

# National Stroke Audit: The Australian experience

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**Background:** National data measuring compliance with stroke clinical guidelines were unavailable in Australia until 2007. The inaugural National Stroke Audit was established to monitor the quality of clinical practices in acute stroke management.

**Aim:** To assess adherence to recommended care known to optimize health outcomes for people after experiencing acute stroke.

**Methods:** Public hospitals managing people with acute stroke conducted a retrospective clinical audit of up to 40 cases admitted between October 1, 2006 and March 31, 2007.

**Results:** Eighty-nine hospitals contributed clinical audit data on 2,724 people with acute stroke. Discrepancies between recommendations and clinical practice were evident. Half the patients audited were treated in a stroke unit. Often multidisciplinary interventions did not occur within two days, as recommended (46%–75%). Few (3%) patients with ischemic stroke received thrombolysis. Secondary prevention on discharge was inadequate: a quarter did not receive antihypertensives, a third did not receive lipid-lowering medication, and two-thirds did not receive lifestyle advice. Adherence to discharge planning processes was poor (11%–53%).

**Conclusions:** The audit has provided insights into the performance of the Australian health system on providing acute stroke care. These findings provide an opportunity to develop action plans for improving clinical practice and to monitor temporal progress.

**Keywords:** stroke, stroke unit, adherence, clinical audit

## Introduction

Stroke is a major health issue for Australia with an estimated 60,000 new and recurrent strokes in Australia each year.<sup>1,2</sup> Stroke is a leading cause of permanent adult disability and the second leading cause of death in Australia, responsible for approximately 9% of all deaths.<sup>1,3</sup> The lifetime cost of first-ever stroke in Australia is estimated to be over \$2 billion per year.<sup>4,5</sup> The burden of stroke goes far beyond the measured cost, with an enduring impact on individuals, families and the workforce.

The National Stroke Foundation (NSF) in Australia has been committed to reducing the impact of stroke on the Australian community for over ten years. A priority of the NSF is the facilitation of the delivery of evidence-based stroke care. This is achieved through a national quality improvement “Stroke Services” program incorporating clinical guidelines development, national audit and provision of structured and tailored quality improvement programs to improve the use of recommended interventions known to be effective.

The NSF has been developing clinical guidelines<sup>6–8</sup> for stroke management since 2003. These guidelines provide an overview of current research evidence and present recommendations for clinical practice, based on the highest level of evidence available.

They make specific recommendations on organization of stroke services (including stroke units), hyperacute (within 48 hours) interventions, including brain and other diagnostic imaging, delivery of clot-busting agents (thrombolysis) or hyperacute aspirin to patients with ischemic stroke, and the timeliness of intervention by the multidisciplinary team members as well as discharge planning and support for life after stroke.

Until 2007, national quantitative data on compliance with clinical guidelines in Australian hospitals was unavailable. During 2006 and 2007 the NSF developed and launched the national audit program for stroke. This program was modeled on the Sentinel Stroke Audit Program in the United Kingdom (UK) and included an organizational survey and clinical audit component.<sup>9,10</sup> The Organizational Survey was developed to describe the nature of acute stroke services. The results of the Organizational Survey<sup>11</sup> component are not reported in this article. The aim of collecting national clinical audit data on acute stroke services was to identify adherence to clinical guidelines and use these data to improve the quality of care. Local results and the national aggregate results were provided to clinicians to encourage the use of these data for benchmarking purposes or to monitor clinical practice through time and motivate appropriate changes to clinical practice. The audit program is run biennially with measurement of the quality of post-acute stroke care in the alternate years. International experience has shown that audit can be effectively used to influence and change clinical practice.<sup>12–15</sup> Availability of Australian data would also permit international comparisons over time. A second national audit of acute stroke services was performed in 2009, although its findings are not discussed here, these data will enable longitudinal comparisons. This article provides an overview of the methods used to establish the audit program in Australia and provides the baseline results from the inaugural Australian clinical audit of acute stroke management. Further information relating to the full National Audit Program is available from <http://www.strokefoundation.com.au/>.

## Methods

### Development

An expert working group, the National Advisory Committee, was convened in 2006 to guide the development of the national audit. The group included medical, nursing, allied health and clinical research representatives from across Australia. A comprehensive set of questions derived from the clinical guidelines were agreed to be piloted in this

first national audit. This would provide an insight into the areas of greatest strength and weakness of inpatient acute stroke care. These initial variables provide a focus for future biennial acute care hospital audits as part of the audit program.

The Clinical Audit was designed as a retrospective patient case note audit of up to 40 consecutive acute stroke admissions during a defined timeframe. Questions asked during the audit were based on processes of care matched to recommendations in the clinical guidelines. In addition to patient baseline characteristics, such as age, gender, and living status pre- and post-stroke, some patient functional outcomes were included.

