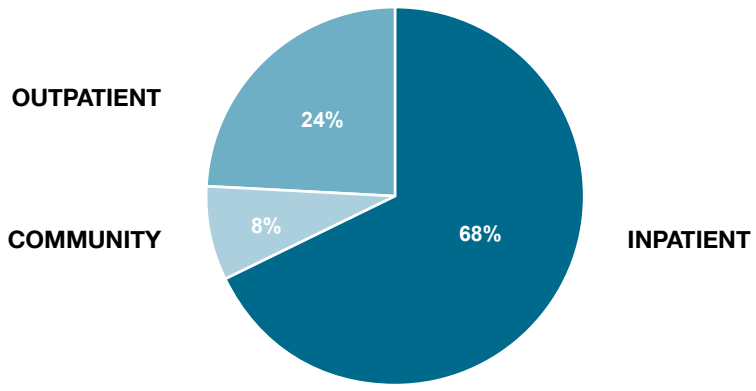
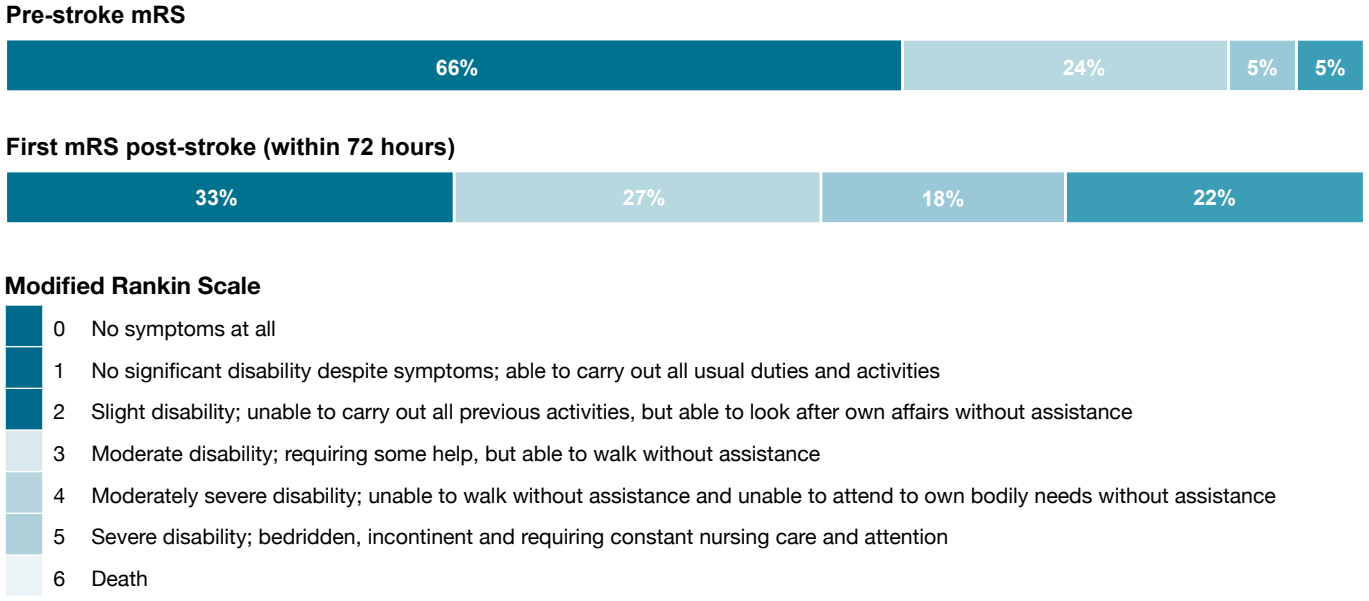


Table 41: Discharge destination by DHB category				
	NZ total (N=832)	**A/large** (N=277)	**B/medium** (N=273)	**C/small** (N=282)
Discharged to own home	306 (37%)	94 (34%)	105 (39%)	107 (38%)
Discharged to relative's home	27 (3%)	12 (4%)	10 (4%)	5 (2%)
Residential care	90 (11%)	28 (10%)	32 (12%)	30 (11%)
Inpatient rehabilitation	224 (27%)	79 (29%)	83 (30%)	66 (23%)
Statistical discharge	61 (7%)	27 (10%)	9 (3%)	25 (9%)
Died in hospital	120 (14%)	37 (13%)	34 (12%)	49 (17%)

Functional status at discharge

Of the 712 patients who were discharged, the median Modified Rankin Score was 3 (requiring assistance for simple personal activities) with an interquartile range 2 to 4.

Figure 5: Functional status pre-stroke and at discharge as per modified Rankin Scale



Appendix A

National Advisory Committee and National Stroke Foundation writing team

Membership of the National Advisory Committee (Australia)

