Stroke FOUNDATION

National Stroke Audit

Acute Services Report 2019

strokefoundation.org.au

About the Stroke Foundation

The Stroke Foundation is a national charity that partners with the community to prevent, treat and beat stroke. We stand alongside stroke survivors and their families, healthcare professionals and researchers. We build community awareness and foster new thinking and innovative treatments. We support survivors on their journey to live the best possible life after stroke.

We are the voice of stroke in Australia and we work to:

- Raise awareness of the risk factors, signs of stroke and promote healthy lifestyles.
- Improve treatment for stroke to save lives and reduce disability.
- Improve life after stroke for survivors.
- Encourage and facilitate stroke research.
- Advocate for initiatives to prevent, treat and beat stroke.
- Raise funds from the community, corporate sector and government to continue our mission.

About the National Stroke Audit

The National Stroke Audit is a Stroke Foundation initiative delivered as part of our commitment to promoting evidence-based stroke care. The National Stroke Audit provides longitudinal data on clinical performance. The National Stroke Audit first commenced in 2007 and each alternate year the Stroke Foundation switches focus between acute hospital services and inpatient rehabilitation services for stroke.

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Note: The National Stroke Audit – Acute Services Report and additional documents are available at:
informme.org.au/stroke-data

Table of contents

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Clinical governance and advice were provided by the Stroke Foundation's Clinical Council.

Data analyses were undertaken by the Translational Public Health and Evaluation Division, Stroke and Ageing Research, School of Clinical Sciences at Monash Health, Monash University.

Data were collected using the Australian Stroke Data Tool (AuSDaT), an integrated, web-based data management system developed through a collaboration of programs, and led by the Stroke Foundation and the Florey Institute for Neuroscience and Mental Health. AuSDaT was specifically produced as a consensus-based, fit-for-purpose tool for monitoring stroke care in Australia.

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Foreword

Every nine minutes stroke strikes in Australia.[1] It occurs in an instant attacking our brain, our most vital organ, depriving it of oxygen and causing brain cells to die. Stroke can be treated, yet this disease remains one of this country's biggest killers and a leading cause of disability.

Stroke Foundation's goal is to prevent stroke, save lives and enhance recovery.

With each edition of the National Stroke Audit we are working towards this goal. The 2019 *National Stroke Audit Acute Services* highlights improvements that have been made. Barry's story is the perfect example of how far we have come. However, there is still a long way to go.

Regional and rural Australians are continuing to be denied standard emergency stroke treatments simply because of where they live.

I am not just talking about the latest innovations in stroke, this is about accessing clot-dissolving drugs to stop ischaemic (caused by clots) stroke and receiving care in a stroke unit; both have been recognised as standard treatments for more than a decade. This is especially concerning because rural and regional Australians have a greater stroke risk. It doesn't need to be this way.

The Report demonstrates the impact of investment in highly coordinated state-wide acute stroke services, bringing together the clinicians, the health system and maximising the benefits of telehealth technology. Victoria and South Australia are proving geography is no longer a barrier to accessing emergency stroke treatment.

It is time to extend the learnings from these states across the country. The Australian Government has paved the way with the development of the National Strategic Action Plan for Heart and Stroke. Improved access to emergency stroke treatment through telehealth and clinical pathways are highlighted as key actions in the Plan. Governments must now work together to enable all Australians to benefit from the advances that a national telestroke network can realise.

We must also focus on supporting stroke survivors as they transition from acute hospital care back to the community. Recovery from stroke can be a long and challenging journey but with appropriate support, many can make a meaningful recovery. Co-ordinated discharge, secondary prevention advice and targeted follow-up will ensure every survivor has the best chance possible of returning to work or living an active life in retirement.

Photo credit: Peter Casamento

When Melbourne man Barry Collins, 69, had a stroke at work in July 2019, his path to recovery unfolded like a best-case scenario in a textbook.

Barry's colleagues recognised the F.A.S.T. (Face. Arms. Speech and Time) signs of stroke. They immediately called triple zero (000) for an ambulance.

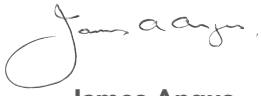
Australia's only Mobile Stroke Unit or Stroke Ambulance attended. On the spot, in the car park of his workplace, Barry was given a brain scan in the Ambulance diagnosing an ischaemic stroke (caused by a clot). Barry was treated in the Ambulance with a drug to dissolve the clot.

The stroke attacking Barry's brain was stopped within 70 minutes. Barry was transported to hospital and admitted straight into a stroke unit where he was up walking again within hours. He was discharged three days later.

In closing, I thank the hundreds of amazing health professionals, researchers and health services who have contributed their valuable time and expertise to this Audit. Your commitment to using this data to improve outcomes for patients with stroke is commended.

With your help we are moving closer to ensuring all Australians have access to life-saving, high quality, evidence-based care. There can be more Australians like Barry.

Sharon McGowan
Chief Executive Officer
Stroke Foundation



James Angus
President
Stroke Foundation

Executive Summary

Australian stroke patients no longer need to be forced into a postcode lottery.

Results of the 2019 *National Stroke Audit: Acute Stroke Services Report* revealed Victoria and South Australia were leading the way. The states have developed pathways of care linking rural centres with comprehensive stroke centres in major cities via telestroke services.

The Report showed for the remainder of Australia there is more to be done.

There have been significant advancements in emergency stroke treatment, meaning stroke is more treatable. However, the Audit Report showed regional health services and their patients were being left behind. Regional patients had limited access to well established standard stroke treatments, while major city hospitals were innovating, enabling their patients to benefit from the latest break-throughs.

In 2019, ten hospitals – all located in major cities – were found to meet all elements of a comprehensive stroke centre (an increase from six services in 2017) ensuring they were equipped to deliver best-practice care. This includes the provision of hyperacute care (reperfusion therapies – endovascular thrombectomy [clot removal] services and thrombolysis [clot dissolving] services) 24 hours a day, seven days a week.

In addition, these centres have a dedicated stroke unit.

Tasmania, the Northern Territory and the Australian Capital Territory do not have a comprehensive stroke centre* or formal clinical pathways to ensure patient access to a centre in another state.

Of further concern was the routine use of evidence-based Clinical Guidelines to guide treatment and care. A total of 69% of major city services reported routine use of Guidelines, care plans and protocols as part of their care delivery for patients with stroke. In inner regional areas this figure fell to 45% and in outer regional 47%.

Patients outside of major cities were also limited in their access to hospital enablers to prevent stroke. More than 40 percent of stroke patients will experience a warning prior to their stroke.[1] A Transient Ischaemic Attack or TIA happens when the blood supply to your brain is blocked temporarily. The signs are the same as for a stroke, but they disappear within a short time.

A patient's risk of a stroke is highest in the days following a TIA. However, if risk factors are managed in line with Clinical Guidelines, a stroke may be avoided. The vast majority (85%) of services report a defined process, policy or pathway for TIA patients. However, the average wait time to these clinics was three days. TIA clinics were more common in large hospitals.

'Time is brain' therapies

Stroke attacks the brain. When a stroke strikes it can destroy 1.9 million brain cells a minute.[2] 'Time is brain' or reperfusion therapies can stop this damage, and if delivered quickly many people can recover from stroke. There are time limits on these therapies.

Step one in accessing time is brain therapies is ensuring people get to hospital. Similar to the findings from the 2017 audit, only 35% of all patients with acute stroke reached hospital within the critical 4.5-hour time window for thrombolysis treatment. Results indicated not enough Australians were aware stroke is a time critical medial emergency.

*The ACT Government has announced plans to develop a 24/7 thrombectomy service by the end of 2019.

Reperfusion therapies highlighted in the audit are utilised to stop ischaemic strokes [caused by clots]. These account for around 80% of all strokes:

Thrombolysis

More hospitals report the availability of thrombolysis treatment, 82% from 72% in 2017. Increased availability has unfortunately not led to an increase in access. The overall use of thrombolysis in the clinical audit has remained largely unchanged at 10%.

Speed of delivering reperfusion therapies must also improve. Only one in three patients received thrombolysis within the targeted 60 minutes of hospital arrival. This is well below rates (~60% or more) achieved in other countries with similar developed health systems such as UK[3, 4] and US[5,6].

Endovascular thrombectomy

Endovascular thrombectomy was proven effective in 2015. This reperfusion therapy benefits patients with the biggest clots and subsequent worse strokes. It is being offered at 19 major city locations nationally, 13 of these provide the treatment 24 hours a day, seven days a week. Delivery of the treatment has risen steeply from 872 in 2017 to 1907 patients in 2019.

Stroke Foundation recognises endovascular thrombectomy is a specialist procedure requiring a high level of expertise and equipment. It is not practical to have the treatment available at all health services treating stroke. However, there is now potential for all Australians to access this treatment.

Central to ensuring access to reperfusion treatments are maximised is the use of advanced brain imaging to select appropriate patients and, established protocols and clinical pathways to the nearest comprehensive stroke centre.

It is estimated 20–25% of all patients with ischaemic stroke could benefit from reperfusion therapy, which means more than double the current numbers are likely to be eligible. Subsequently thousands of stroke patients may be missing out on treatments that reduce disability and death.

Stroke unit care

Building on time-critical treatments, access to stroke unit care is proven to deliver improved outcomes for patients.[7] Stroke unit care is characterised by provision of care in one location by an interdisciplinary team including medical, nursing and allied health professionals with expertise in stroke. This team is led by a dedicated stroke coordinator.

The number of stroke units remained static at 91. Access to stroke unit care has not improved (67% versus 69% in 2017). Access for regional stroke patients (55% inner regional, 35% outer regional) was well below those in major cities (79%). For those patients who did have access to a stroke unit, fewer than half (41%) spent the Clinical Guideline recommended time >90% on the unit to maximise its benefit.

It was also worrying to note 22 stroke units (24%) reported not having a dedicated stroke coordinator – a critical role in assisting the team to deliver best practice care.

Positively, most services (93%) reported integration between acute and rehabilitation services.

Only 39% of patients were assessed for rehabilitation needs, yet of those assessed almost 75% of patients were found to have ongoing rehabilitation needs. This demonstrates recovery opportunities were not being made the most of.

Helping patients to live well after stroke

For treatments to be capitalised upon, patients and their families need support and advice in this transition from hospital to rehabilitation or home.

Discharge care plans, developed with patients and their families, have long been emphasised in Clinical Guidelines, yet only 69% of patients received a comprehensive plan. This was a small improvement compared to previous years (65% in 2017). However, more must be done. Patients in stroke units, were more likely to have access to a discharge plan (75% vs 56%).

Further, patients were being discharged from hospital without vital advice and medication to reduce their risk of having another stroke. Three-in-ten patients were not given advice on lifestyle and other modifiable risk factors to avoid another stroke and up to one-quarter were not prescribed recommended secondary prevention medications.

Four in ten stroke survivors will go on to experience another stroke within ten years[8], however with medication and lifestyle modification many of these may be prevented.

Carers were forgotten in the transition home or to a rehabilitation service. Almost 40% of carers, where patients were moderately to severely affected from the stroke, were inadequately assessed for their needs or trained in ways to support the stroke survivor outside of hospital.

Supports in the transition home were more likely to be provided where patients were treated in a stroke unit. This means patients treated outside of major cities were again disadvantaged.

Opportunities for improvement

Results of the Audit Report demonstrated gaps in services and current major city and regional inequity. It also revealed investment and focused interventions have improved stroke treatment and care at a local and state level. Now the opportunity is to take these learnings and apply them nationally. Equity of access must be improved.

This is the first *National Stroke Audit – Acute Services* since the implementation of the *2017 Clinical Guidelines for Stroke Management*. The Guidelines have now transitioned to a 'living mode' thanks to an Australian Government funded Medical Research Future Fund. This means the Guidelines are reviewed and updated regularly as significant new research is available, aiming to reduce the time for implementation of new evidence.

Recommendations

- All patients must have access to specialist stroke assessment, including advanced brain imaging and early treatments. Formal policies and pathways across the whole system are needed including links between dedicated stroke centres to others via telehealth.
- Rapid assessment, including stroke specialist input, and procedures to identify and ensure quicker delivery of reperfusion therapies.
- Patient access to dedicated stroke unit care. Acute hospitals with more than 75 annual stroke admissions need a stroke unit with clear medical leadership and a dedicated stroke care coordinator.
- Increased emphasis on prevention of stroke within hospitals. This includes:
  - increased timely access to TIA clinics.
  - ensuring all people after stroke receive appropriate secondary prevention information and support prior to hospital discharge.
- Carers assessed, supported and trained to maximise recovery opportunities and live well.

