New Zealand National Acute Stroke Services Audit: acute stroke care delivery in New Zealand

Nicholas Child, John Fink, Shelley Jones, Kevin Voges, Mark Vivian, P Alan Barber

Abstract

Aims To audit the care of a consecutive group of acute stroke patients admitted to all District Health Boards (DHBs) in New Zealand.

Methods A clinical audit involving a review of up to 40 consecutive stroke patients treated and discharged from each DHB between 1st of June 2008 and 31st of December 2008.

Results The clinical care of 832 patients [400 men; median age 77 (interquartile range 67–84) years] admitted to 20 of 21 DHBs was audited. This represents approximately 20% of all stroke patients admitted to hospital in New Zealand over this 6 month period. Most of the audited patients were independent (66%, mRS ≤ 2) and 90% lived at home prior to their strokes. At stroke onset, 40% had a known diagnosis of atrial fibrillation (AF), of whom only 24% were taking anticoagulants. Thirty-eight percent of patients arrived in hospital within 4.5 hours of stroke onset but only 3% were treated with stroke thrombolysis. Only 28% of patients were managed in a stroke unit but these patients had higher rates of thrombolysis, more rapid access to multidisciplinary team assessments and a lower rate of stroke progression (8% vs 15%, p<0.01). Only 21% of ischaemic stroke patients received aspirin within 48 hours and 35% of patients had a speech-language therapist assessment within 48 hours of admission.

Conclusion Access to stroke unit care and thrombolysis rates remain low in New Zealand and should be seen as the top priorities for acute stroke care improvement along with anticoagulation for stroke prevention in AF, acute aspirin use and increased speech language therapy assessments.

Stroke is the third most common cause of death after heart disease and all cancers combined and a the major cause of long term adult disability. There were approximately 6 000 first ever and 2 000 recurrent strokes in New Zealand in 2009 of whom 90% were admitted to hospital.1 The annual life-time cost of stroke to New Zealand is estimated to be $450 million per year.2

The Diabetes and Cardiovascular Disease Quality Improvement Plan 2008 (QIP) identified improvement of stroke services as a healthcare priority.3 However, there has been little information on the provision of stroke services and this hampers the evaluation and benchmarking of District Health Board (DHB) service provision. The National Acute Stroke Services Audit was an initiative of the Stroke Foundation of New Zealand (SFNZ) to audit stroke care in all DHBs and was supported by the Ministry of Health. We report the results of an audit of the clinical care provided to 40 consecutive patients in each DHB.4
Methods

The National Acute Stroke Services Audit was carried out in collaboration with the Australian National Stroke Foundation (NSF). The audit determined the resources available to support the delivery of evidence-based care and examined conformance of clinical practice with evidence-based best practice recommendations. Audit questions were developed by the Australian National Stroke Foundation Audit Advisory Committee, on which there were New Zealand representatives, and question terminology was revised to reflect the New Zealand situation.

The audit was comprised of two parts: an organisational survey of structural and process elements of acute stroke care service provision, which is reported separately; and a clinical audit involving retrospective review of patient records of 40 consecutive stroke patients admitted, treated and discharged from acute care in each DHB.

All 21 DHBs were contacted inviting them to participate in the audit. All 21 DHBs participated in the organisational component of the audit and 20 participated in the clinical audit of acute stroke care delivery, with one small DHB opting not to take part. A stroke unit was defined as a discrete ward, or beds within a ward, with a dedicated specialised multi-disciplinary team (MDT) and could include acute stroke units that discharge patients to a rehabilitation service, or an integrated acute and rehabilitation unit.

An audit team was established within each DHB and consisted of medical, nursing, and allied health professionals. An hour of on-line training was provided via teleconference by the NSF National Audit program manager and project officer. Responses could only be recorded where there was documented evidence for process of care indicators.

The audit was carried out online and the person reviewing the notes entered the data. The clinical audit period in which patients must have been admitted, treated and discharged from acute care occurred between 1 June 2008 and 31 December 2008.

DHBs were split into three groups on the basis of population served and the predicted number of stroke admissions per year. These groups were: Large, with a population catchment > 200 000 people, Medium with a population of 120 000 – 200 000 and Small with a population of < 120 000. Where data was reported from more than one acute hospital within a DHB it was aggregated and reported for the whole DHB.