Prof John McNeil (Chair)	Head of Department, Epidemiology & Preventive Medicine, Alfred Hospital, VIC
Prof Alan Barber	Consultant Neurologist, Auckland City Hospital, Auckland District Health Board, New Zealand
Dr David Blacker	Consultant Neurologist Stroke Neurosciences CSU Sir Charles Gairdner Hospital, WA
Dr Geoffrey Boddice	Clinical Neuropsychologist/Clinical Psychologist, The Prince Charles Hospital, QLD
Dr Dominique Cadilhac	Head – Public Health Division, National Stroke Research Institute, VIC
Dr David Dunbabin	Specialist in the Health of the Elderly, Royal Hobart Hospital, TAS
Mr Craig Harris	Clinical Nurse Consultant, Nepean Hospital, NSW
Ms Dawn Harris	Manager, National Audit Program, National Stroke Foundation
Mr Michael Hill	Consumer Representative, Board Director, National Stroke Foundation
Dr Susan Hillier	Senior Lecturer, School of Health Sciences, University of SA
Ms Isobel Hubbard	Lecturer, Stroke Management Postgraduate Courses, University of Newcastle, NSW
Dr Lynette Joubert	Lecturer, School of Social Work, University of Melbourne, VIC
Ms Claire Kelly	Dietitian, Community Integrated Rehabilitation Service, Logan Central Community Health, QLD
Mr Chris Price	Divisional Director Stroke Services, National Stroke Foundation
Ms Clare Quinn	Head of Department, Speech Pathology Prince of Wales Hospital, NSW
Dr Stephen Read	Director – Stroke Unit, Royal Brisbane and Women's Hospital, QLD
Ms Elizabeth Ritchie	Audit Project Officer, National Stroke Foundation
Prof Cate Storey	Director – Stroke Unit, Royal North Shore Hospital, NSW
Ms Kathryn Whitfield	Program Manager – Stroke Care Department of Human Services, VIC

Writing of the Organisational Survey and Clinical Audit reports on behalf of the National Stroke Foundation and the National Stroke Audit Collaborative was undertaken by

Ms Dawn Harris	Manager, National Audit Program, National Stroke Foundation
Ms Elizabeth Ritchie	Audit Project Officer, National Stroke Foundation
Dr Dominique Cadilhac	Head – Public Health Division, National Stroke Research Institute, VIC
Dr Geoffrey Boddice	Clinical Neuropsychologist/Clinical Psychologist, The Prince Charles Hospital, QLD
Mr Chris Price	Divisional Director Stroke Services, National Stroke Foundation
Dr Stephen Read	Director – Stroke Unit, Royal Brisbane and Women's Hospital, QLD
Ms Monique Kilkenny	Public Health Research Office, Public Health Dividion, National Stroke Research Institute

Appendix B

Organisational Survey questions (New Zealand version)

1 HOSPITAL [DHB] DETAILS

1.1 Auditor discipline
- Doctor
- Manager
- Nurse
- Allied health
- Other

1.2 Name of hospital [site code]

1.3 State [default to 'NZ']

1.4 How many beds are there in your hospital? *Text*

1.5 Does your hospital have: *Yes/No*
- High Dependency/Intensive Care unit
- Access to on-site neurosurgery
- Access to on-site physicians allocated to look after stroke patients?
- A local stroke register listing all new referrals admitted to your hospital with a diagnosis of stroke
- Access to telehealth facilities for clinical support?
- Access to telehealth facilities for professional education?
- Transfer protocols with other hospitals
- Co-located stroke beds within a geographically defined unit specifically for stroke?
- A dedicated, multidisciplinary team with members who have a special interest in stroke?

1.6 Has there been any organisational change affecting the organisation of stroke services in the last 6 months? *Yes/No*

2 PRESENTATION AT HOSPITAL

2.1 Are there arrangements with the local ambulance service for emergency/rapid transfer to hospital for stroke patients with acute stroke over and above the regular system? *Yes/No*

2.2 Are there ED protocols for:
a. Rapid triage for patients presenting with acute stroke. *Yes/No*
b. Transfer of patients to another hospital for care. *Yes/No*

2.3 Does your hospital manage all strokes including complex strokes? *Yes/No*

If no, do you transfer *Tick all that apply*
i. Moderately complex strokes; semi conscious with multiple deficits and/or have co-morbid medical conditions that may require further management
ii. High complexity strokes; May require surgical intervention and/or have a tracheotomy and are not medically stable

2.4 Which ward is a patient with acute stroke most likely to be admitted to first: *Tick one only*
- Medical assessment unit/admission ward (MAU)
- General medical ward (GMW)
- Geriatric ward (GW)
- Geriatric rehabilitation ward (GRW)
- Acute stroke unit (ASU)
- Other Stroke unit (e.g. rehabilitation stroke unit, combined comprehensive stroke unit) (SU)
- Neurological ward (NW)
- Other

2.5 Do you offer intravenous thrombolysis for appropriate stroke patients at your site?
Yes/No
If 'yes'
a. Is this offered 24hrs 7 days a week? *Yes/No*
b. Are all patients who arrive in the 3hr time frame assessed for rt-PA? *Yes/No/Unknown*
c. Do you use standardized protocol when administering intravenous thrombolysis? *Yes/No*
d. How many patients have you thrombolysed in your site during the past 12mths? *Text*
If 'no'
e. Is this due to lack of resources *Yes/No*
f. Is this due to a lack of facilities *Yes/No*
g. Not considered? *Yes/No*
h. Is intravenous thrombolysis offered under trial condition? *Yes/No*

3 ORGANISATION OF CARE

3.1 Does your hospital have a specialist stroke unit or units? *Yes/No*

a If 'yes' then how many beds are on the unit? *Text*

b What type of Stroke unit is it? *Tick one only*
i. Acute Stroke Unit
ii. Integrated Stroke Unit (acute and rehabilitation care provided on same unit for a period up to 4 weeks)
iii. Rehabilitation Stroke Unit

3.2 How many patients with acute stroke:
(a) are present in the hospital today, *Text*
(b) were admitted to your hospital in the last year (approx)? *Text*

3.3 (Only answer if yes to 3.1)
How many patients with acute stroke:
i. are present in your stroke unit today? *Text*
ii. were admitted to your stroke unit last year? *Text*