About the Audit

The 2019 National Stroke Audit is a systematic and representative snapshot of acute stroke care provided within Australian hospitals. The National Report is a comprehensive document highlighting where the hospital system for acute stroke treatment is working well, and identifying where improvements or changes may be needed.

Information presented permits tracking the performance of Australia's stroke care against the evidence-based *National Clinical Guidelines* (2017), the Acute Stroke Services Framework 2019 and the Australian Commission on Safety and Quality in Health Care's Acute Stroke Clinical Care Standard published in 2015.

Clinicians, healthcare administrators and governments alike use the data in this report to review services and clinical care in order to improve the quality of stroke management throughout Australia.

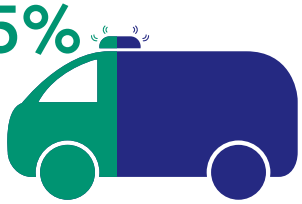
- Data was collected in two parts:
  - 120 services completed a survey on local resources, processes and infrastructure.
  - 4,176 patient case notes retrospectively audited.
- Participating public and private hospitals reported admitting more than 35,000 stroke patients in the previous 12 months.
- Of the 120 participating services, just over half (65) were based in major cities, with the others in inner and outer regional centres.
- Admission numbers across participating hospitals ranged from 20 to 1005 acute stroke patients in the last year.

At a glance

- 120 Hospitals
- 35,164 Acute stroke admissions

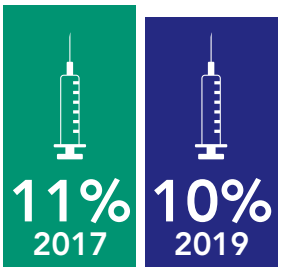
Time critical stroke therapy

35%



of patients reached hospital in 4.5 hour time window for thrombolysis

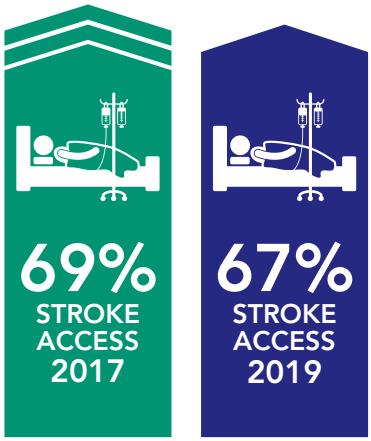
Use of thrombolysis stagnated



Thrombolysis given in hospital within **60 MINUTES** lags internationally

59% 62% 32%

Stroke unit care



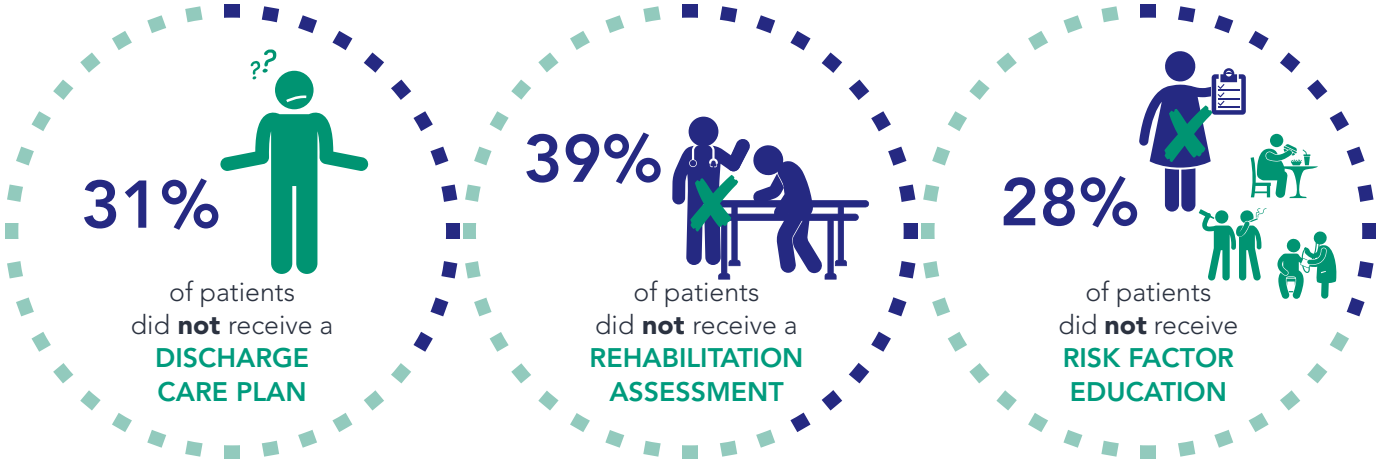
Patients who received stroke unit care

Routine use of Clinical Guidelines

in hospital **WITH** stroke unit

in hospital **WITHOUT** stroke unit

More patient care needed



Chapter 1: Introduction

Stroke is one of Australia's biggest killers and a leading cause of disability. In 2016–17 there were over 80,200 hospitalisations where stroke was recorded as the principal or additional diagnosis.[2] This represents 0.7% of all hospitalisations in Australia. In 81% (65,000) of these hospitalisations, stroke was recorded as the principal diagnosis.[2]

In 2015, around 394,000 Australians (1.7% of the population) had experienced a stroke at some time in their lives, based on self-reported data from the Australian Bureau of Statistics 2015 Survey of Disability, Ageing and Carers.[3] In 2016, there were an estimated 37,800 stroke events in Australia—more than 100 every day, based on hospital and mortality data.[2]

1.1 Clinical Guidelines and the National Stroke Audit

The Stroke Foundation has coordinated the development of national Clinical Guidelines for stroke care since 2003. Clinical Guidelines empower clinicians in understanding the best evidence-based interventions to help people recover from stroke. The *Clinical Guidelines for Stroke Management 2017*[4] were approved by the National Health and Medical Research Council (NHMRC) and help to form the basis of the National Stroke Audit, determining what essential clinical care data should be collected.

Clinical Guidelines are only useful when they are used effectively in clinical practice. An important strategy to encourage change to be in line with what is known to be best practice, is an 'audit and feedback' process.[5] The National Stroke Audit was designed by the Stroke Foundation in consultation with experts to measure adherence to the *Acute Stroke Clinical Care Standard*[6] and recommendations in the *Clinical Guidelines for Stroke Management*. As well as monitoring stroke care at nationwide and state-wide levels, the National Stroke Audit promotes quality improvement by through a tailored report provided back to individual hospitals. These individualised reports enable teams to compare their performance against national averages, achievable benchmarks obtained from the 'top-performing' hospital's, and peers based on other similar-sized (admissions per year) stroke services. The National Stroke Audit commenced in 2007 and provides longitudinal, cross-sectional data to track changes over time, allowing hospitals to understand where they have, and have not, improved between each National Stroke Audit.

This report measures against the *Clinical Guidelines for Stroke Management 2017*.

1.2 The National Stroke Audit Program

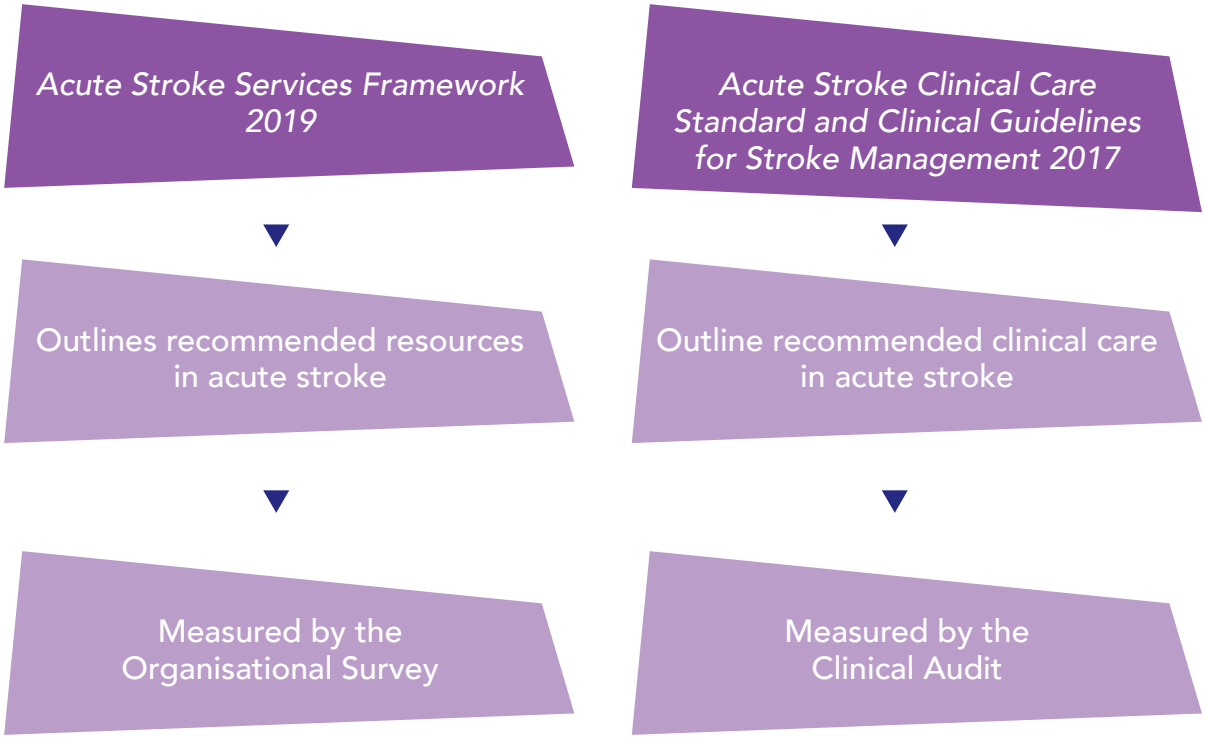
The National Stroke Audit – Acute Services comprises:

- An Organisational Survey of acute hospitals across Australia. The Organisational Survey provides information about the resources available to deliver acute stroke care such as the availability of stroke units, imaging services and interdisciplinary staff. The Organisational Survey questions assess the adherence to the *National Acute Stroke Services Framework 2019*[7] (the Framework) which provides national recommendations related to acute stroke elements of care including what defines a stroke unit, Comprehensive Stroke Services, Primary Stroke Services and General Hospital services.
- A Clinical Audit involving the retrospective review of up to 40 consecutive patients admitted to each participating hospital between 1 June – 31 December 2018. The Clinical Audit is used to measure the adherence to evidence-based processes of care such as timely assessments by clinicians, diagnostic procedures, early interventions, interdisciplinary care and discharge planning.

Timing of the delivery of various aspects of care and discharge outcomes are also measured.

The basis of the Organisational Survey and Clinical Audit is represented in Figure 1.

Figure 1: Components of acute care reflected in this report



The National Stroke Audit – Acute Services is conducted biennially to provide standardised, cross-sectional data on clinical performance. Each alternate year, the Stroke Foundation undertakes an audit of inpatient rehabilitation services for patients with stroke. The methods for the audit are outlined in Appendix 1.

1.3 Structure of the report

For this report, 'acute care' refers to care provided following a new stroke events in hospital from arrival to discharge from acute care hospitals, statistical discharges to a different ward/unit in the same hospital, or transfer to inpatient rehabilitation.

This report outlines the resources and structures available at the participating hospitals mapped to the Framework, as well as adherence to the Australian Commission of Safety and Quality in Health Care's (ACSQHC) *Acute Stroke Clinical Care Standard*[6] and the *Clinical Guidelines for Stroke Management 2017*[4].

- Chapter 2 includes details of the participating services.
- Chapter 3 includes the responses to the Organisational Survey. Responses are analysed at a service level.
- Chapter 4 provides results of the Clinical Audit, which reflects individual patient care.
- Chapter 5 includes changes in care delivered since 2013.
- Chapter 6 includes discussion and recommendations regarding the data from the 2019 National Stroke Audit.

I was 41 years old when I had my stroke. I believe if it had not been for the expertise of the team at the stroke unit where I was treated, my recovery would have been greatly impaired. Research shows dedicated stroke units save lives and reduce disability, improving the quality of life post stroke for survivors.

Brenda Booth, stroke survivor.

Chapter 2: Participating acute hospital services

Response rates and characteristics of participating hospitals

One hundred and fifty-one services (n=151) were identified nationwide based on criteria of admitting at least 40 patients with acute stroke in a year. This includes 141 public services deemed eligible to participate in the National Stroke Audit – Acute Services. The total number of private services that could be eligible was unknown. However, based on previous participation and partnerships with state-based clinical networks, 10 eligible private services were identified based on minimum annual admitted stroke numbers.

Eligible services were targeted with active recruitment procedures that included phone calls and emails. In total, 115 public services and 5 private services completed the Organisational Survey, and of these, 107 public services and all 5 private services participated in the Clinical Audit. This represents an 82% participation rate in the Organisational Survey and a 76% participation rate in the Clinical Audit by eligible public services.