The audit was conducted in Australia at the same time and was identical with the exception that patients admitted to individual hospitals and not DHBs were audited with the results reported by hospital size.

DHB datasets were de-identified and analysed using PASW Statistics Version 18.0. Organisation data from DHBs was aggregated to provide national estimates with results divided into DHB category (large, medium or small) and stroke unit status. The median (50th percentile) and interquartile (25th percentile) ranges were reported for continuous data. Data collection was carried out from April to August 2009.

Results

The clinical care of 832 patients [400 men (48%); 108 (13%) Maori, median (interquartile age) 77 (67-84) years] was audited. Equal numbers of patients were audited from large (33%), medium (33%) and small (34%) DHBs.

791 of 832 (95%) patients had brain imaging; 90% had computed tomography (CT), 18% magnetic resonance imaging (MRI) and 8% had both imaging modalities.

Of the patients with brain imaging, 657 (83%) had an ischaemic stroke and 134 (17%) had intracerebral haemorrhage. Stroke subtype was documented by the Oxford Stroke Classification in 401 of 608 ischaemic stroke patients; of whom 32% had partial anterior circulation infarcts, 25% had posterior circulation infarcts, 24% had lacunar infarcts and 19% total anterior circulation infarcts.

751 of 832 (90%) patients had lived at home prior to the stroke and 549 of 832 (66%) had a pre-stroke modified Rankin scale score of 0-2. Pre-stroke risk factors were
recorded in 69–90% of patients (depending on the risk factor) (Table 1), with zero, one, two and multiple risk factors seen in 9%, 18%, 23% and 50% of patients, respectively.

Prior to the stroke, 463 of 536 (87%, where this data was recorded) of hypertensive patients were taking anti-hypertensive therapy, 171 of 244 (71%) of patients with elevated cholesterol were taking lipid lowering therapy and 66 of 272 (24%) of patients with atrial fibrillation were taking anti-coagulant therapy.

Table 1. Known risk factors prior to stroke where recorded

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>N / total N*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous stroke / Transient ischaemic attack (TIA)</td>
<td>308 / 685 (45%)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>272 / 682 (40%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>536 / 747 (72%)</td>
</tr>
<tr>
<td>Hypercholesterolaemia</td>
<td>244 / 606 (40%)</td>
</tr>
<tr>
<td>Current / past smoker</td>
<td>320 / 666 (48%)</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>232 / 678 (34%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>158 / 696 (23%)</td>
</tr>
<tr>
<td>High alcohol consumption</td>
<td>58 / 547 (11%)</td>
</tr>
<tr>
<td>Valvular heart disease</td>
<td>71 / 572 (12%)</td>
</tr>
<tr>
<td>Myocardial infarction within 6 months</td>
<td>/ 656 (6%)</td>
</tr>
</tbody>
</table>

* Where this information was recorded.

Where this information was recorded 578 (69%) patients were transported to hospital by ambulance, 176 (21%) arrived by private vehicles and 20 (3%) patients had strokes while in hospital.

290 of 772 (38%) patients, where this information was recorded, arrived in hospital within 4.5 hours of symptom onset. Only 28% of patients were managed in a stroke unit, which was less than the 49% of Australian patients managed in stroke units. Even in the eight DHBs with stroke units, only 52% of patients actually received stroke unit care.

Aspirin was given acutely (<48 hours) to 126 of 602 (21%) ischaemic stroke patients where this data was recorded. Patients presenting to the 8 DHBs with stroke units were more likely to be treated with stroke thrombolysis than those without stroke units (13% versus 4% of patients arriving within the 3-hour treatment window; p=0.04, Fisher’s exact test).

Patients in large DHBs and in those DHBs with stroke units were more likely to have a physiotherapy, speech language and social work assessment within 48 hours (Table 2). Patients treated in a DHB with a stroke unit were less likely to suffer complications of stroke progression and pulmonary embolism than those treated in a DHB outside of a stroke unit (Table 3).