3.4 Are the following health professionals actively involved with the management of stroke at your hospital? [An appendix with equivalent titles was provided as some New Zealand health professional titles differ from those used in Australia]. *Yes/No*
Advanced Trainee
Clinical nurse consultant (CNC)
Clinical nurse specialist (CNS)
Clinical psychologist
Dietitian
General physician
General practitioner
Geriatrician
Neurologist
Stroke nurse educator
Other nurse educator
Nurse practitioner
Nursing unit manager
Occupational therapist
Physiotherapist
Rehabilitation physician
Social worker
Speech pathologist
Stroke specialist research nurse

3.5 What is the total establishment of Full Time Equivalents (FTEs) of the following clinicians for all your **stroke unit** beds?
Enter 0 if no establishment.
Advanced Trainee
Clinical psychology
Dietetics
General physician
General practitioner
Geriatrics
Neurology
Nursing*
Occupational therapy
Physiotherapy
Rehabilitation physician
Social work
Speech pathology
Other

3.6 What team usually manages acute stroke patients?
- General medical team
- Stroke geriatric team
- General geriatric team
- Stroke neurology team
- General neurology team
- General practitioner/Visiting medical officers

Tick one only

3.7 Is there a consultant physician with specialist knowledge of stroke who is formally recognized as having a principal responsibility for stroke? *Yes/No*

3.8 Does the team managing stroke have a protocol for referral to the following; *Yes/No*
a. Physiotherapist
b. Speech pathologist
c. Occupational therapist
d. Dietitian
e. Psychologist
f. Social worker

3.9 Do you have a mobile inpatient stroke team?
If yes, which of the following are regular members of the team:
i. Specialist Doctor
ii. Occupational Therapist
iii. Specialist nurse [An appendix listing possible specialist nurse titles used in New Zealand was provided].
iv. Dietitian
v. Social worker
vi. Psychologist
vii. Speech Pathologist
viii. Physiotherapist
ix. Resident Medical doctor
x. Registrar
xi. Other
Tick all that apply

4 IMAGING, TIA & NEUROVASCULAR SERVICE

4.1 Does your hospital have access to any of the following for your stroke patients?
a. CT scanning
If yes,
i. Is it located in your hospital? *Yes/No*
ii. Can you access onsite CT within 24hrs of stroke presentation to your hospital? *Yes/No*
iii. Can you access CT off site within 24 hrs of stroke presentation to your hospital? *Yes/No*
b. MRI scanning
If yes,
i. Is it located in your hospital? *Yes/No*
ii. Can you access onsite MRI within 24hrs of stroke presentation to your hospital? *Yes/No*
iii. Can you access MRI off site within 24 hrs of stroke presentation to your hospital? *Yes/No*
c. Carotid Doppler
If yes,
i. Is it located in your hospital? *Yes/No*
ii. Can you access onsite Carotid Doppler within 24hrs of stroke presentation to your hospital? *Yes/No*
iii. Can you access Carotid Doppler off site within 24 hrs of stroke presentation to your hospital? *Yes/No*

4.2 With respect to TIA patients presenting to your hospital emergency department:
a. Does your hospital have a defined and documented process, policy or clinical pathway for assessing TIA patients? *Yes/No*
b. At your hospital are ***all*** TIA patients admitted or are only ***selected*** patients admitted?
All/Selected
If 4.2b = Selected…
i. Does patient selection for admission incorporate one of the published TIA risk stratification scores (ABCD, ABCD2 or California scores)? *Yes/No*
If 4.2b = Selected…
ii. For TIA patients not admitted to hospital is there a rapid access TIA clinic?
If 4.2bii = Yes…
iii What is the waiting time for this clinic? *Text*/days
If 4.2bii = Yes…
iv. How often is the clinic run?
Text/days per week

5 CONTINUING EDUCATION AND RESEARCH

5.1 Is there a program of continuing education of staff relating to the management of stroke? *Yes/No*

5.2 How many stroke research studies are registered with your R&D dept (on the day you complete this form)? Please give as a total and then estimate by type of study:
- Total
- Acute
- Rehab
- Prevention
- Other

6 TEAM MEETINGS & ASSESSMENT MEASURES

TEAM WORK

6.1 Do all professions contribute to a single set of patient records for the management of stroke? *Yes/No*

6.2 Does the hospital have clinical care pathways for managing stroke? *Yes/No*

6.3 Do you have regular multidisciplinary team, meetings for the interchange of information about individual stroke patients? *Yes/No*

6.4 How often are these meetings held per month? *Text*/Month

6.5 Which of the following disciplines regularly attend the team meetings? *Tick all that apply*
- Dietitian
- Doctor
- Nurse
- Occupational Therapist
- Physiotherapist
- Psychologist
- Social worker
- Speech pathologist
- Other

AGREED ASSESSMENT MEASURES

6.6 Are there locally agreed assessment protocols for the following? *Yes/No*
a. Consciousness level
b. Motor impairment
c. Visual impairment
d. Sensory impairment
e. Executive function
f. Activities of Daily Living
g. Mood
h. Dysphagia
i. Incontinence of urine
j. Incontinence of faeces
k. Nutrition
l. Communication
m. Hydration

7 ACCESS TO FURTHER SERVICES

7.1 Are all your patients assessed in conjunction with a rehabilitation team for the need for further inpatient rehabilitation? *Yes/No*

7.2 Is there access to a stroke specialist early supported discharge team? *Yes/No*

7.3 Is there access to ongoing rehabilitation services either on-site/off-site?

7.4 Is there access to community based rehabilitation for continuing longer term management? *Yes/No*

7.5 Are there local protocols for routinely reviewing stroke patients discharged from hospital? *Yes/No*

7.6 Does your hospital have access to palliative care? *Yes/No*

8 PATIENT/CARER COMMUNICATION

8.1 Does the team routinely meet with the family (and/or patient regarding care)? *Yes/No*

8.2 Is there patient information literature routinely available/ offered on the following topics? *Yes/No*
a. Condition specific literature on stroke
b. Patient versions of national or local guidelines/ standards
c. Local community care arrangements
d. Local voluntary agencies
e. Complaints procedure
f. Community stroke support groups
g. Is aphasia friendly communication available for all of the above?