A total of 24 eligible public services elected not to participate: 12 from New South Wales (NSW), five from Queensland (QLD), three from Victoria (VIC) and South Australia (SA), and one each from Western Australia (WA), Northern Territory (NT) and Tasmania (TAS). Most of these were small hospitals with <50 beds.

Defining remoteness areas

Classification of participating services as metropolitan or regional/rural was based on the Accessibility and Remoteness Index of Australia (ARIA+). The Australian Statistical Geography Standard (ASGS) defines Remoteness Areas into 5 classes of relative remoteness across Australia.

These 5 classes of remoteness are:

- Major Cities of Australia
- Inner Regional Australia
- Outer Regional Australia
- Remote Australia
- Very Remote Australia

The audit only used three classes of remoteness (Major Cities of Australia, Inner Regional Australia, Outer Regional Australia), as none of the participating services are classified as Remote Australia or Very Remote Australia (refer to Appendix 1 for more information).

Tables 1 and 2 below show the characteristics of services participating in the 2019 audit.

Table 1: Participating services by location and region

	Organisational Survey			Clinical Audit		
	Total	Public	Private	Total	Public	Private
Australia	120	115	5	112	107	5
ACT	2	2	0	2	2	0
NSW	43	41	2	42	40	2
NT	1	1	0	1	1	0
QLD	24	23	1	22	21	1
SA	7	7	0	6	6	0
TAS	3	3	0	3	3	0
VIC	29	27	2	26	24	2
WA	11	11	0	10	10	0
Region*						
Major Cities	65	60	5	62	57	5
Inner Regional	40	40	0	38	38	0
Outer Regional	15	15	0	12	12	0

*Rurality by ARIA+ classification: Accessibility and Remoteness Index of Australia

In 2019, the 120 hospitals that completed the Organisational Survey reported a total of 35,213 patient admissions requiring acute stroke care.

The number of patients with stroke admitted to the 120 services in the 2019 Organisational Survey ranged from 20 to 1,005 (median: 203; Quartile 1 (Q1):93; Quartile 3 (Q3): 386). Over half the services (59%) reported having between 75 and 499 acute stroke admissions in 2019.

Services that reported 74 or fewer annual acute stroke admissions (N=25) accounted for 1,071 (3%) of all reported admissions. Services admitting 500 or more patients with acute stroke per year (N=24) reported admitting 18,371 (52%) patients. The 112 services participating in the Clinical Audit accounted for a total of 34,805 admissions, or 99% of the reported caseload from the survey.

Table 2: Participating services by location, region and setting, and reported number of acute beds and annual stroke admissions

	Median number of acute beds (Q1, Q3)	Median number of annual stroke admissions (Q1, Q3)	Total reported annual stroke admissions	Participating services by annual stroke admissions			
				<75	75-349	350-499	≥500
Australia (N=120)	**250 (117, 476)**	**203 (93, 386)**	**35,164**	**25**	**60**	**11**	**24**
ACT (N=2)	Min 254, Max 600	Min 230, Max 350	580	0	1	1	0
NSW (N=43)	235 (150, 440)	225 (90, 400)	12,381	7	24	4	8
NT (N=1)	345	234	234	0	1	0	0
QLD (N=24)	242 (124, 536)	203 (136, 334)	6,057	4	14	3	3
SA (N=7)	123 (52, 588)	120 (34, 602)	2,608	3	1	1	2
TAS (N=3)	264 (103, 384)	320 (129, 370)	819	0	2	1	0
VIC (N=29)	270 (115, 437)	150 (80, 521)	9,472	7	13	1	8
WA (N=11)	182 (85, 488)	165 (60, 600)	3,013	4	4	0	3
Region							
Major Cities (N=65)	430 (254, 600)	320 (155, 613)	27,060	6	27	8	24
Inner Regional (N=40)	131 (76, 220)	147 (66, 241)	6,305	11	28	1	0
Outer Regional (N=15)	100 (72, 143)	67 (35, 129)	1,799	8	5	2	0

Q1. 1st quartile; Q3: 3rd quartile

Chapter 3: Results of the Organisational Survey and adherence to the *Acute Stroke Services Framework*

Key findings

- 10 comprehensive stroke centres (CSCs) across Australia (an increase from only 6 services in 2017).
- Increase in the median number of Framework elements met.
- More services offering thrombolysis – increased from 72% (2017) to 82% (2019).
- A 119% increase in the number of endovascular clot retrieval procedures performed.
- Increase in services that have arrangements with local ambulance services (58% in 2017 to 74% in 2019).
- Nine services admitting ≥75 strokes annually do not have a dedicated stroke unit service (where it is recommended). However, the capacity of Australian services has grown to 769 stroke beds (increased from 676 beds in 2017).
- More services are using telehealth to coordinate care (72% in 2019, increased from 53% in 2017).

This section of the report describes the current resources available in Australia to support best-practice stroke care (the Organisational Survey) mapped to the Framework elements.

The intended use of the Framework is to:

- Outline where stroke services should be developed and what they should include, to assist planning of stroke services.
- Provide a basis for measuring adequacy of current structures and resources for best-practice stroke care.
- Provide information to advocate for improved services where gaps are identified.
- Guide decisions about resource requirements (including minimum stroke unit bed numbers in comprehensive stroke centres).
- Provide an outline for monitoring quality of care delivered by stroke services.

The Framework comprises 20 elements (refer to Figure 2 or Table 4 for list of elements), of which CSCs have all elements. Primary stroke centres (PSCs) should have most elements, and where they do not, they should have processes in place to transfer to CSCs. As the Framework was updated in 2019, the 2017 data have been mapped to the 2019 Framework to enable comparisons.

3.1 Overall adherence to the Framework

The median number of Framework elements met by the 120 services completing the Organisational Survey was 15 out of the 20 elements.

- 10 services (8%) were found to meet all 20 elements
- 4 services (3%) met 19 elements
- 9 services (8%) met 18 elements
- 12 services (10%) met 17 elements.

The largest proportion of services (n=19, 16%) met 16 elements.

As seen in Table 3, the median number of elements varied by:

- Region – Major Cities median: 16 elements; Inner and Outer Regional median: 13 elements).
- Stroke unit access – services with a stroke unit median: 16 elements; services without a stroke unit median: 11 elements.
- Service size – services admitting 500+ stroke patients per annum median: 18 elements; <75 stroke admissions per annum median: 11 elements.

Comprehensive Stroke Centres are hospitals that have highly specialised resources and personnel available 24 hours a day, 365 days a year. They are able to manage a large volume of patients with stroke, including the most complex presentations. They have a dedicated stroke unit, established and well-organised systems to link emergency services and hyperacute care, and coordinated processes for ongoing inpatient rehabilitation, secondary prevention and community reintegration.

CSCs have timely neurovascular imaging and expert interpretation (including advanced imaging capability), and offer thrombolysis and endovascular therapy 24 hours a day, 7 days a week (24/7), along with links to other specialist services. They also have a leadership role in establishing partnerships with other local services for supporting stroke care.

It is a concern that only 9 of the 24 services admitting 500+ patients with stroke in the past year were found to meet all 20 elements of the Framework, allowing them to be classified as a CSC7 There were no CSCs identified in the ACT, NT, or TAS.

Another concern is that 16 services (13%) met less than, or equal to, half of the Framework elements (≤10 elements). However, 54 services (45%) met 16+ elements, and 50 services (42%) met 11–15 elements. Services located in the major cities with a large number of annual stroke admission meet more elements of the Framework and therefore, can be deemed to have more stroke care resources.

Table 3: Median number of Framework elements, by region and stroke volume

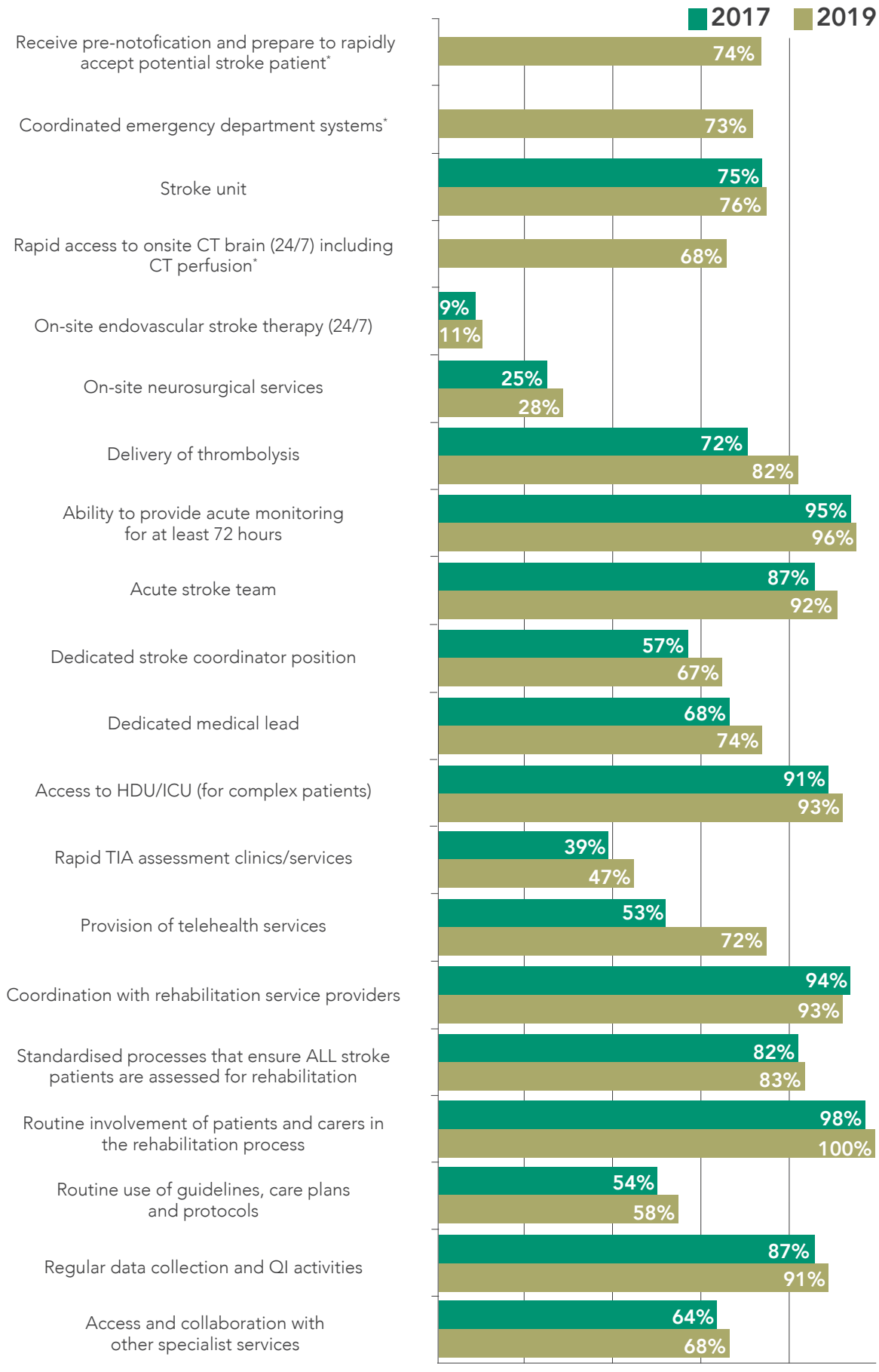
	Australia (N=120)	Region			Reported annual stroke admissions				
		Major Cities (N=65)	Inner Regional (N=40)	Outer Regional (N=15)	<75 (N=25)	75-199 (N=32)	200-349 (N=28)	350-499 (N=11)	500+ (N=24)
Median number of Framework elements met (Q1, Q3)	15 (12, 17)	16 (15, 18)	13 (11, 16)	13 (9, 16)	11 (8, 12)	15 (12, 16)	16 (13, 17)	16 (15, 19)	18 (16, 20)

Q1: 1st quartile; Q3: 3rd quartile

Figure 2 on the following page shows the progress in Australia's aggregated adherence to the 20 individual elements of the Framework since the 2017 National Stroke Audit – Acute Services.

Please note: While cohorts were similar, they are not identical (127 services participated in the 2017 Organisational Survey and 120 services participated in the 2019 Organisational Survey with five services in 2019 having not participated in the 2017 audit).

Figure 2. Australia's aggregated adherence to the 20 elements of the Framework, 2017 and 2019



Framework: National Acute Stroke Services Framework 2019; CT: computed tomography; 24/7: 24 hours a day, 7 days a week; HDU: High Dependency Unit; ICU: Intensive Care Unit; TIA: transient ischaemic attack; QI: quality improvement
*New element and variable or changed significantly from 2017 so no comparison data could be included.