### Sampling

Hospitals previously identified as admitting acute stroke patients (N = 338) using a national survey<sup>16</sup> were invited to join the National Stroke Audit Collaborative. Hospitals were recruited between November 1, 2006 and June 23, 2007. Information sessions were provided in Western Australia, Queensland and New South Wales. The audit was also promoted via the Australian Council on Healthcare Standards (ACHS) Newsletter and via the Australasian Stroke Unit Network (ASUN) and the Stroke Society of Australasia (SSA). Private hospitals were not actively recruited, but were not excluded if they elected to participate. Each hospital was asked to nominate a primary auditor and a lead clinician to be responsible for the audit locally.

For each participating hospital up to 40 eligible patients, who had been consecutively admitted, with an *International Classification of Diseases, 10th edition* (ICD-10) code of I61.0–I61.9 (intracerebral hemorrhage), I63.0–I63.9 (cerebral infarction), I64 (stroke not specified as hemorrhage or infarction), and I62.9 (intracerebral hemorrhage unspecified) were eligible for inclusion in the Clinical Audit. Patients presenting with transient ischemic attack (TIA) or subarachnoid hemorrhage (SAH) were excluded from the audit. Admission, treatment and discharge must have occurred between October 1, 2006 and March 31, 2007. Given the size or location of some hospitals, it was anticipated that several would be unable to provide 40 eligible admissions. However, it was important for this national audit to capture the full range of hospital services who admit stroke patients. To ensure consecutive admissions were used, detailed explanation of what was required was included in the auditors training, and written guidelines were also provided.

## Data collection

Auditors at each site entered data via a web-based data entry tool (webtool) between March 1, 2007 and June 30, 2007. The webtool allowed auditors to enter and monitor data via a standard internet connection. Security and confidentiality were maintained by assigning hospitals with a site code and password, each of which had to be entered in order to access the website.

Auditors entering data attended a telephone training session and were provided with telephone and email support, as well as a detailed data dictionary to ensure consistent approaches to data collection between auditors. The webtool was capable of significant administrative functions including allowing the program manager to monitor data collection at a local and central level, as well as having inbuilt logic checks to minimize missing data. Data from the first five patients' clinical notes at each site were entered twice using different auditors to provide a reliability check. These data are not reported here.

Participants were able to change their responses prior to June 30, 2007 at which point the webtool was locked. Programmed logic checks were then performed on the data. Inconsistent data were checked with each participating hospital (for example, negative length of stay) via telephone contact. Corrections were made directly on the webtool up to August 2007. Following this stage, a lead clinician from each participating hospital was sent a copy of their raw data in a Microsoft Excel (Microsoft, Redmond, WA) spreadsheet to verify before the final analyses were completed.

## Data analysis

Data were analysed by staff from the Public Health Division at the National Stroke Research Institute (NSRI). To ensure confidentiality data were de-identified prior to transmission to NSRI, a hospital site identification number was used so that re-identification by NSF could be possible for the provision of individual hospital reports. The data were analyzed using computer programs including Intercooled STATA 8.0 for Windows (StataCorp, College Station, TX) and Microsoft Excel.<sup>17</sup> The data were exported from the webtool as an Excel spreadsheet and transferred into STATA. Data were then recoded into variable definitions recording Yes = 1 and No = 0, Unknown = 9. Variables were derived from the data for some indicators for more accurate reporting. For example, length of stay was calculated using admission and discharge dates.

It was assumed that a process did not occur where there was a lack of documented evidence in the clinical file and the auditor was advised to select a negative response. Adherence to processes of care was generally calculated on

the entire sample (excluding missing data). In some instances, eligibility criteria for processes of care were specified. For example, adherence to the use of antithrombotics on discharge was calculated only for patients presenting with ischemic stroke.

## Results

In total, 89 public hospitals contributed clinical audit data on 2,724 patients with acute stroke admitted to their hospital during the period of October 1, 2006 and March 31, 2007. The 89 hospitals participating in the clinical audit accounted for the care of 18,860 (68%) of the 27,767 patients reported as having received care previously by all hospitals that had participated in the organizational survey.<sup>11</sup> Three (3%) of the hospitals were from the private sector. The majority of the cases audited were managed in urban hospitals (86%). The minimum number of cases audited was 2 and the maximum 45. The median number of cases audited was 40 with an interquartile (IQR) range of 19 to 40. Figure 1 demonstrates the professional background of the auditors.

The audit cohort comprised 52% males and the median age was 76 years (IQR 65 to 83). Most (71%) patients had been diagnosed with an ischemic stroke, confirmed by brain imaging. One percent of the audited patients were from an Aboriginal and/or Torres Strait Islander background. Prior to their index stroke most of the audited patients had been independent (82%) and lived at home (87%). Two-thirds of the audited patients had multiple pre-existing risk factors for stroke on admission. A third had experienced a previous cerebrovascular event, either TIA or completed stroke.