8.3 Is there evidence that patients are given a discharge care plan? *Yes/No*

8.4 Are patients/carers given details of a hospital contact on transfer from hospital to community? *Yes/No*

These questions were presented with rationales and help notes in the *National Acute Stroke Audit 2009 Handbook Organisational Survey*. Auditors also had access to help notes while using the oniline webtool.

Appendix C

Clinical Audit questions (New Zealand version)

DEMOGRAPHIC AND AUDITOR DATA

A Patient Audit Number

B Auditor discipline
- Doctor
- Manager
- Nurse
- Allied health
- Other

C Patient Date of Birth

D Gender

E Ethnicity
- European (includes NZ European)
- Maori
- Pacific Island
- Asian
- Other ethnic group

1 STROKE ONSET AND HOSPITAL STAY

1.1 Stroke onset date
DDMMYY/Not documented
Stroke onset time
HH:MM/Not documented

1.2 Mode of arrival: *Tick one only*
- Ambulance (emergency)
- Ambulance (non emergency)
- Private
- In-hospital stroke
- *Not documented*

1.3 Date and time of arrival to emergency department
DDMMYY/HH:MM/Not documented

1.4 Was the patient transferred from another hospital?
Yes/No

1.5 Was the patient transferred to another hospital for acute care after admission to your hospital? *Yes/No*
If yes then, *DDMMYY/HH:MM/Not documented*
a. Date of transfer
b. Time of transfer

1.6 Date and time of admission to hospital
DDMMYY/HH:MM/Not documented

1.7 Was the patient treated in a Stroke Unit at any time during their stay? *Yes/No/Unknown*
If yes then;
a. Date of admission to stroke unit
b. Date of discharge from stroke unit
DDMMYY/Not documented

1.8 What date was the patient discharged from acute stroke care (e.g. home/rehabilitation/ other department/ hospital/supported care/ death etc)? *DDMMYY*

1.9 What is the discharged ICD 10 classification Code?
Select from drop down menu

1.10 What is the patients discharge destination?
Tick one only
- Own accommodation, alone
- Own accommodation, with partner/carer
- Relative's/carer's accommodation
- High level supported residential care – nursing home [NZ equivalent is 'Hospital care']
- Low level supported residential care – hostel [NZ equivalent is 'Rest home']
- Statistical discharge (Discharged from the care of the acute stroke team to other episode/ department/hospital etc.)
- In-patient rehabilitation
- Deceased

1.11 Was the patient being discharged home with formal supports (e.g. at least one community support, nursing, home help, outpatient rehabilitation)? *Yes/No*

2 PRIOR TO STROKE

RISK FACTORS

2.1 Any history of known risk factors prior to admission?
Please select all that apply
a. Atrial fibrillation
Yes/No/Not documented
b. Previous stroke
Yes/No/Not documented
c. Previous TIA
Yes/No/Not documented
d. Diabetes mellitus
Yes/No/Not documented
e. Hypercholesterolaemia
Yes/No/Not documented
f. Hypertension
Yes/No/Not documented
g. Recent myocardial infarction
Yes/No/Not documented
h. Ischaemic heart disease
Yes/No/Not documented
i. Rheumatic or other valvular heart disease?
Yes/No/Not documented
j. High alcohol consumption
Yes/No/Not documented
k. Current Smoker
Yes/No/Not documented
l. Past Smoker
Yes/No/Not documented
m. Family history of stroke
Yes/No/Not documented
n. Other serious illness that influences prognosis or management of stroke
Yes/No/Not documented
o. Depression/anxiety
Yes/No/Not documented

PRE-ADMISSION MEDICATION

A drug classification list for NZ was supplied.

2.2 Did the patient take daily aspirin or other antithrombotic agent prior to this event?
Yes/No/Not documented

a. If Yes which of the following were prescribed? *Tick all that apply*
   a. Aspirin
   b. Clopidogrel
   c. Dipyridamole MR
   d. Other antiplatelet (including trial antiplatelet drugs)
   e. Warfarin
   f. Other anticoagulant

2.3 Did the patient take antihypertensives prior to this stroke?
Yes/No/Not documented

a. If Yes which of the following were prescribed? *Tick all that apply*
   - ACE inhibitor or Angiotensin-II receptor antagonists
   - Alpha blocker
   - Beta blocker
   - Calcium channel blocker
   - Thiazide diuretic
   - Other

2.4 Did the patient take lipid lowering treatment prior to this stroke?
Yes/No/Not documented

a. If Yes then *Tick all that apply*
   - Statin
   - Other

DEPENDENCY PRIOR TO ADMISSION

2.5 Functional status prior to stroke?
Modified Rankin Scores of 0 through to 5 (or not known for very rare cases).
Simple algorithm used by web-tool for calculating Modified Rankin Score

Q1. Is patient alive?
If No score 6
If Yes go to Question 2.