3.2 State-wide implementation of the Framework

A systematic approach to resolving barriers that delay hyperacute stroke care and the implementation of geographically appropriate models of emergency care should help achieve increased access to reperfusion therapies, ensure faster treatment delivery and improve access to stroke unit care across Australia.

Hyperacute care can substantially reduce the risk of death and disability. Reperfusion therapies (intravenous thrombolysis and endovascular thrombectomy) are extremely time critical and reducing the delay from stroke onset to treatment directly benefits patients. Furthermore, endovascular thrombectomy for large vessel occlusion is one of the most potent therapies in modern medicine, but this intervention is only available at a limited number of CSCs. Finely tuned coordination of multiple systems (the ambulance service, medical retrieval service, emergency department (ED), radiology department, stroke and neurointervention teams) is required to improve access to reperfusion therapy and reduce treatment delays.

All eight states and territories completed the system-wide organisational survey questions relating to the Framework recommendations:

- Pre-hospital services: 3/8 states have statewide agreed arrangements with ambulance services (four states had partial, e.g. regional/local hospital-specific, agreements).
- Designated stroke-capable services: 4/8 states have agreed statewide services identified as PSCs or CSCs (or general hospitals with telehealth support) that also have statewide agreement/policies for transfers (the other four states had partial, e.g. regional/local hospital-specific, agreements).
- Use of telestroke services for acute assessment and treatment: 3/8 states have statewide agreed telestroke services in general (non-stroke specialist) hospitals for decision-making around hyperacute care and/or transfers (two states had partial, e.g. regional/local hospital-specific,agreements).
- Use of telestroke services for rehabilitation assessment and treatment: no states have agreed statewide telestroke services for assessment and rehabilitation in general (non-specialist) hospitals (five states had partial, e.g. regional/local hospital-specific, agreements).

3.3 Adherence to the Framework by state

A summary of adherence to the individual elements of the Framework for each state is shown in Table 4, excluding sites that are not recommended to have dedicated stroke services (i.e. those with <75 annual stroke admissions).

Table 4: Adherence to elements of the Framework, by location for services with ≥75 annual stroke admissions or a stroke unit

Elements of the Framework	Australia (N=103)	ACT (N=2)	NSW (N=40)	NT (N=1)	QLD (N=21)	SA (N=5)	TAS (N=3)	VIC (N=23)	WA (N=8)
Receive pre-notification and prepare to rapidly accept potential stroke patient from pre-hospital services	80 (78%)	2 (100%)	29 (73%)	0	16 (76%)	4 (80%)	0	23 (100%)	6 (75%)
Coordinated ED systems (includes use of validated screening tools; agreed triage categories; rapid imaging; rapid referral and involvement of stroke team; protocols for IV thrombolysis and ECR intervention/ transfer)	80 (78%)	2 (100%)	27 (68%)	1 (100%)	18 (86%)	4 (80%)	0	22 (96%)	6 (75%)
Stroke unit	91 (88%)	2 (100%)	35 (88%)	1 (100%)	21 (100%)	4 (80%)	2 (67%)	20 (87%)	6 (75%)
Rapid access to onsite CT brain (24/7) including CT perfusion and aortic arch to cerebral vertex angiography	78 (76%)	2 (100%)	31 (78%)	1 (100%)	13 (62%)	4 (80%)	1 (33%)	21 (91%)	5 (63%)
On-site endovascular stroke therapy (24/7)	13	0	4	0	3	1	0	4	1
On-site neurosurgical services (e.g. for hemicraniectomy due to large middle cerebral artery infarcts)	33	1	13	1	6	2	1	7	2
Delivery of intravenous thrombolysis	89 (86%)	2 (100%)	31 (78%)	1 (100%)	20 (95%)	5 (100%)	2 (67%)	22 (96%)	6 (75%)
Ability to provide acute monitoring (telemetry and other physiological monitoring) for at least 72 hours	100 (97%)	2 (100%)	40 (100%)	1 (100%)	20 (95%)	5 (100%)	3 (100%)	22 (96%)	7 (88%)
Acute stroke team	101 (98%)	2 (100%)	39 (98%)	1 (100%)	21 (100%)	5 (100%)	3 (100%)	22 (96%)	8 (100%)
Dedicated stroke coordinator position	76 (74%)	2 (100%)	29 (73%)	1 (100%)	16 (76%)	3 (60%)	0	21 (91%)	4 (50%)
Dedicated medical lead	85 (83%)	2 (100%)	32 (80%)	1 (100%)	18 (86%)	4 (80%)	1 (33%)	20 (87%)	7 (88%)
Access to HDU / ICU (for complex patients)	101 (98%)	2 (100%)	39 (98%)	1 (100%)	20 (95%)	5 (100%)	3 (100%)	23 (100%)	8 (100%)
Rapid (within 48 hours) Transient Ischaemic Attack (TIA) assessment clinics/services	52 (50%)	0	28 (70%)	1 (100%)	6 (28%)	3 (60%)	1 (33%)	9 (39%)	4 (50%)

Use of telehealth services for acute assessment and treatment	72 (70%)	1 (50%)	25 (63%)	1 (100%)	15 (71%)	3 (60%)	1 (33%)	20 (87%)	6 (75%)
Coordination with rehabilitation service providers (this should include a standardised process, and/or a person, used to assess suitability for further rehabilitation)	96 (93%)	1 (50%)	36 (90%)	1 (100%)	21 (100%)	5 (100%)	3 (100%)	22 (96%)	7 (88%)
Standardised processes that ensure ALL stroke patients are assessed for rehabilitation. This includes use of standardised tools to determine individual rehabilitation needs and goals (ideally within 48 hours of admission)	87 (84%)	0	34 (85%)	1 (100%)	19 (90%)	5 (100%)	2 (67%)	20 (87%)	6 (75%)
Routine involvement of patients and carers in the rehabilitation process	103 (100%)	2 (100%)	40 (100%)	1 (100%)	21 (100%)	5 (100%)	3 (100%)	23 (100%)	8 (100%)
Routine use of guidelines, care plans and protocols	66 (64%)	2 (100%)	30 (75%)	0	12 (57%)	2 (40%)	0	16 (70%)	4 (50%)
Regular data collection and stroke specific quality improvement activities	100 (97%)	2 (100%)	37 (93%)	1 (100%)	21 (100%)	5 (100%)	3 (100%)	23 (100%)	8 (100%)
Access and collaboration with other specialist services (cardiology, palliative care, vascular)	77 (75%)	1 (50%)	31 (78%)	1 (100%)	17 (81%)	4 (80%)	2 (67%)	15 (65%)	6 (75%)

Framework: *National Acute Stroke Services Framework 2019*

ED: emergency department; IV: intravenous; ECR: endovascular clot retrievual; CT: computed tomography; 24/7: 24 hours a day, 7 days a week; HDU: high dependency unit; ICU: intensive care unit;

*Recommended for comprehensive stroke centres only, denominator will vary from state to state so % is not calculated.

3.4 Adherence to specific aspects of the Framework

Rapid transfer, assessment and investigations

Hospital-based acute stroke services need to provide rapid assessment supported by streamlined communication with pre-hospital services and the emergency department to diagnostic investigations are undertaken with minimal time delays, such as brain imaging.

The pre-hospital communication and clinical processes are designed to ensure prompt transfer to hospitals that have the resources to deliver appropriate care and ensure swift diagnosis and intervention, as required.

In this hyperacute phase of care, organised pre-hospital services and coordinated regional stroke systems are essential to support appropriate patient transfer, if required, or provide best-practice stroke management.

Table 5: Adherence to recommended pre-hospital, ED and imaging services, by region and stroke volume.

	Australia (N=120)	Region			Reported annual stroke admissions			
		Major Cities (N=65)	Inner Regional (N=40)	Outer Regional (N=15)	<75 (N+25)	75-199 (N=32)	200-349 (N=28)	350-499 (N=11)
Element of service: pre-hospital and ED								
Receive pre-notification and prepare to rapidly accept potential stroke patient from pre-hospital services	89 (74%)	52 (80%)	30 (75%)	7 (47%)	11 (44%)	22 (69%)	23 (82%)	9 (82%)
Coordinated ED systems	88 (73%)	51 (78%)	27 (68%)	10 (67%)	12 (48%)	20 (63%)	22 (79%)	10 (91%)
Element of service: imaging								
Onsite CT brain (24/7) including CT angiography	81 (68%)	49 (75%)	27 (68%)	5 (33%)	6 (24%)	19 (59%)	23 (82%)	9 (82%)

ED: emergency department, CT: computed tomography; 24/7: 24 hours a day, 7 days a week

Hospitals in major cities and inner regional areas were noted to have greater access to computerised tomography (CT) brain scan (75% major cities, 68% inner regional) compared with outer regional services (33%). A larger proportion of hospitals in major cities and inner regional areas had access to pre-notification and pre-hospital services (80% major cities, 75% inner regional) compared with outer regional services (47%).

Almost all services (92%) that admit <75 patients with acute stroke each year had ED protocols for rapid triage of patients presenting with acute stroke. Nineteen out of 25 services (83%) reported providing rapid brain imaging (e.g. with the first 30 minutes), however only 24% had onsite CT brain scan (24/7) including CT angiography. Furthermore, only six services (24%) reported having an agreement in place with the local ambulance service to bypass the hospital for another stroke specific service, and 6 services (24%) had no arrangement in place with local ambulance services.

Reperfusion services

Acute stroke services should provide access (onsite or by transfer) to recommended reperfusion therapy, including thrombolysis and endovascular clot retrieval (thrombectomy). Reperfusion therapies are time dependent and should be provided rapidly (e.g. within hours after stroke onset). Prompt treatment with clot-dissolving (thrombolytic) drugs can restore blood flow before major brain damage has occurred and assist people to make a good recovery from their stroke.[4]

Endovascular thrombectomy is a highly effective treatment with evidence of benefit in selected patients with large vessel occlusion.[4] Treatment may occur either following thrombolysis or as initial treatment in patient's ineligible for thrombolysis. Given that this treatment is only appropriate to provide in CSCs, system-wide transfer and management policies are needed to ensure efficient pathways between hospitals and ambulance services.

Table 6: Adherence to recommended reperfusion services, by region and stroke volume

	Australia (N=120)	Region			Reported annual stroke admissions				
		Major Cities (N=65)	Inner Regional (N=40)	Outer Regional (N=15)	<75 (N=25)	75-199 (N=32)	200-349 (N=28)	350-499 (N=11)	500+ (N=24)
Element of service: reperfusion therapies									
Delivery of intravenous thrombolysis	98 (82%)	54 (83%)	33 (83%)	11 (73%)	13 (52%)	26 (81%)	24 (86%)	11 (100%)	24 (100%)
On-site endovascular stroke service (24/7)	13 (11%)	13 (20%)	0	0	0	0	0	3 (27%)	10 (42%)

24/7: 24 hours a day, 7 days a week

Ninety-eight services (82%) reported offering thrombolysis and 91 of these services provided the service 24/7. These services reported thrombolysing 2,649 patients with stroke in the previous 12 months (Table 7).

Twenty-six services, excluding services that reported no access to thrombolysis, reported thrombolysing fewer than 8 patients in the past 12 months. This includes three services that reported having a thrombolysis service available, but had not thrombolysed any patients in the last 12 months.

Table 7: Annual thrombolysis numbers, by region, setting and presence of stroke unit

	Australia (N=98)	Region			Setting		Stroke Unit	
		Major Cities (N=54)	Inner Regional (N=33)	Outer Regional (N=11)	Public (N=93)	Private (N=5)	Stroke Unit (N=80)	No Stroke Unit (N=18)
Median (Q1,Q3) number of patients receiving thrombolysis per hospital in the last year	16 (6,34)	32 (11,58)	11 (6,19)	6 (2,16)	18 (7,37)	4 (3,4)	23 (10,47)	5 (2,11)
Total number of patients receiving thrombolysis in the last year	2,649	2,132	408	109	2,632	17	2,520	129

Q1: 1st quartile; Q3: 3rd quartile

Time to receiving reperfusion stroke therapies is important for patient outcomes and is discussed with the Clinical Audit results in Chapter 4.

Services with greater numbers of stroke admissions provided more thrombolysis per service. Victoria reported the largest overall rate of any jurisdiction, with NSW and SA reporting similar numbers thrombolysed per service.