Carotid imaging was obtained in 182 of 832 (22%; SU 19%, no SU 24%) of patients compared with 50% of all Australian patients.
Table 2. Multi-disciplinary team assessment

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Total (N=832)</th>
<th>Large (N=277)</th>
<th>Medium (N=273)</th>
<th>Small (N=282)</th>
<th>Stroke unit (N=336)</th>
<th>No stroke unit (N=496)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT assessment</td>
<td>639 (82%)</td>
<td>240 (91%)</td>
<td>205 (79%)</td>
<td>194 (76%)</td>
<td>276 (86%)</td>
<td>363 (79%)</td>
</tr>
<tr>
<td>– within 48 hrs</td>
<td>316 (41%)</td>
<td>143 (54%)</td>
<td>104 (40%)</td>
<td>69 (27%)</td>
<td>162 (51%)</td>
<td>154 (34%)</td>
</tr>
<tr>
<td>OT assessment</td>
<td>515 (68%)</td>
<td>197 (77%)</td>
<td>171 (67%)</td>
<td>147 (60%)</td>
<td>223 (71%)</td>
<td>292 (66%)</td>
</tr>
<tr>
<td>– within 48 hrs</td>
<td>134 (18%)</td>
<td>53 (21%)</td>
<td>58 (23%)</td>
<td>23 (9%)</td>
<td>75 (24%)</td>
<td>59 (13%)</td>
</tr>
<tr>
<td>SLT assessment</td>
<td>447 (61%)</td>
<td>167 (70%)</td>
<td>144 (59%)</td>
<td>136 (55%)</td>
<td>198 (66%)</td>
<td>249 (58%)</td>
</tr>
<tr>
<td>– within 48 hrs</td>
<td>259 (35%)</td>
<td>99 (41%)</td>
<td>88 (36%)</td>
<td>72 (29%)</td>
<td>131 (43%)</td>
<td>128 (30%)</td>
</tr>
<tr>
<td>Swallow assessment*</td>
<td>280 (61%)</td>
<td>85 (54%)</td>
<td>99 (70%)</td>
<td>96 (61%)</td>
<td>123 (63%)</td>
<td>157 (61%)</td>
</tr>
<tr>
<td>SW assessment</td>
<td>331 (44%)</td>
<td>152 (60%)</td>
<td>99 (41%)</td>
<td>80 (32%)</td>
<td>161 (53%)</td>
<td>170 (38%)</td>
</tr>
<tr>
<td>– within 48 hrs</td>
<td>69 (9%)</td>
<td>43 (17%)</td>
<td>20 (8%)</td>
<td>6 (2%)</td>
<td>49 (16%)</td>
<td>20 (4%)</td>
</tr>
</tbody>
</table>

* Swallow screened within 24 hours; PT=physiotherapy; OT=occupational therapy; SLT=speech language therapist; SW=social worker.