Q2. Can the patient walk on his/her own (i.e. without assistance of another person, but may include a walking aid)?
If No go to question 3
If Yes go to question 4

Q3. If the patient can't walk on their own can they walk if someone is helping him/her?
If Yes score 4
If No score 5

Q4. If the patient can walk on his/her own does s/he need help with simple usual personal activities (toilet, bathing, dressing, cooking, household tasks, simple finances)?
If Yes score 3
If No go to question 5

Q5. If he can perform simple personal activities does he need help with more complex usual activities (driving, golf, finances, household bills, work tasks)?
If Yes score 2,
If No go to question 6

Q6. If he has no disability does he have any symptoms?
If Yes score 1
If No score 0

2.6 Living arrangements prior to admission?
Tick one only
- Home
- Supported accommodation e.g. nursing home, hostel etc.
- Other

3 EARLY INVESTIGATIONS AND TREATMENT

NEUROIMAGING

3.1 Did the patient have a brain scan after this stroke? *Yes/No*

a. What type of brain scan was performed? *Tick one only*
   CT
   MRI
   Both CT & MRI

b. Date and time of first brain scan after the stroke
DDMMYY/HH:MM or *Not documented*

c. Stroke type
   - Infarct – LACI
   - Infarct – PACI
   - Infarct – POCI
   - Infarct – TACI
   - Infarct – *Not documented* Oxfordshire Classification
   - Intracerebral haemorrhage
   - *Not documented* type

d. if no, then reason the patient did not have a scan: *Tick one only*
   - Patient refused/unable to co-operate
   - Palliative care
   - Scan not routinely available
   - Patient died before scan
   - Patient transferred before scan
   - Scan had been performed prior to admission
   - Scan contraindicated for this patient
   - Not recorded

THROMBOLYSIS

3.2 Was the patient assessed for eligibility for intravenous thrombolysis? *Yes/No*

3.3 Did the patient receive intravenous thrombolysis? *Yes/No*

a. If yes, then what was the date and time of delivery?
DDMMYY/HH:MM or *Not documented*

ELECTROCARDIOGRAPH

3.4 Did the patient have a 12 lead ECG in hospital:*Yes/No*

CAROTID DUPLEX EXAMINATION

3.5 Did the patient have a doppler ultrasound of the carotid arteries while in hospital? *Yes/No*

SWALLOWING

3.6 Has swallow function (not gag reflex) been evaluated and specifically recorded by trained personnel before the patient is offered food, fluids, or oral medication? *Yes/No*

a. If yes, then what was the date and time of the swallow screen? *DDMMYY/HH:MM*
b. Did the patient pass the screening?
c. Was a swallowing assessment by a speech pathologist/ therapist recorded?
Yes/No/NA
If yes, then what was the date and time of the swallow screen? *DDMMYY/HH:MM*

ANTITHROMBOTIC THERAPY

3.7 Was the patient commenced on aspirin at your hospital as an acute treatment for ischaemic stroke?
Yes/No/No But
If yes, *DDMMYY/HH:MM*

4 OTHER ASSESSMENT AND MANAGEMENT (ALLIED HEALTH)

DEPENDENCY WITHIN 72 HOURS OF ADMISSION

4.1 Modified Rankin Scores within 72hours of admission. Scores of
0 through to 6 or not known.

IMPAIRMENTS IDENTIFIED ON ADMISSION

4.2 On admission were any of the following present:
a. Arm deficit?
Yes/No/No assessment documented
b. Sensory deficit?
Yes/No/No assessment documented
c. Mood impairment?
Yes/No/No assessment documented
d. Able to walk independently (without any assistance)?
Yes/No/No assessment documented
e. Cognitive deficit?
Yes/No/No assessment documented
f. Visual deficit?
Yes/No/No assessment documented
g. Perceptual deficit?
Yes/No/No assessment documented
h. Speech/communication impairment?
Yes/No/No assessment documented
i. Dysphagia?
Yes/No/No assessment documented
j. Hydration problems?
Yes/No/No assessment documented
k. Nutrition problems?
Yes/No/No assessment documented
i. Was the patient receiving nutritional support? *Yes/No/ Not documented*

4.3 Was the patient incontinent (or requiring urinary catheter) within the first 72 hours of stroke?
Yes/No/Not documented

4.4 Did the patient have an indwelling urinary catheter in the first week after admission?
a. If yes which of the following have been documented as the reason for urinary catheterization? Select from drop down menu, more than one can be selected.
- Urinary retention
- Pre-existing catheter
- Urinary incontinence
- Need for accurate fluid balance monitoring
- Critical skin care
- No reason documented

b. Does a continence management plan exist?
Yes/No

4.5 What date and time was the patient first seen by:
Yes/No/Not applicable/No access to therapist
If yes, *DDMMYY/HH:MM*
- Physiotherapist
- Occupational therapist
- Speech Pathologist (NZ: Speech Language Therapist)
- Social Worker
- Dietitian
- Psychologist

PALLIATIVE CARE

4.6 Was the patient receiving palliative care only?
Yes/No

4.7 Did the patient have any of the following complications during their admission? *Tick all that apply*
- Aspiration pneumonia
- Deep Vein Thrombosis (DVT)
- Falls
- Fever
- Pressure Sores (decubitis ulcer)
- Pulmonary thrombo-embolism (PE)
- Raised intracranial pressure
- Shoulder pain
- Acute myocardial infarction
- Depression/anxiety
- Symptomatic haemorrhagic transformation
- Malnutrition
- New onset atrial fibrillation
- New stroke
- Stroke progression
- Urinary tract infection
- Seizures