Table 8: Annual thrombolysis numbers, by stroke volume

	Australia (N=98)	Reported annual stroke admissions				
		<75 (N=13)	75-199 (N=26)	200-349 (N=24)	350-499 (N=11)	500+ (N=24)
Median (Q1, Q3) number of patients receiving thrombolysis per hospital in the last year	16 (6, 34)	2 (1, 9)	8 (4, 12)	14 (9, 27)	32 (16, 38)	62 (47, 78)
Total number of patients receiving thrombolysis in the last year	2,649	68	239	412	328	1602

Q1: 1st quartile; Q3: 3rd quartile

Table 9. Annual thrombolysis numbers, by location

	Australia (N=98)	ACT (N=2)	NSW (N=32)	NT (N=1)	QLD (N=22)	SA (N=6)	TAS (N=2)	VIC (N=27)	WA (N=6)
Median (Q1, Q3) number of patients thrombolysed per hospital during the past 12 months	16 (6, 34)	Min 12, Max 30	25 (8, 34)	6	11 (3, 32)	22 (0, 79)	Min 13, Max 21	20 (9, 47)	9 (7, 47)
Total number of patients thrombolysed during the past 12 months	2,649	42	853	6	429	277	34	860	148

Q1: 1st quartile; Q3: 3rd quartile; Min; minimum; Max: maximum

Nineteen services (16%) reported providing endovascular clot retrieval to 1,907 patients (Table 10) in the past 12 months (up from 872 reported in the 2017 audit from 21 services). These services were in major cities only. While it is recommended in the Framework that endovascular services be available 24/7, six of these services did not provide 24/7 access; four of these services admitted more than 500 patients with stroke in the past 12 months. Endovascular clot retrieval services are not available in the Northern Territory and Tasmania.

Table 10. Access to onsite endovascular services, by location

	Australia (N=120)	ACT* (N=2)	NSW (N=43)	QLD (N=24)	SA (N=7)	VIC (N=29)	WA (N=11)
Hospitals with onsite endovascular services	19 (16%)	1 (50%)	6 (14%)	3 (13%)	1 (14%)	5 (17%)	3 (27%)
Endovascular services with 24/7 access	13	0	4	3	1	4	1
% of endovascular services that have 24/7 access	68%	0%	67%	100%	100%	80%	33%
Total number of endovascular stroke therapy patients during the past 12 months	1,907	29	583	282	207	523	283

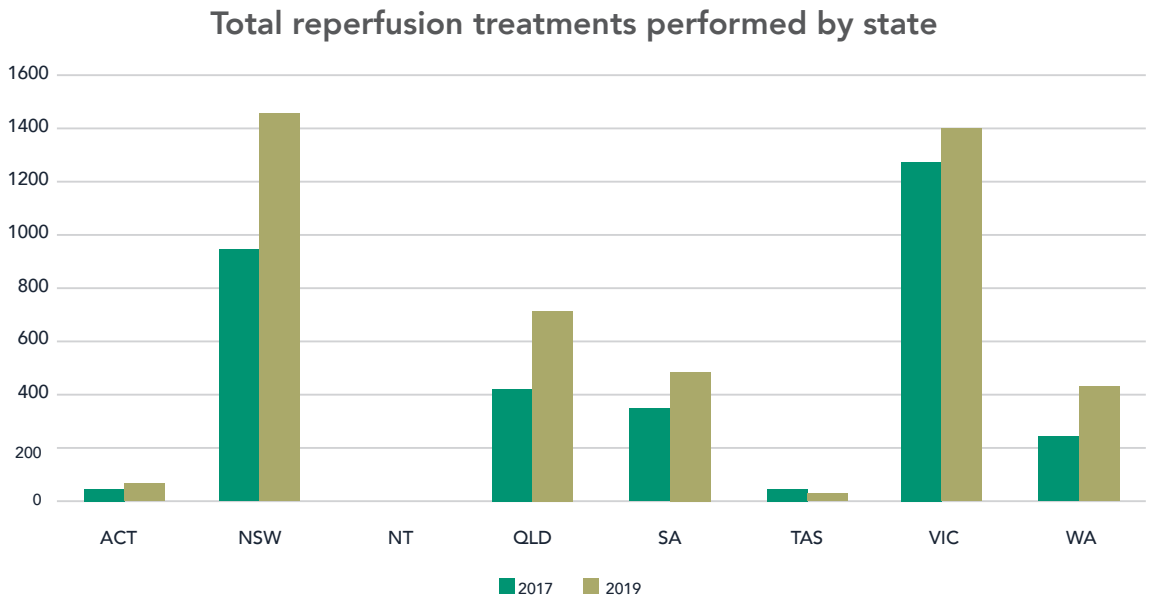
24/7: 24 hours a day, 7 days a week
*Canberra Health Service Endovascular Clot Retrieval services is currently offered in business hours. Works are progressing to grow the service to a 24/7 model.#Recommended for comprehensive stroke centres only, denominator will vary from state to state so % is not calculated.

Reperfusion treatments intravenous (IV) thrombolysis and/or endovascular stroke therapy) have increased across Australia providing an indicative total of 4,555 in 2019 (~36% increase from 3,331 reported in 2017 from 72 services). The most dramatic increase has been in endovascular clot retrieval interventions, which have increased by 119% in Australia (1,907 in 2019 and 872 in 2017).

Western Australia and South Australia have the highest rates of endovascular clot retrieval as related to the overall state population (11 and 12 endovascular stroke therapy procedures per 100,000 population, respectively), and VIC (8 per 100,000) and NSW (7 per 100,000) were consistent with the national average (8 per 100,000).

The total of all reperfusion treatments performed by each state in shown in Figure 3.

Figure 3. Indicative number of annual reperfusion treatments by state



NB. Some patients have received both thrombolysis and endovascular clot retrieval treatments.

Telehealth and regional responsibility

Services may also have links to regional or 'spoke' services (in a hub and spoke referral system) to support acute clinical care and provide education to non-specialist staff.

Telehealth for acute stroke usually takes the form of video-teleconferencing, via telephone or internet to support acute stroke intervention. However, consults with a telephone call and diagnosis through remote imaging are also included as telemedicine.

Table 17. Access to telehealth and regional responsibility, by patient volume and region

	Australia (N=120)	Reported annual stroke admissions					Region		
		<75 (N=25)	75–199 (N=32)	200–349 (N=28)	350–499 (N=11)	500+ (N=24)	Outer Regional (N=15)	Inner Regional (N=40)	Major Cities (N=65)
Element of service: telehealth and regional responsibility									
Use of telehealth services for acute assessment and treatment	86 (72%)	19 (76%)	21 (66%)	19 (68%)	6 (55%)	21 (88%)	15 (100%)	32 (80%)	39 (60%)
If yes, is this usually used to provide support to another service (% is of those that do use telehealth)	34 (40%)	1 (5%)	0	8 (42%)	6 (100%)	19 (90%)	4 (27%)	3 (9%)	27 (69%)
Regional responsibility (e.g. coordination across a local health district)	65 (54%)	4 (16%)	15 (47%)	16 (57%)	7 (64%)	23 (96%)	9 (60%)	22 (55%)	34 (52%)

There were 65 services (54%) reporting they had regional responsibility for specialist stroke care and offering support to smaller services (Table 17). However, medical leads and SCCs were absent in four of those services. A further eight services reporting regional responsibility also reported not having a stroke unit.

Stroke unit care

Organisation of acute stroke services with dedicated personnel and processes is fundamental to maximising patient outcomes.

The Framework recommends that all patients with suspected stroke should be transported to a hospital with a stroke unit. Stroke units are not recommended for small services, where stroke numbers are insufficient to justify dedicated resources. Instead, these smaller hospital services should have appropriate systems in place to rapidly screen and then transfer patients with stroke to the nearest dedicated stroke service.

A stroke unit differs from other wards. Stroke units that have been shown to deliver highly effective stroke care share several characteristics,[4] including:

- Location in a geographically discrete unit
- Comprehensive assessments
- A coordinated multidisciplinary team
- Early mobilisation and avoidance of bedrest
- Staff with a special interest in the management of stroke, and access to ongoing professional education and training
- Clear communication, with regular team meetings to discuss management (including discharge planning) and other meetings as needed (e.g. family conferences)
- Active encouragement of stroke survivors and their carers/families to be involved in the rehabilitation process.[4]

Ninety-one services (82%) reported having co-located beds within a geographically defined stroke unit. These 91 services admitted a total of 32,492 patients with acute stroke in the past year (92% of all patients). However, only 24,735 (70%) patients in these services were admitted to their stroke unit.

All services admitting ≥75 strokes annually are required to have a dedicated stroke unit. However, nine services admitting 75–199 patients in the last year, two services admitting 200–349 patients with stroke in the last year, and one service that admitted 438 stroke patients in the last year, reported NOT having a stroke unit.

Clinicians completing the Organisational Survey provided evidence of 769 dedicated acute stroke unit beds in the 120 participating services. There was a median of 6 beds per stroke unit (Q1:4; Q3: 11), an increase from a median of 5 in the 2017 audit based on 127 services.

Stroke unit capacity at a single point in time was established by analysing the number of patients with stroke in a service on the day the Organisational Survey was completed, compared with the number of dedicated stroke unit beds in all services and in stroke unit services (Table 11). There was variability in the availability of dedicated stroke unit beds to manage patients with stroke.

On the day of completion of the Organisational Survey, 678 patients with acute stroke were present in these services. Among these patients, 463 patients (68%) were being cared for in a dedicated acute stroke unit. However, 162 patients (26%) in these services were not in a stroke unit bed, despite the availability of 306 stroke unit beds (i.e. Beds were occupied by non-stroke patients). This suggests that bed management systems should be reviewed so that hospitals can prioritise moving patients into stroke unit beds.

Routine admission directly to a stroke unit from the ED was reported in only 76 services (63%), with general medical ward (21%), neurology ward (4%), medical assessment unit (3%) and other geriatric wards (1%) being the next most commonly reported wards for direct admission.

Table 11. Stroke unit size and capacity, by location and patient volume

	On day Organisational Survey was completed					
	Total hospitals N	Patients with acute stroke in all hospitals	Dedicated stroke unit beds per hospital – median (Q1, Q3)	Hospitals with a stroke unit N	Patients with acute stroke in hospitals with stroke unit	Patients in stroke unit bed on day of audit
Australia	120	678	6 (4, 11)	91	625	463
Location						
ACT	2	16	Min 4, Max 4	2	16	7
NSW	43	244	4 (4, 8)	35	226	141
NT	1	6	4	1	6	3
QLD	24	124	6 (4, 7)	21	120	102
SA	7	53	18 (11, 26)	4	49	46
TAS	3	23	10 (8, 11)	2	19	15
VIC	29	143	7 (4, 18)	20	130	105
WA	11	69	12 (6, 12)	6	59	44
Reported annual stroke admissions						
<75	25	29	4 (4, 5)	8	11	10
75-199	32	100	4 (4, 5)	23	80	61
200-349	28	144	5 (4, 7)	26	138	101
350-499	11	92	10 (8, 16)	10	83	60
500+	24	313	12 (8, 16)	0	313	231

Q1: 1st quartile; Q3: 3rd quartile; Min: minimum; Max: maximum

Acute stroke team

The Framework specifies that the minimum criterion for acute stroke care is a "dedicated, interprofessional team with members who have a special interest in stroke and/or rehabilitation". The minimum team would consist of medical, nursing and allied health, including occupational therapy, physiotherapy, speech pathology, social work and dietetics. A stroke care coordinator is essential in all primary and comprehensive services to facilitate coordinated care.

Eighty-nine services (74%) reported that a consultant physician with specialist knowledge of stroke was formally recognised as having principal responsibility for stroke management at their service (Table 12). However, of the 91 services with a stroke unit, nine (10%) services reported not having a dedicated stroke medical lead. In this latter situation, six services reported a Stroke Care Coordinator and one services had a Clinical Nurse Consultant while two services reported no specialist medical or nursing staff.

Table 12. Acute stroke team, by location and stroke volume

	Stroke specialist medical lead	Stroke care coordinator	Multidisciplinary stroke team
Australia (N=120)	89 (74%)	80 (67%)	110 (92%)
ACT (N=2)	2 (100%)	2 (100%)	2 (100%)
NSW (N=43)	32 (74%)	29 (67%)	39 (91%)
NT (N=1)	1 (100%)	1 (100%)	1 (100%)
QLD (N=24)	19 (79%)	16 (67%)	24 (100%)
SA (N=7)	4 (57%)	3 (43%)	6 (86%)
TAS (N=3)	1 (33%)	0	3 (100%)
VIC (N=29)	22 (76%)	22 (76%)	26 (90%)
WA (N=11)	8 (73%)	7 (64%)	9 (82%)
Reported annual stroke admissions			
<75	11 (44%)	10 (40%)	17 (68%)
75–199	22 (69%)	23 (72%)	31 (97%)
200–349	22 (79%)	20 (71%)	27 (96%)
350–499	10 (91%)	8 (73%)	11 (100%)
500+	24 (100%)	19 (79%)	24 (100%)

All services with large annual stroke admissions (350+ per annum) reported having a neurologist actively involved in stroke management. However, only 20% of services with <75 stroke admissions per annum reported neurologist involvement. Specialist neurologists were less prominent outside major city locations (actively involved with stroke management at 40% of outer regional services and 28% of inner regional services, compared with 83% in services in major cities). Neurology input varied by state and territory (33–100%) with a 'Stroke neurology team' reported to be the team who usually manages patients with acute stroke in less than 50% of all services with a stroke unit (45 out of 91).