Table 3. Complications during hospital stay

<table>
<thead>
<tr>
<th>Complication</th>
<th>Total (N=832)</th>
<th>A/large (N=277)</th>
<th>B/medium (N=273)</th>
<th>C/small (N=282)</th>
<th>Stroke Unit (N=336)</th>
<th>No Unit (N=496)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke progression</td>
<td>100 (12%)</td>
<td>32 (12%)</td>
<td>23 (8%)</td>
<td>45 (16%)</td>
<td>27 (8%)</td>
<td>73 (15%)</td>
</tr>
<tr>
<td>New stroke</td>
<td>32 (4%)</td>
<td>13 (5%)</td>
<td>7 (3%)</td>
<td>12 (4%)</td>
<td>13 (4%)</td>
<td>19 (4%)</td>
</tr>
<tr>
<td>Fever</td>
<td>98 (12%)</td>
<td>43 (15%)</td>
<td>30 (11%)</td>
<td>25 (9%)</td>
<td>37 (11%)</td>
<td>61 (12%)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>83 (10%)</td>
<td>32 (12%)</td>
<td>31 (11%)</td>
<td>20 (7%)</td>
<td>29 (9%)</td>
<td>54 (11%)</td>
</tr>
<tr>
<td>UTI</td>
<td>60 (7%)</td>
<td>18 (6%)</td>
<td>21 (8%)</td>
<td>21 (7%)</td>
<td>20 (6%)</td>
<td>40 (8%)</td>
</tr>
<tr>
<td>New AF</td>
<td>41 (5%)</td>
<td>12 (4%)</td>
<td>15 (5%)</td>
<td>14 (5%)</td>
<td>15 (4%)</td>
<td>26 (5%)</td>
</tr>
<tr>
<td>Pressure sores</td>
<td>14 (2%)</td>
<td>5 (2%)</td>
<td>3 (1%)</td>
<td>6 (2%)</td>
<td>5 (1%)</td>
<td>9 (2%)</td>
</tr>
<tr>
<td>MI</td>
<td>19 (2%)</td>
<td>10 (4%)</td>
<td>4 (1%)</td>
<td>5 (2%)</td>
<td>6 (2%)</td>
<td>13 (3%)</td>
</tr>
<tr>
<td>DVT</td>
<td>6 (1%)</td>
<td>3 (1%)</td>
<td>0 (0%)</td>
<td>3 (1%)</td>
<td>2 (1%)</td>
<td>4 (1%)</td>
</tr>
<tr>
<td>PE</td>
<td>4 (1%)</td>
<td>1 (1%)</td>
<td>0 (0%)</td>
<td>3 (1%)</td>
<td>0 (0%)</td>
<td>4 (1%)</td>
</tr>
</tbody>
</table>

* UTI=urinary tract infection; AF=atrial fibrillation; MI=myocardial infarction; DVT=deep vein thrombosis; PE=pulmonary embolus.

Of the 832 patients, 120 (14%) died while still in hospital, 224 (27%) were transferred from acute services to inpatient rehabilitation, 333 (40%) were discharged to their own or a relative’s home and 90 (11%) were discharged to residential care.

Prior to discharge, 297 of 712 (42%) had a discharge care plan provided where this information was recorded, 268 of 832 (32%) received patient education and 53 of 408 (13 %) had a home visit performed.

The median Modified Rankin Score of patients discharged from acute care services was 3 (IQR 2-4).

At discharge, prescriptions were given for anti-hypertensive therapy in 71% of patients, lipid lowering therapy in 73% and anti-thrombotic therapy in 94% of ischemic stroke patients. There was no difference in rate of secondary prevention medication use in DHBs with and without a stroke unit and rates were also comparable between New Zealand and Australia.
Discussion

The clinical care of 832 patients, representing approximately 20% of all stroke patients admitted to hospital in New Zealand over this 6 month period, has been audited. All but one small DHB participated so that the results presented are nationally representative of the state of acute stroke care.

There is overwhelming evidence that stroke unit care significantly reduces death, disability and need for institutional care compared with care in general wards. Only 18 patients need to receive organised inpatient stroke care to prevent one from dying or being dependent at one year.

New Zealand stroke guidelines have stated that “the most important intervention that can improve outcomes for all people with stroke is the provision of organised stroke services, an important component of which is a stroke unit. Without an organised stroke service, adherence to recommendations about specific interventions is likely to have little impact on outcomes for people with stroke.” It is clear from an earlier survey that New Zealand clinicians recognise the benefits of stroke units.

It is therefore of concern that only just over one quarter of stroke in-patients in New Zealand were being managed in a stroke unit on the day of the audit and only half of all patients admitted to a DHB with a stroke unit were being managed in the stroke unit.

Access to stroke unit care remains a key deficiency in stroke patient management in New Zealand and requires urgent action. The 2010 New Zealand stroke guideline specifies the level of service provision expected from small, medium and large DHB’s for stroke patients. Further work is required in many DHBs to meet these obligations, including improved access for patients to the stroke unit where one is provided.

This audit has confirmed that patients admitted to a stroke unit have better access to thrombolytic therapy. However, very few stroke patients are actually treated with thrombolysis in either New Zealand or Australia. Improving the rate of stroke thrombolysis should be a top priority for all stroke service providers.