DVT PROPHYLAXIS

4.8 Did management of the patient include: *Yes/No*
a. Heparin?
b. Anti-thrombotic stockings?
If anti-thrombotic stockings select which type: *Tick one only*
i. Knee-length
ii. Thigh-length

MULTIDISCIPLINARY TEAM MEETING

4.9 Was there a meeting documented between the multidisciplinary team and the patient (and/or family/ carer) to discuss assessment results and treatment plans/goals? *Yes/No*
a. If yes, what was the date of the first family meeting? *DDMMYY*

5 DISCHARGE AND TRANSFER OF CARE

5.1 Is there evidence that a care plan outlining post-discharge care in the community was developed with the team and the patient?
Yes/No/No but

5.2 Is there evidence that the general practitioner and/or the community providers were provided with a copy of the discharge summary?
Yes/No/No but

5.3 Does the patient have a carer?
Yes/No/Not required
a. Did the carer receive relevant training?
Yes/No/Not required
b. Did the carer receive a support needs assessment?
Yes/No/Not required

5.4 Was a home visit performed by an occupational therapist? *Yes/No*/Not required
If yes then was the patient present during the home assessment? *Yes/No*/Not required

5.5 Functional status on discharge?
Modified Rankin Scores of 0 through to 6 or not known.

FURTHER REHABILITATION ASSESSMENT

5.6 Was a formal assessment for in-patient rehabilitation by a rehabilitation specialist made? *Yes/No*

5.7 Did the patient access further rehabilitation?
Yes/No
a. If yes was this: *Tick one only*
- Inpatient rehabilitation?
- Outpatient rehabilitation?
- Community rehabilitation?

6 SECONDARY PREVENTION

6.1 Is there evidence of patient education about behaviour change for modifiable risk factors prior to discharge?
Yes/No/No but

6.2 On discharge was the patient prescribed
a. Antithrombotics *Tick all that apply*
- Aspirin
- Clopidogrel
- Dipridamole MR
- Warfarin/other anticoagulant
- Other
- None
If none select reason:
- Contraindicated
- Patient refused
- Under review

b. Antihypertensives *Tick all that apply*
- ACE inhibitor
- Angiotensin-II receptor antagonists
- Alpha blocker
- Beta blocker
- Calcium channel blocker
- Thiazide diuretic
- Other
- None
If none select reason:
- Contraindicated
- Patient refused
- Under review

c. Lipid-lowering treatment *Tick all that apply*
- Statin
- Other
- None
If none select reason:
- Contraindicated
- Patient refused
- Under review

7 RESEARCH

7.1 Has this patient consented to participate in a research study?*Yes/No/No but*

These questions were presented with rationales and help notes in the *National Acute Stroke Audit 2009 Handbook Organisational Survey*. Auditors also had access to help notes while using the oniline webtool.

NOTE: '*No but*' responses enabled the auditor to give an explanation which was reviewed within 24 hours and discussed with the auditor by a NSF team member if necessary.

Appendix D

Recommended organisation of inpatient stroke services (2003)

Life after stroke. New Zealand guideline for management of stroke (Baskett and McNaughton 2003) made recommendations for inpatient organisation for different-sized District Health Boards as follows:

> The level of organisation of stroke services in a particular region will depend partly on the number of people with stroke admitted per year.
> The following recommendations are based on the evidence for effectiveness combined with practical considerations in District Health Boards of different sizes.

LARGE DISTRICT HEALTH BOARDS

(population serviced ≥ 180,000; expected number of strokes per year ≥ 340; expected stroke admissions per year > 260, i.e. > 5 per week on average)

- All people with stroke should be admitted under the care of a designated stroke clinician, in a separate stroke unit or a designated area within a general unit.
- The ongoing rehabilitation of all people with stroke should occur in a geographically designated area (i.e. a stroke unit) under the care of a coordinated multidisciplinary team involving stroke specialist clinicians.
- If at all possible, the acute AND rehabilitation management should be in the same area (i.e. an integrated acute and rehabilitation stroke unit)
- The multidisciplinary team should use written protocols for the management of common problems following stroke and have an ongoing programme of education about stroke for staff, people with stroke and families.

MEDIUM-SIZED DISTRICT HEALTH BOARDS

(population serviced 80,000–180,000; expected number of strokes per year 150–340; expected stroke admissions per year 120–260, i.e. 2–5 per week on average)

- All people with stroke should be admitted to a defined area for acute management, in a separate area or a designated area within a general unit. The acute care of all people with stroke should occur in consultation with the hospital's designated stroke clinician(s).
- The ongoing rehabilitation of all people with stroke should occur in a geographically designated area (i.e. a stroke unit) under the care of a coordinated multidisciplinary team involving stroke specialist clinicians. It is possible that people with stroke will not be the only patients managed by this team.
- The multidisciplinary team should use written protocols for the management of common problems following stroke and have a programme of regular education about stroke for staff, people with stroke and families.

SMALL DISTRICT HEALTH BOARDS

(population serviced < 80,000; expected number of strokes per year < 150; expected stroke admissions per year <120, i.e. < 2–3 per week on average)

- The acute care of all people with stroke should occur in consultation with the hospital's designated stroke clinician(s).
- The ongoing rehabilitation of all people with stroke should occur under the care of a coordinated multidisciplinary team involving people knowledgeable and enthusiastic about stroke. People with stroke will not be the only patients managed by this team.
- The multidisciplinary team should use written protocols for the management of common problems following stroke and have a programme

(Extracted from *Life after stroke. New Zealand guideline for management of stroke* (Baskett and McNaughton 2003), pp.25-26)

Appendix E

Sample page from reports prepared for individual DHBs

Shows column for own DHB findings in data tables, and prompt for the team to consider implications of the key messages and findings for their DHB's stroke service.