Stroke care coordinators (SCCs) were reported to be working at 80 services (67%), (Table 12). In the 91 services with a stroke unit, 69 (76%) reported an SCC on staff. In 29 services without a stroke unit, where coordinated care may be even more important, this role was reported in 11 services (38%). Most SCCs were based in major cities (72%), with lower representation in regional areas (inner regional 65%; outer regional 47%).

Nineteen of the 24 services (79%) with 500+ stroke admissions per annum reported that an SCC was actively involved with stroke management. However, only 40% of services with <75 stroke admissions per annum had an SCC on staff. Of the 40 services without an SCC, 26 (65%) reported having a specialist nurse role. Table 13 shows the involvement of specialist nurses in the management of stroke across Australia. Further work is needed to understand the different roles related to ensuring coordinated and specialised stroke care.

Table 13. Specialist nurses actively involved in the management of stroke, by location

	Australia (N=120)	ACT (N=2)	NSW (N=43)	NT (N=1)	QLD (N=24)	SA (N=7)	TAS (N=3)	VIC (N=29)	WA (N=11)
Clinical nurse consultant (CNC)	45 (38%)	2 (100%)	15 (35%)	0	11 (46%)	4 (57%)	2 (67%)	9 (31%)	2 (18%)
Clinical nurse specialist (CNS)	51 (43%)	1 (50%)	22 (51%)	1 (100%)	2 (8%)	1 (14%)	0	17 (59%)	7 (64%)
Nurse practitioner	13 (11%)	0	3 (7%)	0	4 (17%)	0	0	5 (17%)	1 (9%)

Clinical psychologists (28%) and neuropsychologists (30%) were actively involved in the management of patients with stroke (Table 14) at fewer than one third of services. Most of the psychology professionals were based in major cities (40% clinical psychologists, 46% neuropsychologists), with a lower representation in regional areas (inner regional 10% clinical psychologists and neuropsychologists; outer regional 20% clinical psychologists, 13% neuropsychologists).

Table 14. Allied Health professionals actively involved in the management of stroke, by location

	Australia (N=120)	ACT (N=2)	NSW (N=43)	NT (N=1)	QLD (N=24)	SA (N=7)	TAS (N=3)	VIC (N=29)	WA (N=11)
Clinical psychologist	33 (28%)	1 (50%)	9 (21%)	0	9 (38%)	3 (43%)	0	8 (28%)	3 (27%)
Neuropsychologist	36 (30%)	1 (50%)	14 (33%)	0	7 (29%)	1 (14%)	1 (33%)	10 (34%)	2 (18%)
Dietitian	119 (99%)	2 (100%)	42 (98%)	1 (100%)	24 (100%)	7 (100%)	3 (100%)	29 (100%)	11 (100%)
Occupational therapist	119 (99%)	2 (100%)	43 (100%)	1 (100%)	24 (100%)	6 (86%)	3 (100%)	29 (100%)	11 (100%)
Physiotherapist	119 (99%)	2 (100%)	43 (100%)	1 (100%)	24 (100%)	6 (86%)	3 (100%)	29 (100%)	11 (100%)
Social worker	119 (99%)	2 (100%)	43 (100%)	1 (100%)	23 (96%)	7 (100%)	3 (100%)	29 (100%)	11 (100%)
Speech pathologist	120 (100%)	2 (100%)	43 (100%)	1 (100%)	24 (100%)	7 (100%)	3 (100%)	29 (100%)	11 (100%)

Team communication and protocols

Regular communication among the interdisciplinary team is vital to address key issues that may arise during a patient's hospital admission in a timely manner. Case conferences and team meetings facilitate communication, coordination of care and discharge care planning. The Framework specifies that the "interprofessional team meet at least once per week to discuss patient care".

Regular team meetings (case conferences) occurred at 114 services (95%). Of these, the median frequency of meetings was 4 per month, or 1 per week.

A total of 102 services (85%) reported having a clinical care pathway in place for managing stroke. Protocols for referral to physiotherapy, speech pathology, occupational therapy and dietetics were reported at 98% of services, with social work referral protocols at 94% of services, and psychology referral protocols at only 41% of services.

Routine use of guidelines, care plans and protocols were in use more at services with stroke units (67%) than services without a stroke unit (31%).

Services in major cities (86%) and with a stroke unit (78%) reported increased access and collaboration with other specialist services (cardiology, palliative care, and vascular specialties) than inner and outer regional services (40% and 67% respectively) and services without a stroke unit (38%).

Rehabilitation

Acute services must coordinate with rehabilitation services to facilitate seamless transfer of care for people with stroke. Rehabilitation is a holistic process that should begin the first day after stroke, with the aim of maximising the participation of the person with stroke in the community.[4] Adherence to recommended rehabilitation practices is shown in Table 15.

Table 15. Adherence to recommended rehabilitation practices, by stroke volume

	Australia (N=120)	Reported annual stroke admissions				
		<75 (N=25)	75–199 (N=32)	200–349 (N=28)	350–499 (N=11)	500+ (N=24)
Element of service: rehabilitation						
Coordination with rehabilitation service providers	112 (93%)	24 (96%)	30 (94%)	26 (93%)	9 (82%)	23 (96%)
Standardised processes that ensure ALL stroke patients are assessed for rehabilitation	99 (83%)	20 (80%)	27 (84%)	22 (79%)	8 (73%)	22 (92%)
Routine involvement of patients and carers in the rehabilitation process	120 (100%)	25 (100%)	32 (100%)	28 (100%)	11 (100%)	24 (100%)

Eighty-nine services (74%) reported having a rehabilitation physician actively involved in patient management. More services in major cities reported involvement of a rehabilitation physician (85%) compared with inner (63%) and outer (60%) regional services, as did services with a stroke unit (85%) compared with services without a stroke unit (41%).

Regarding assessing suitability for rehabilitation, most services (96%) reported that the acute interdisciplinary team were responsible for making the referral to rehabilitation, followed by the acute physician (82%) and then a joint decision from both the acute and rehabilitation team members (75%). Overall, 99 services (83%) reported a standardised process regarding assessing suitability for further rehabilitation at their service.

One hundred and eleven services (93%) reported having access to ongoing inpatient rehabilitation, 107 services (89%) reported having access to outpatient rehabilitation, and 101 services (84%) reported the ability to access community-based rehabilitation provided in the home. Very few services reported access to day hospital rehabilitation (32%) or stroke specialist Early Supported Discharge (13%).

Access to other specialist services

Access and collaboration with specialist services (cardiology, palliative and vascular surgery) were routinely reported in major cities and in services with higher stroke volume (100%). Among those services admitting <75 strokes per year, only 28% had access to specialist services (47% for inner and outer regional services combined). Neurosurgical services were also more common in higher volume services (69% if admitting >350 annual stroke admissions, versus 11% if <350 annual stroke admissions).

Quality improvement activities

Embedding a culture of evidence-based practice can be facilitated by targeted education and collaborative involvement in data collection and quality improvement. Access to regular stroke-specific education is a core component of effective and efficient stroke care. The Framework specifies that there be access to "regular programs of staff education and training relating to stroke (e.g. dedicated stroke in-service program and/or access to annual national or regional stroke conferences)".

A total of 105 services (88%) reported having access to a program of continuing education for stroke management staff (93% in the 2017 audit). There was variability across the states and territories, ranging from 67% to 100%. Staff in major cities and larger services were more likely to have opportunities for professional development (95% in major cities versus 80% in inner regional and 73% in outer regional services; 97% in 350+ stroke admission services versus 60% for <75 stroke admissions).

Services for patients with transient ischaemic attack (TIA)

Hospitals should also have systems for rapid assessment and management of people with suspected TIA to prevent stroke. Diagnostic work-up and implementation of optimal therapy for patients with suspected TIA should be completed within 24 hours.[4]

It is highly recommended that all services develop a local TIA pathway involving primary care, ED, and stroke specialist teams to ensure patients are managed as rapidly and comprehensively as possible, matching locally available resources.[4]

Table 16. Adherence to recommended TIA services, by stroke volume

	Australia (N=120)	Reported annual stroke admissions				
		<75 (N=25)	75–199 (N=32)	200–349 (N=28)	350–499 (N=11)	500+ (N=24)
Element of service: TIA services						
Rapid (within 48 hours) TIA assessment clinics/services	56 (47%)	9 (36%)	15 (47%)	12 (43%)	7 (64%)	13 (54%)
Does your hospital have a defined and documented process, policy or clinical pathway for assessing TIA patients?	102 (85%)	19 (76%)	25 (78%)	26 (93%)	10 (91%)	22 (92%)

TIA: transient ischaemic attack

One hundred and two services (85%) reported having a defined and documented process, policy or clinical pathway for assessing TIA patients (Table 16). Forty services (33%) reported admitting all TIA patients, while 80 services (67%) reported admitting only select TIA patients. Of these, 29 services (36%) reported having a rapid access TIA clinic for TIA patients not admitted.

However, while the recommendation is for assessment within 48 hours, the median waiting time for an appointment at a TIA clinic is 3 days (Q1:2 days, Q3:10 days).

Access to rapid assessment clinics or management services for patients with TIA is highest in services with 350–499 reported annual stroke admissions (64%). Fewer very large services (500+ stroke admissions annually) provided this rapid access (54%).

The following chapter provides the results of the clinical audit of medical records to put into context the self-reported data provided in this chapter related to organisational resources available to manage stroke.

Melbourne grandfather Felix was fixing carpet in his bedroom when he suffered his stroke. **Thankfully Felix's wife knew the F.A.S.T. signs of stroke and called triple zero (000) straight away.** The specially fitted Stroke Ambulance arrived with a specialist team who were able to give him a brain scan on board. They determined that a blood clot had caused his stroke and immediately administered a clot-dissolving drug right there in the ambulance outside Felix's home.

Chapter 4: Results of the Clinical Audit and performance against the Acute Stroke Clinical Care Standard Indicators

The *Acute Stroke Clinical Care Standard* (Standard), released in June 2015 by the ACSQHC, outlines nineteen suggested process indicators covering seven quality statements for stroke care. While many are based on existing national performance indicators for stroke, this report provides data for all indicators except assessment by ambulance services.

Key findings 2017 to 2019:

- Positive performance was noted on several Standard indicators, including:
- Transport to appropriate hospitals for access to thrombolysis and stroke unit care (71% in 2017, 76% in 2019).
- Use of a stroke screen in ED (46% in 2017, 52% in 2019).
- Thrombolysis occurring within 60 minutes of hospital arrival (30% in 2017, 32% in 2019).
- Carer training (57% in 2017, 61% in 2019) and carer support needs assessment (62% in 2017, 63% in 2019).
- Education about behaviour change and risk factors (70% in 2017, 72% in 2019).
- Care plan development with the team and patient/family (65% in 2017, 69% in 2019).

Although adherence to multiple Acute Stroke Care Standard indicators has improved since the 2017 audit, other results are very disappointing, including:

- Thrombolysis [without exclusions] (11% in 2017, 10% in 2019).
- Stroke unit care (69% in 2017, 67% in 2019).
- Being discharged on an antihypertensive for patients with intracerebral haemorrhage (80% in 2017, 72% in 2019).

4.1 Characteristics of patients in the Clinical Audit

A total of 4,176 patient case notes were audited. The median age of patients was 75 years, 43% of patients were female, only 3% of patients were identified as being of Aboriginal and/or Torres Strait Islander background, and 6% were not of English-speaking background and required an interpreter (Table 18).