The treatment window for stroke thrombolysis at the time of this audit was 3 hours. This window has subsequently been extended out to 4.5 hours, and this will likely lead to an increase in stroke thrombolysis rates. However, it is still of concern that only 38% of patients with a known time of symptom onset arrived in hospital within 4.5 hours of symptom onset. This may in part be due to the finding that only two thirds of people with stroke are transported to hospital by ambulance.

Public awareness of stroke, including recognition of acute stroke in the community and the need to call emergency services for rapid transport to hospital must also be improved if stroke thrombolysis rates are to be improved.

Although patients with hypertension and hypercholesterolaemia were generally on primary prevention treatment for these conditions, a surprisingly low number of patients identified as having AF in both New Zealand and Australia were taking anti-coagulant therapy to prevent stroke and systemic embolism.

While half of New Zealand ischemic stroke patients with AF may have contraindications to anti-coagulant therapy, this audit still suggests the benefit that
could be achieved from increased use of anticoagulant therapy for stroke prevention in AF would be great.\textsuperscript{15, 16}

The recent introduction of dabigatran, an oral direct thrombin inhibitor, may improve anticoagulant therapy rates as this agent does not require regular blood-test monitoring or dose adjustment and has fewer food and drug interactions than warfarin.\textsuperscript{17}

The use of aspirin within the first 48 hours of stroke onset appeared to be very low (21\%) compared with the 94\% uptake of antithrombotic treatment at discharge. Early use of aspirin is shown to reduce early stroke recurrence.\textsuperscript{18} Greater use of rectal administration of aspirin or sub-lingual use of dispersible formulations of aspirin could ensure that patients who are made ‘nil by mouth’ due to dysphagia are not denied access to this medication.

Urgent access to swallowing screening by trained personnel is another area in need of improvement. New Zealand stroke guidelines specify that “All stroke patients should have their swallowing screened as soon as possible, but at least within 24 hours of admission.”\textsuperscript{11} Rates of SLT assessment in New Zealand are significantly lower than in Australia with 61\% of patients receiving documented SLT assessment during acute hospital admission here, compared with 81\% in Australia, and only 35\% of New Zealand patients assessed within 48 hours of admission compared to 60\% in Australia. The SLT assessment rates in DHB’s without a SU are lower than those with a SU.

Access to brain imaging is satisfactory and similar to that seen in Australia. However, early brain imaging was reduced in medium DHB’s with 76\% of patients having scans within 24 hours compared with 93\% in large DHB’s, 94\% at small DHB’s and 91\% in Australia.

Carotid ultrasound rates were reasonably consistent among NZ centres, regardless of DHB size but were lower than in Australia. It is of note that carotid ultrasounds were less likely to be ordered in DHBs with stroke units. This finding suggests that the difference in trans-Tasman practice is not primarily related to availability of ultrasound but rather a more conservative approach to investigation of carotid disease.

We speculate that carotid ultrasound in New Zealand is being reserved for good potential carotid surgery candidates. Utilisation of secondary prevention therapies at hospital discharge appeared reasonably good and was a consistent finding across New Zealand DHBs with similar rates as those seen in Australian centres.

This audit allows comparison between stroke services provided in New Zealand and Australia. More Australian patients are admitted to stroke units (49\% vs 28\%) than New Zealand however the proportion of patients thrombolysed is similarly low across the two countries.

New Zealand compares favourably with Australia in other areas with similar proportions of patients seen by physiotherapy, occupational therapy and social workers. Hospital mortality, length of acute hospital stay and discharge destination of patients after acute stroke were also similar in New Zealand and Australia.

This audit has some limitations. The data collection was retrospective and only aspects of stroke management that were clearly documented in the patient notes were captured. Although large DHBs admit 60\% of all stroke patients, there were equal
numbers of patients audited between large, medium and small DHBs, given the requirement to audit 40 consecutive patients in each of the DHBs. The reasons why a DHB may not have a stroke unit were not explored and this should be addressed in future studies.

This audit provides a comprehensive overview of the clinical care of people presenting to hospital with stroke in New Zealand and it is reasonable to assume that the responses reflect the current state of stroke management. It provides a benchmark with which to measure improvements over time and against our international peers. It is clear that the implementation of best practice guidelines for stroke care has been patchy and there is significant regional variation.


**Competing interests:** None known.

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**References:**