KEY MESSAGES:

There is a marked discrepancy in the proportion of patients having carotid artery imaging between Australia (50%) and New Zealand (22%).

Early assessment and investigation

Diagnostic imaging

RATIONALE

Brain imaging is required to delineate cerebral ischaemia from haemorrhage in a patient presenting with stroke. Brain imaging also identifies non-vascular causes of a 'stroke-like' syndrome i.e. stroke mimics. Although MRI is more sensitive to ischaemic changes and may be preferred by some clinicians, CT is more commonly available in New Zealand and Australia and has been described as the most cost-effective imaging modality for acute stroke (Wardlaw et al 2004).

FINDINGS

Auditors were asked to provide information about the type of imaging performed, and the time and date of imaging. Where imaging was not obtained, they were also asked to report the reasons why; for example, the patient refused or was unable to cooperate, patient was for palliative care only, or the patient had died before the scan could be performed. In patient records where times of stroke onset, arrival to the emergency department and brain imaging were not documented it was assumed that imaging did not occur within the defined timeframe. Patients with contraindications were excluded from analysis.

Auditors were also asked if cardiac and carotid imaging was undertaken during the hospital admission.

Patients in large DHBs were more likely to receive brain imaging during admission (Chi-square = 10.7, df = 2, $p < 0.01$) [Table 29]. Patients in large and small DHBs were more likely to receive brain imaging within twenty-four hours (Chi-square = 45.0, df = 2, $p < 0.001$) [Table 29].

The low rate of use of carotid imaging in New Zealand compared with Australia is an area of potential concern, but the appropriateness of use of this investigation has not been specifically addressed in this audit.

Table 29: Use of brain imaging (CT or MRI) by DHB category and stroke unit status

	Aust total	NZ total	A/large	B/medium	C/small	SU	No SU
Brain imaging during admission	(N=3,247)	(N=832)	(N=277)	(N=273)	(N=282)	(N=336)	(N=496)
	3,229 (99%)	791 (95%)	273 (99%)	255 (93%)	263 (93%)	322 (96%)	469 (95%)
Brain imaging within 24 hours of hospital arrival*	(N=3,247)	(N=724)	(N=249)	(N=244)	(N=231)	(N=303)	(N=421)
	2,946 (91%)	635 (88%)	232 (93%)	186 (76%)	217 (94%)	272 (90%)	363 (86%)

(Australian data from NSF 2009a, p. 21, Table 10 – ASSF and stroke unit figures not available)
* Percentage of patients where time known.

Table 30: Use of ECG and carotid artery imaging while in hospital by DHB category and stroke unit status

	Aust total (N=3,307)	NZ total (N=832)	A/large (N=277)	B/medium (N=273)	C/small (N=282)	SU (N=336)	No SU (N=496)
ECG	3,068 (93%)	774 (93%)	261 (94%)	253 (93%)	260 (92%)	316 (94%)	458 (92%)
Carotid artery imaging	1,654 (50%)	182 (22%)	58 (21%)	57 (21%)	67 (24%)	65 (19%)	117 (24%)

(Australian data from NSF 2009a, p. 21, Table 11 – ASSF and stroke unit figures not available)

References

Baskett JJ and McNaughton H. *Life after stroke. New Zealand guideline for management of stroke*. 2003. Stroke Foundation of New Zealand: Wellington

Brown P. Economic burden of stroke in New Zealand. *Three decades of Auckland regional community stroke (ARCOS) studies: What have we learned and what is next for stroke care and stroke research?* 2009 AUT University. Auckland

Cadilhac DA, Pearce DC, Levi CR, Donnan GA; Greater Metropolitan Clinical Taskforce and New South Wales Stroke Services Coordinating Committee. Improvements in the quality of care and health outcomes with new stroke care units following implementation of a clinician-led, health system redesign programme in New South Wales, Australia. *Qual Saf Health Care*. 2008;17(5):329-33.

Carnaby G, Hankey GJ, and Pizzi J. *Behavioural intervention for dysphagia in acute stroke: a randomised controlled trial.[see comment]. Lancet Neurology.* 2006. 5(1):31-7.

Chalela JA, Kidwell CS, Nentwich LM, Luby M, Butman JA, Demchuk AM, *et al.* Magnetic resonance imaging and computed tomography in emergency assessment of patients with suspected acute stroke: a prospective comparison. Lancet. 2007. 369(9558):293–8.

Gommans J, Barber PA and Fink JN *New Zealand Guideline for the assessment and management of people with recent transient ischaemic attack* (TIA). 2008. Stroke Foundation of New Zealand. Wellington.

Grimshaw JM, Eccles MP. Is evidence-based implementation of evidence-based care possible? *Medical Journal of Australia*. 2004;180(6):S50-S51.

Hacke W, Kaste M, Bluhmki E, Brozman M, Dávalos A, Guidetti D, *et al.* Thrombolysis with alteplase 3 to 4.5 h after acute ischemic stroke. *N Engl J Med.* 2008;359(13):1317–29.