Patients from outer regional services appear to have greater pre-stroke risk factors, which is consistent with other data showing regional Australians are 19% more likely to suffer a stroke.[1]

Table 18. Patient demographics, by region

Patient demographics	Australia (N=4,176)	Major Cities (N=2,498)	Inner Regional (N=1,233)	Outer Regional (N=445)
Age – median (Q1, Q3)	75 (65,83)	75 (65,83)	76 (67,84)	73 (62,82)
Sex – female	1,808 (43%)	1,084 (43%)	537 (44%)	187 (42%)
Patient identifying as Aboriginal and/or Torres Strait Islander background	146 (3%)	52 (2%)	44 (4%)	50 (11%)
Patient requiring interpreter	257 (6%)	217 (9%)	21 (2%)	19 (4%)
Stroke type				
Ischaemic stroke	3,483 (83%)	2,096 (84%)	1,045 (85%)	342 (77%)
Intracerebral haemorrhage	498 (12%)	320 (13%)	127 (10%)	51 (11%)
Undetermined stroke type	195 (5%)	82 (3%)	61 (5%)	52 (12%)
Pre-stroke information				
Independence prior to admission (mRS 0–2)	3,430 (82%)	2,071 (83%)	987 (80%)	372 (84%)
Risk factors prior to admission				
Atrial fibrillation	1,043 (27%)	590 (25%)	341 (29%)	112 (28%)
Previous stroke	933 (23%)	526 (22%)	310 (26%)	97 (25%)
Previous TIA	486 (13%)	262 (11%)	175 (16%)	49 (13%)
Diabetes mellitus	1,127 (29%)	689 (29%)	301 (26%)	137 (35%)
Hypercholesterolaemia	1,626 (42%)	994 (42%)	453 (40%)	179 (46%)
Hypertension	2,750 (68%)	1,664 (68%)	785 (66%)	301 (72%)
Ischaemic heart disease	996 (26%)	568 (24%)	310 (27%)	118 (31%)
High alcohol consumption	394 (12%)	227 (11%)	117 (12%)	50 (17%)
Current smoker	588 (17%)	316 (14%)	178 (18%)	94 (30%)
Past smoker	970 (31%)	585 (29%)	288 (34%)	97 (35%)
Dementia	329 (9%)	209 (9%)	90 (8%)	30 (9%)

Q1: 1st quartile, Q3: 3rd quartile
mRS: modified Rankin Scale, TIA: transient ischaemic attack

Eighty-two per cent of patients had a modified Rankin Scale (mRS) score of 0–2 prior to their stroke, indicating they had no disabilities or minor disabilities (mRS is a commonly used scale for measuring the degree of disability or dependence in the daily activities of people). Most patients lived at home with others (67%) or lived alone (25%).

Table 19 lists the type and rates of impairments that patients with stroke presented with on admission to hospital. More than half of patients had upper limb deficits or speech/ communication impairments, and just under half had issues with their balance. Approximately, a third of patients had sensory deficits, cognitive issues, visual deficits or dysphagia.

Table 19. Impairments on admission

Impairments present on admission:	Australia (N=4,176)
Arm deficit	60%
Speech/communication impairment	56%
Lower limb deficit	50%
Balance	47%
Sensory deficit	35%
Dysphagia	33%
Cognitive deficit	32%
Visual deficit	31%
Continence	26%
Perceptual deficit	19%
Hydration problems	14%
Nutrition problems	14%
Other impairment	13%

4.2 National Performance on the Acute Stroke Clinical Care Standard indicators

The ACSQHC provides a set of suggested indicators to assist with local monitoring of the Standard (https://www.safetyandquality.gov.au/our-work/clinical-care-standards/acute-stroke-clinical-care-standard).[8] Clinicians and healthcare services can use the indicators to identify where improvements are needed.

Definitions of the indicators reported (including numerators and denominators, and exclusion criteria) are available in the supplement for this report at https://informme.org.au/stroke-data.

Seventeen of the 19 national indicators and how they have changed over the last two audit cycles are reported in Figure 4 below. The indicator for assessment by ambulance services is unable to be reported through the National Stroke Audit, and the indicator for time from stroke onset to thrombolysis cannot be reported in graphical form.

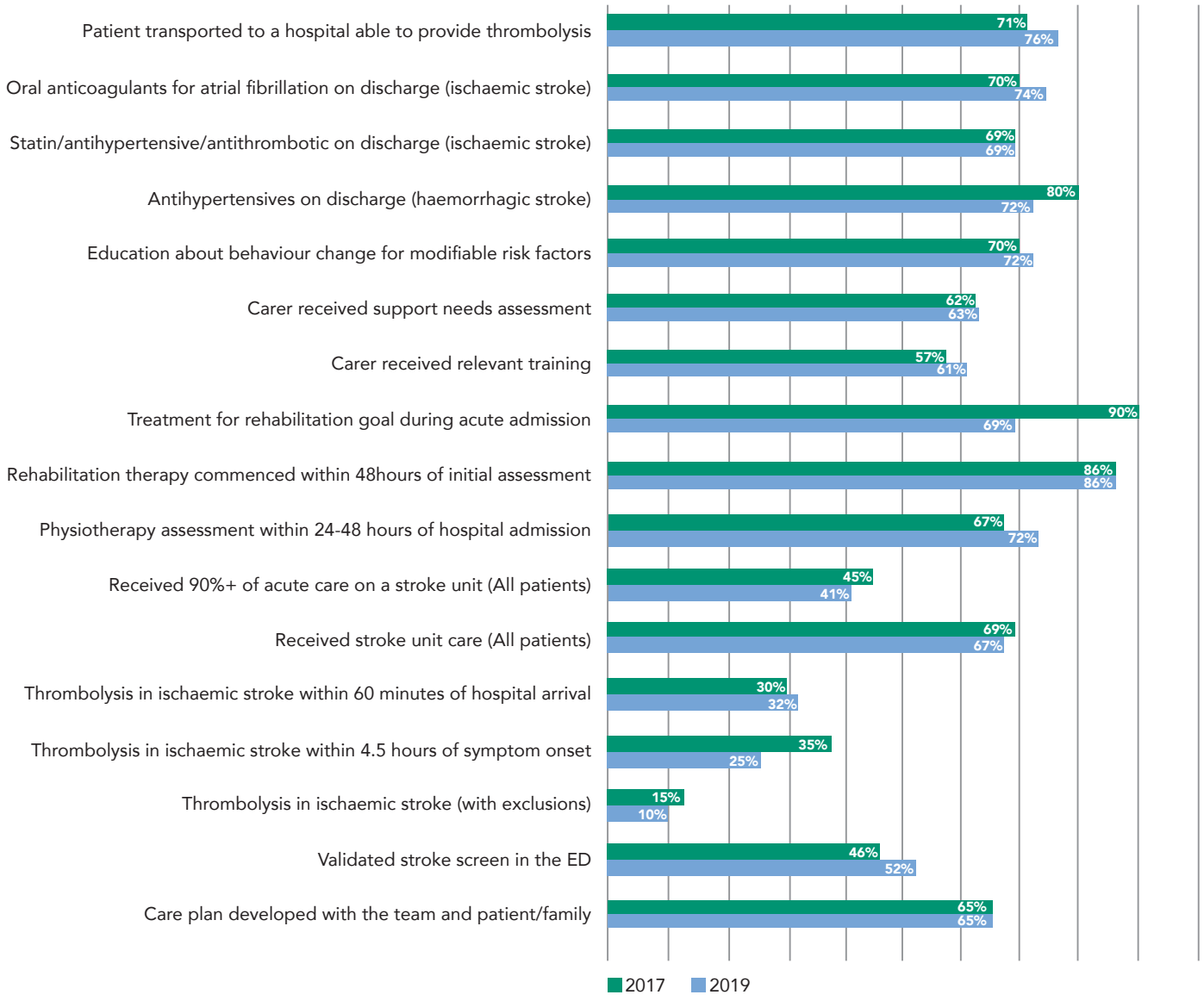


Table 20 details the adherence to select clinical recommendations outlined in the Standard, with results split by hospital location. The national benchmarks are based on a modified version of the Achievable Benchmark of Care (ABC™) methodology[9] (refer to Appendix 1).

Services with very small annual admissions (<75 per year), mostly found to be general hospital services based on the Framework (see supplement), were the lowest performing group for almost all indicators.

High-volume services were found to perform better for assessment in ED, thrombolysis and stroke unit access.

Similarly, CSCs performed the best for hyperacute and stroke unit care. There was less variation between CSCs and PSCs in assessment for rehabilitation, physiotherapy assessment, secondary prevention and preparing carers and patients for discharge (Table 21). Services adhering to higher numbers of elements outlined in the Framework achieved higher performance on the Standard indicators (Table 21).

Table 20. Performance on Acute Stroke Clinical Care Standard Indicators, by location

	Australia	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	National Benchmark %
Patient transported to a hospital able to provide thrombolysis*	76%	91%	71%	67%	81%	92%	51%	84%	52%	94%
Assessment in the emergency department†	52%	35%	62%	3%	37%	70%	20%	55%	38%	90%
Thrombolysis in patients with ischaemic stroke	10%	14%	9%	3%	11%	17%	8%	12%	4%	27%
Thrombolysis in patients with ischaemic stroke who arrive within 4.5 hours of symptom onset	26%	40%	26%	20%	25%	40%	22%	29%	9%	56%
Thrombolysis within 60 minutes of hospital arrival	32%	60%	34%	0%	35%	17%	13%	31%	18%	70%
Median time from onset to thrombolysis (hours:minutes) (Q1, Q3)	2:45 (2:09, 3:32)	2:19 (1:31, 3:50)	2:50 (2:16, 3:32)	3:08	2:42 (2:00, 3:34)	2:15 1:57, 3:27)	3:00 (2:25, 3:52)	2:31 (2:14, 3:11)	2:49 (1:50, 3:21)	-
Admission to a stroke unit	67%	86%	69%	85%	78%	65%	58%	65%	42%	96%
90% of acute hospital care on a stroke unit	41%	36%	37%	40%	43%	43%	31%	51%	30%	75%
Assessment for rehabilitation by physiotherapist within 48 hours of hospital admission‡	73%	79%	72%	57%	77%	65%	77%	74%	68%	87%

Discharged on antihypertensive medication (haemorrhagic stroke)§	72%	100%	67%	100%	77%	100%	75%	71%	57%	77%
Discharge on statin, antihypertensive and antithrombotic medications (ischaemic stroke)§	69%	73%	70%	58%	71%	66%	75%	66%	63%	88%
Risk factor modification advice before leaving the hospital	72%	93%	79%	76%	71%	75%	57%	60%	75%	95%
Carer support needs assessment‡	63%	13%	69%	100%	55%	68%	45%	67%	61%	89%
Written care plan‡	69%	85%	76%	88%	70%	77%	34%	59%	56%	97%

*Excludes in-hospital stroke, arrivals >4.5 hours from stroke onset
†Excludes in-hospital stroke, inter-hospital transfer, unconscious patients
‡Excludes patients declining involvement
§Excludes those where treatment contraindicated, futile, or refused

Table 21. Performance on selected Standard indicators, by Framework adherence and service level

	Framework elements met (% = patient cases)			Service level (% = patient cases)		
	16–20 (54 services)	11–15 (47 services)	0–10 (11 services)	CSC (10 services)	PSC (92 services)	GH (10 services)
Patient transported to a hospital able to provide thrombolysis*	87%	68%	35%	90%	75%	59%
Assessment in the emergency department†	58%	44%	42%	77%	49%	41%
Thrombolysis in patients with ischaemic stroke	13%	8%	3%	16%	9%	5%
Thrombolysis in patients with ischaemic stroke for those who arrive within 4.5 hours of symptom onset	31%	21%	10%	35%	25%	13%
Thrombolysis in ischaemic stroke within 60 mins of hospital arrival	34%	28%	17%	38%	30%	50%
Median time from onset to thrombolysis (hours: minutes)	2:40	2:51	2:52	2:20	2:49	2:49

Received stroke unit care	83%	56%	17%	82%	71%	-
Received 90%+ of acute care on a stroke unit	52%	33%	9%	60%	42%	-
Assessment by a physiotherapist within 24-48 hours of hospital admission‡	76%	72%	58%	72%	74%	56%
Rehabilitation therapy commenced within 48 hours of initial assessment	90%	86%	60%	85%	89%	61%
Treatment for a rehabilitation goal commenced during acute hospital admission	95%	89%	76%	91%	93%	72%
Carer received relevant training‡	58%	64%	52%	50%	62%	58%
Carer received support needs assessment‡	58%	71%	43%	67%	63%	62%
Patient received education about behaviour change for modifiable risk factors	76%	71%	58%	61%	75%	51%
Antihypertensives on discharge (haemorrhagic stroke)§	70%	74%	80%	72%	72%	67%
Discharge on statin, antihypertensive and antithrombotic medications (ischaemic stroke)§	70%	69%	57%	70%	69%	57%
Discharge on oral anticoagulants for atrial fibrillation (ischaemic stroke)§	76%	72%	74%	83%	73%	76%
Care plan developed with the team and the patient (or family alone if patient has severe aphasia or cognitive impairments)‡	75%	66%	41%	74%	71%	34%

*Excludes in-hospital stroke, arrivals >4.5 hours from stroke onset
†Excludes in-hospital stroke, inter-hospital transfer, unconscious patients
‡Excludes patients declining involvement
§Excludes those contraindicated to treatment, futile, or refused

4.3 Adherence to specific aspects of the Acute Stroke Clinical Care Standard indicators

Time-critical therapy

Access to appropriate screening, assessment, imaging, investigation and treatment is essential for positive patient outcomes. This is especially the case for thrombolysis, which reduces overall disability and improves functional outcomes when administered as early as possible after onset of ischaemic stroke, but is limited by a narrow therapeutic time window and important contraindications.[4]

Seventy-four per cent of stroke patients arrived at hospital by ambulance and 17% were transferred from another hospital. The median time from stroke onset to arrival in the ED was 3.6 hours. Twenty-eight per cent of patients arrived at hospital within 3 hours and 35% arrived within 4.5 hours of stroke symptom onset.