Most (76%) patients had arrived from the community by ambulance. About two-thirds of the cohort were treated in a hospital that had a stroke unit, although only half the cohort had been treated in a stroke unit. The most commonly reported impairments on admission included upper limb deficit (74%), communication/speech problems (66%), dysphagia (44%),

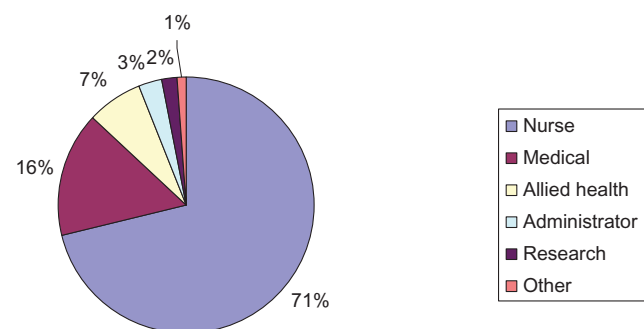


Figure 1 Auditor discipline.

hydration/nutrition problems (33%), cognitive (44%) or visual/perceptual deficit (42%), incontinence (38%) and many (67%) were unable to walk. Few (3%) patients with ischemic stroke were thrombolized. Timely assessment by

allied health varied depending on discipline (46%–81%). Discharge planning processes were poorly adhered to and are described in Table 1 which summarizes adherence to the main recommended processes of care.

**Table 1** Summary of clinical audit findings

	Known N <sup>#</sup>	Number receiving process of care	Adherence to indicator (%)
<b>Prehospital care</b>			
Arriving by ambulance	2724	2066	76
<b>Early intervention</b>			
Receiving stroke unit care	2671	1332	50
Brain imaging (CT or MRI) within 24 hours	2561	2336	91
12 lead electro-cardio-graph while in hospital	2724	2537	93
Presented within 3 hours of onset*	1787	795	45
Received intravenous thrombolysis*	1944	56	3
Aspirin within 48 hours*	1068	986	92
Assessed by physiotherapy within 48 hours	2136	1591	75
Assessed by occupational therapy within 48 hours	1854	1039	56
Assessed by speech pathologist within 48 hours	1315	1063	81
Assessed by dietitian within 48 hours**	904	416	46
<b>Management</b>			
Assessment results and treatment plans discussed with patient	2359	1353	57
Mood assessed during admission	2724	791	29
Assessed by social work within 7 days	1071	849	79
Swallow screened before being given food or drink	2724	1365	50
Indwelling catheter within one week of admission	2724	639	24
Incontinent patients with continence plan	985	439	45
Deep vein thrombosis prophylaxis	1691	931	55
<b>Secondary prevention</b>			
Discharged on antihypertensives <sup>^</sup>	2359	1739	74
Discharged on lipid-lowering treatment* <sup>^</sup>	1747	1080	62
Discharged on antithrombotics* <sup>^</sup>	1747	1591	91
Received lifestyle advice <sup>^</sup>	2359	895	38
<b>Discharge planning</b>			
Received patient education	2179	1151	53
Care plan provided	2359	1074	46
General practitioner sent a discharge summary	2281	1807	79
Received caregiver training	2061	383	19
Caregiver needs assessment	2358	677	38
Home assessment <sup>+</sup>	2359	250	11
<b>Outcomes</b>			
Independent on discharge	2714	1140	42
Discharged home	2359	949	40
Died in hospital	2724	365	13
Discharged to inpatient rehabilitation	2359	606	26

**Notes:** \*Ischemic strokes only; \*\*Patients that have nutrition/hydration problems or dysphagia; <sup>^</sup>Those discharged home only; <sup>#</sup>Known N is all cases for which a response was provided. Missing cases are excluded; <sup>+</sup>It is important to note home assessment is not always indicated but this information was not obtained (eg, when the patient is transferred to inpatient rehabilitation or patient is independent at time of discharge).

Fever (9%) and falls (6%) were the most commonly reported in-hospital complications. Of the 2,724 patients, 365 (13%) died while they were in hospital. The average time to death was 9 days. Of the 2,359 patients discharged from hospital alive, 595 (25%) were still in hospital at 14 days. The average length of stay for discharged patients was 11 days.