Hardie K, Hankey GJ, Jamrozik K, Broadhurst RJ, Anderson C. Ten-year risk of first recurrent stroke and disability after first-ever stroke in the Perth Community Stroke Study. *Stroke*. 2004;35(3):731– 5.

Irwin P, Hoffman A, Lowe D, Pearson M, Rudd AG. Improving clinical practice in stroke through audit: Results of three rounds of National Stroke Audit. *Journal of Evaluation in Clinical Practice*. 2005;11(4):306-14

Jamtvedt G, Young JM, Kristoffersen DT, O'Brien MA, Oxman AD. *Audit and feedback: effects on professional practice and health care outcomes*. Cochrane database of systematic reviews 2006. Dol 10.1002/14651858. CD000259.pub.2

Kaste M, Boysen G, Indredavik B, Norrving B. Stroke unit care in Scandinavian countries. *International Journal of Stroke*. February 2006; 1:44.

Kidwell CS, Chalela JA, Saver JL, Starkman S, Hill MD, Demchuk AM, *et al.* Comparison of MRI and CT for detection of acute intracerebral hemorrhage. *JAMA*. 2004 Oct 20;292(15):1823–30.

Kwan J, Sandercock P. In-hospital care pathways for stroke. *The Cochrane Database of Systematic Reviews* 2004, Issue 4. Art. No.: CD002924pub2 DOI: 101002/14651858CD002924pub2.

Kwan J. Care pathways for acute stroke care and stroke rehabilitation: From theory to evidence. *Journal of Clinical Neuroscience*. 2007;14(3):189–200.

Langhorne P, Dey P, Woodman M, Kalra L, Wood-Dauphinee S, Patel N, *et al.* Is stroke unit care portable? A systematic review of the clinical trials. *Age and Ageing*. 2005. 34(4):324-30.

Langhorne P, Pollock A. *What are the components of effective stroke unit care?* Age and Ageing. 2002 Sep;31(5):365–71.

Ministry of Health. *Diabetes and Cardiovascular Disease Quality Improvement Plan 2008*. 2007. Ministry of Health. Wellington

National Stroke Foundation. *Acute Stroke Services Framework*. 2008. Melbourne. Australia

National Stroke Foundation. *Clinical Guidelines for Acute Stroke Management.* 2007a. Melbourne. Australia.

National Stroke Foundation. *Walk in our shoes: Stroke survivors and carers report on support after stroke*. 2007b. Melbourne. Australia.

National Stroke Foundation. *National Stroke Audit Acute Services Clinical Audit Report*. 2009b. Melbourne. Australia

National Stroke Foundation. *National Stroke Audit Acute Services Organisational Survey Report*. 2009a. Melbourne. Australia

Nazir FS, Petre I, Dewey HM. Introduction of an acute stroke team: an effective approach to hasten assessment and management of stroke in the ED. *J Clin Neurosci*. 2009. Jan 16(1):21-5.

Royal College of Physicians of London. *National Sentinel Stroke Audit Phase II (clinical audit) 2008. Report for England, Wales and Northern Ireland.* 2008.

Sandercock PAG, Counsell C, Gubitz GJ, Tseng MC. Antiplatelet therapy for acute ischaemic stroke. *Cochrane Database of Systematic Reviews* 2008, Issue 3.Art. No.: CD000029. DOI: 10.1002/14651858.CD000029.pub2.

Schwamm LH, Fonarow GC, Reeves MJ, Pan W, Frankel MR, Smith EE *et al.* Get with the guidelines - stroke is associated with sustained improvement in care for patients hospitalized with acute stroke or transient ischemic attack. *Circulation.* 2009;119(1):107-15

Sherman DG. Prevention of venous thromboembolism, recurrent stroke, and other vascular events after acute ischemic stroke: The role of low-molecular-weight heparin and antiplatelet therapy. *Journal of Stroke and Cerebrovascular Diseases*. 2006;15(6):250–259.

Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. *Cochrane Database of Systematic Reviews* 2007, Issue 4. Art. No.: CD000197. DOI: 10.1002/14651858.CD000197.pub2.

The ATLANTIS ECASS and NINDS rt-PA Study Group Investigators. Association of outcome with early stroke treatment: Pooled analysis of ATLANTIS, ECASS, and NINDS rt-PA stroke trials. *Lancet*. 2004;363(9411):768-74.

The CLOTS Trials Collaboration* Effectiveness of thigh-length graduated compression stockings to reduce the risk of deep vein thrombosis after stroke (CLOTS trial 1): a multicentre, randomised controlled trial. *Lancet*. 2009 Jun 6;373(9679):1958-65

Tobias M, Cheung J, Carter K, Anderson C, Feigin V. Stroke surveillance: Population-based estimates and projections for New Zealand. *Australian and New Zealand Journal of Public Health* 2007; 31(6):520-525.

Wardlaw JM, Keir SL, Seymour J, Lewis S, Sandercock PA, Dennis MS, *et al.* What is the best imaging strategy for acute stroke? *Health Technology Assessment* (Winchester, England). 2004 1-180, 2004 Jan;8(1):iii, ix-x, 1–180.

Wardlaw JM, Murray V, Berge E, del Zoppo GJ. Thrombolysis for acute ischaemic stroke. *Cochrane Database of Systematic Reviews*. 2009. Issue 4. Art. No.: CD000213. DOI: 10.1002/14651858.CD000213.pub2.

Wikander B, Ekelund P, Milsom I. An evaluation of multidisciplinary intervention governed by functional independence measure (FIMSM) in incontinent stroke patients. *Scand J Rehabil Med*. 1998 Apr;30(1):15–21.

Notes