## Discussion

The National Stroke Audit was the first national data collection program for stroke performed in Australia. It provides a measure of adherence to important aspects of care outlined in the *Clinical Guidelines for Acute Stroke Management*.<sup>6</sup>

Examination of adherence to recommended processes of care allows us to determine how often patients are receiving recommended aspects of stroke care that are proven to improve patient outcomes. The results of this National Stroke Audit provide an insight into the standard of acute hospital stroke care. This included access to, and timing of many important interventions such as imaging, management of stroke risk factors, assessment by members of the multidisciplinary team and provision of discharge planning.

Our findings suggest that adherence to certain aspects of stroke care was very good. Most patients received prompt brain imaging and many were discharged on appropriate secondary prevention medications, such as antihypertensives. The proportion of patients accessing stroke unit care in our audit hospitals was modest. However, when patients did get into a stroke unit they spent more than 50% of their admission there. Nonetheless, with only one in two Australians accessing this gold-standard care for stroke, it was still a long way behind access in other countries in 2007, such as the UK (62%)<sup>18</sup> and Scandinavian countries (70%–75%).<sup>19,20</sup> The audit also highlighted some areas where considerable change is needed. Half the audited patients did not have their swallowing assessed before being given food and drink, and many did not receive key processes of the discharge planning process. Almost half of the patients in the cohort were presented to hospital within 3 hours. This is slightly higher than estimates reported in the US (21%–38%).<sup>21,22</sup> However, despite the fact that many (45%) patients in Australia are arriving in time for consideration of intravenous thrombolysis, few (3%) patients with ischemic stroke are being given this treatment. Although there are other important exclusion criteria for using intravenous thrombolysis (including size of infarct on brain imaging) this result suggests that other barriers to this treatment exist.

This may include those associated with delay to presentation, as well as factors associated with prompt assessment and intervention. Studies have shown that stroke units provide greater adherence to these important processes of clinical care.<sup>13,23</sup> Therefore, improving access to stroke unit care will be a major contributor to improving patient outcomes, reducing associated costs and reducing the burden of stroke on the community.

Secondary prevention is a key aspect of stroke care in light of the fact that people who have suffered stroke are six times more at risk of a stroke compared to the general population.<sup>24</sup> Fear of another stroke is common amongst stroke survivors and their carers<sup>25</sup> and there is good evidence for treatments to reduce the risk of recurrent stroke.<sup>26–28</sup> Adherence to processes of care for secondary prevention was relatively high in all centres, but there is no room for complacency. Despite evidence to suggest that all stroke patients should receive an antihypertensive unless contraindicated,<sup>28</sup> nearly a quarter of patients were not discharged on antihypertensives. Delivery of appropriate secondary prevention is such an important care process proven to reduce recurrent stroke, and associated avoidable hospital admissions.

## Limitations

There are some limitations in considering these results. Because the audit is retrospective there is the potential for reporting bias. In addition, hospital clinicians were required to collect and enter the data. Investigators of other studies have found that the use of hospital clinicians in the collection of audit data has been reproducible by independent auditors.<sup>13,29</sup> Another source of reporting bias included abstracting process of care data from medical records, which may not have been routinely recorded or required subjective judgments. Sampling bias was minimized by providing a defined period for inclusion of cases and requesting consecutive admissions. Steps to minimize bias in this audit included using a separate organization to analyze the data, performing programmed logic checks to identify inconsistent data, verifying in a subsample inter-rater reliability, providing detailed and consistent auditor training and supplying a comprehensive data dictionary.

## Conclusion

The results of the inaugural National Clinical Audit provide a comprehensive overview of the quality of stroke care in Australia. It outlines care delivered to 2,724 patients across Australia from 89 hospitals in metropolitan and rural areas and in hospitals with and without stroke units. The data

allow us to determine how well recommendations in the *Clinical Guidelines for Acute Stroke Management* are being implemented.

The results of the National Clinical Audit will be an important component of quality improvement activities in Australia. Participating hospitals receive local results to assist in identifying gaps in care, and to inform the development of plans to close these gaps. The National Clinical Audit is repeated every two years, ensuring changes over time can be monitored and allowing stroke teams to monitor the success of their quality improvement activities. The NSF also supports improvements in participating hospitals through dissemination of clinical guidelines and through programs supporting the development of quality improvement programs for stroke, known as StrokeLink.

The National Clinical Audit has provided evidence that in many instances, stroke patients in Australia are receiving comparable or better care than those in other countries. However, half of the stroke patients in Australia are still not accessing stroke unit care, a process to ensure they receive all other important aspects of care. Use of intravenous thrombolysis is relatively low and discharge planning processes are not well delivered in most hospitals. The National Stroke Audit is the first time a body of clinical data has been collected from such a cross section of hospitals in Australia and will allow us to monitor and benchmark delivery of recommended stroke care into the future.

Lessons learned in this inaugural audit, including the importance of data reliability, epidemiological soundness and reproducibility, will be carried forward as future audits are developed and undertaken.

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