Ninety-nine per cent of patients received a brain scan following their stroke, with 91% occurring within hospital. Thirty-eight per cent of scans were performed within one hour of arrival to hospital and 90% were performed within 24 hours of arrival to hospital.

The majority (79%) of the brain scans were CT scans.

Seventy-six per cent of patients were transported by ambulance to a hospital able to provide thrombolysis, however only 52% of all patients who presented to hospital were screened for thrombolysis eligibility. Consequently, only 10% of all patients with ischaemic stroke received thrombolysis.

Of those patients who arrived within 4.5 hours of stroke onset, 26% received thrombolysis and, of all ischaemic patients who received thrombolysis 32% commenced the procedure within 60 minutes of hospital arrival. The national median time from onset of stroke symptoms to thrombolysis was 2 hours and 45 minutes (Q1: 2:09; Q3: 3:32), which is longer than the 2017 audit (2 hours and 36 minutes).

Median time from arrival at hospital to brain scan (door to scan) for those thrombolysed was 21 minutes (Q1:13, Q3:42 minutes), and median time from arrival at hospital to receiving thrombolysis (door to needle) was 75 minutes (Q1:50, Q3:100 minutes).

There appears to be higher performance related to time-critical therapy in services with a higher number of Framework elements met (especially CSCs) and in those services with higher annual stroke volumes. Not surprisingly, access to appropriate stroke therapies and the provision of thrombolysis treatment was higher in major cities than regional areas (Table 22).

Table 22. Early access and thrombolysis indicators, by region

	Australia (N=4,176)	Major Cities (N=2,498)	Inner Regional (N=1,233)	Outer Regional (N=445)
Patient transported to a hospital able to provide thrombolysis*	76%	78%	74%	69%
Validated stroke screen in the emergency department	52%	58%	49%	21%
Thrombolysis in ischaemic stroke	10%	11%	9%	10%
Thrombolysis in ischaemic stroke for those who arrive within 4.5 hours of symptom onset	26%	28%	22%	26%
Thrombolysis in ischaemic stroke within 60 mins of hospital arrival	32%	37%	22%	22%
Median time from onset to thrombolysis (hours:minutes)	2:45	2:39	3:00	2:52

*Excludes in-hospital stroke, arrivals >4.5 hours from stroke onset

Stroke unit care

The organisation of hospital services to provide stroke unit care is the single most important recommendation for improving stroke management.[4] The benefit of patient access to a stroke unit is shown in the analysis below (Table 23), which supports the configuration of services to ensure patients with stroke receive interdisciplinary care on a stroke unit.

Fifty-three per cent of patients were admitted directly to a stroke unit on arrival at hospital, with 23% of patients admitted to a medical ward on admission, and 7% of patients admitted directly to the ICU. The median time from hospital arrival to admission to a stroke unit was 7.6 hours.

Of all patients, only 67% received care during their acute admission on a stroke unit, and only 41% spent at least 90% of their acute hospital stay on a stroke unit. Access to stroke unit care varied considerably across location.

Table 23. Stroke Unit care, by region

	Australia (N=4,176)	Major Cities (N=2,498)	Inner Regional (N=1,233)	Outer Regional (N=445)
Received stroke unit care (all patients)	67%	79%	55%	35%
Received 90% of acute care on a stroke unit (all patients)	41%	47%	35%	20%

All acute stroke services should implement standardised protocols to manage fever, glucose and swallowing difficulties in patients with stroke.[18]

Table 24. Fever, glucose and swallow process, by stroke unit access

	Australia (N=4,176)	Treated on a stroke unit (N=2,802)	Not treated on a stroke unit (N=1,374)
Fever			
Patient developed fever ≥ 37.5°C within first 72 hours	12%	12%	12%
Paracetamol for the first elevated temperature administered within 1 hour*	48%	47%	50%
Glucose			
Hyperglycaemia (first 48 hours of admission)	21%	21%	20%
Insulin administered within 1 hour of the first elevated finger-prick glucose (>=10 mmol/L)	30%	30%	31%
Swallow			
Formal swallow screen performed	58%	65%	44%
Swallow screen within 24 hours	51%	57%	37%
Swallow screen within 4 hours of admission	20%	23%	14%
Swallow assessment by speech pathologist	75%	80%	63%
Swallow screen or assessment performed	85%	93%	71%
Swallow screen or assessment performed before given oral intake (medications, food or fluids)	55%	62%	40%

*Excludes those already receiving regular paracetamol or where contraindicated

Early management of fever and raised glucose occurred in less than 50% of patients, and there was no difference between hospitals with or without a stroke unit. More patients treated on a stroke unit received swallow screening or assessment (through the use of a formal swallow screen or assessment by a speech pathologist) and more patients on a stroke unit were screened within 4 or 24 hours of admission and either screened or assessed before being given oral intake, which included medication, food or fluids, than patients not treated on a stroke unit (Table 24). Swallow screen within four hours of admission occurred in only one in five patients.

Compared with patients who did not receive stroke unit care, a higher proportion of patients treated on a stroke unit:

- received malnutrition screening (77% if treated on a stroke unit vs 54% if not treated on a stroke unit)
- were given an incontinence management plan (38% if treated on a stroke unit vs 34% if not treated on a stroke unit)
- had their mood assessed (30% if treated on a stroke unit vs 20% if not treated on a stroke unit).

Early interdisciplinary assessment and intervention

A patient's rehabilitation needs and goals are to be assessed by staff trained in rehabilitation within 24 to 48 hours of admission, with rehabilitation started as soon as possible.[4] It is important that a formal assessment for rehabilitation is performed for all patients after stroke, as those patients with mild stroke often have impairments that can be overlooked unless specific assessments are conducted. Similarly, the rehabilitation needs of patients with severe stroke are inconsistently documented and these patients are not routinely referred to rehabilitation services for ongoing rehabilitation.[4]

One component of stroke unit care and rehabilitation is early mobilisation. "Mobilisation" is defined as out-of-bed activities, and can include sitting out of bed, standing and walking.19 Patients treated on a stroke unit were more likely to be mobilised during admission and more likely to be mobilised if they were unable to walk independently on admission than those patients not treated on a stroke unit (Table 25). However, those patients not treated on a stroke unit were mobilised sooner (on the same day, the day after, or within 2 days of arrival at hospital) regardless of level of independence with mobility.

Table 25. Mobilisation, by stroke unit access

Mobilisation	Australia (N=4,176)	Treated on a Stroke Unit (N=2,802)	Not treated on a Stroke Unit (N=1,374)
Mobilisation during admission	87%	93%	76%
Mobilisation during admission if unable to walk independently on admission	80%	89%	62%
Mobilisation on same day or day after arrival to ED	79%	78%	82%
Mobilisation on same day or day after arrival to ED if unable to walk independently on admission	70%	69%	72%
Mobilisation within 2 days of arrival to ED	91%	91%	92%
Mobilisation within 2 days of arrival to ED if unable to walk independently on admission	86%	86%	86%

ED: emergency department

One-third (32%) of patients had urinary incontinence documented. Of these, only 37% were found to have a documented incontinence management plan (an increase from 18% in 2017). This may be in part due to an increase in patients with urinary retention (41% of those who were incontinent, and up from 32% in 2017). However, an indwelling catheter was reported in almost half (46%) of cases which is an increase from 17% in 2017.

A documented management plan 'Goal setting' helps direct rehabilitation efforts throughout the various stages of recovery, and a 'patient' or 'person-centred' approach is required to establish rehabilitation goals that are relevant to an individual's needs.10 Table 26 details the reported communication between treating teams and patients and families, including goal setting.

Table 26. In-hospital communication, by region and stroke unit access

	Australia (N=4,176)	Major Cities (N=2,498)	Inner Regional (N=1,233)	Outer Regional (N=445)	Treated on a Stroke Unit (N=2,802)	Not treated on a Stroke Unit (N=1,374)
Team met with patient to discuss management	88%	91%	82%	91%	91%	82%
Goals set with input from team and patient	85%	89%	78%	78%	91%	70%
Patient and/or family received information covering stroke, hospital management, secondary prevention and recovery	58%	60%	61%	44%	66%	43%

Although most patients with stroke were assessed by a physiotherapist, occupational therapist or speech pathologist during their hospital admission, fewer patients were assessed by a dietitian or a social worker, and very few patients were assessed by a psychologist.

Patients in inner and outer regional areas had minimal access to psychology services, and patients not treated on a stroke unit had less access to all allied health therapies especially dietetics, social work and psychology services (Table 27).

Table 27. Interdisciplinary assessment, by region and stroke unit access

	Australia (N=4,176)	Major Cities (N=2,498)	Inner Regional (N=1,233)	Outer Regional (N=445)	Treated on a stroke unit (N=2,802)	Not treated on a stroke unit (N=1,374)
Physiotherapy						
Assessed*	94%	96%	93%	87%	98%	86%
Assessed within 48 hours	73%	72%	75%	71%	77%	65%
Occupational Therapy						
Assessed†	90%	91%	90%	84%	95%	77%
Assessed within 48 hours	57%	54%	61%	57%	61%	47%
Speech Pathology						
Assessed†	89%	90%	89%	87%	94%	78%
Assessed within 48 hours	70%	70%	71%	70%	75%	59%
Dietetics						
Assessed†‡	70%	70%	71%	70%	78%	52%
Median time to assessment	2 days	2 days	2 days	1 day	2 days	2 days
Social Work						
Assessed	63%	67%	59%	53%	69%	49%
Median time to assessment	2 days	3 days	2 days	2 days	2 days	2 days
Psychology						
Assessed§†	16%	23%	3%	12%	20%	7%
Median time to assessment	7 days	7 days	7 days	11 days	7 days	8 days

*Excludes where patient declined
†Excludes where not required
‡If nutrition or hydration problems on admission or if failed swallow screen
§If mood impairment identified on admission

Early rehabilitation

Patients not treated on a stroke unit were less likely to commence rehabilitation within 48 hours of initial assessment, receive treatment based on identified rehabilitation goals, or have an assessment for rehabilitation (Table 28).

Assessment for rehabilitation was primarily undertaken by the multidisciplinary team (69%).

In 9% of cases the rehabilitation specialist conducted the assessment for rehabilitation, and the rehabilitation registrar in 7% of cases. Just over half of all patients received an assessment for rehabilitation, even though nearly three-quarters of those who had an assessment for rehabilitation had an identified need for ongoing rehabilitation.

Table 28. Rehabilitation standards, by region and stroke unit access

	Australia (N=4,176)	Major Cities (N=2,498)	Inner Regional (N=1,233)	Outer Regional (N=445)	Treated on a stroke unit (N=2,802)	Not treated on a stroke unit (N=1,374)
Rehabilitation therapy commenced within 48 hours of initial assessment*	86%	88%	89%	73%	92%	71%
Treatment based on patient's identified rehabilitation goals undertaken during acute admission*	92%	93%	90%	86%	96%	80%
Assessment for rehabilitation performed	61%	65%	60%	44%	69%	45%
Use of the Assessment of Rehabilitation Tool†	22%	25%	16%	14%	23%	18%
Assessment identified need for ongoing rehab‡	72%	73%	69%	72%	72%	69%
Referral made for ongoing rehabilitation^	93%	92%	94%	96%	93%	91%
Referral made for ongoing rehabilitation§	45%	46%	45%	36%	50%	33%

*Excludes if patient declined, had returned to pre-morbid level, was unresponsive, or treatment was futile
†Of those who had assessment
‡If assessment performed, excludes unknown responses
^If need identified
§Includes all patients

Minimising risk of another stroke

At the point of discharge from the service, 25–30% of patients miss out on advice or medication to reduce the risk of subsequent stroke. This is irrespective of location or presence of a stroke unit (Table 29).

Table 29. Secondary prevention indicators, by region and stroke unit access*

	Australia (N=4,176)	Major Cities (N=2,498)	Inner Regional (N=1,233)	Outer Regional (N=445)	Treated on a stroke unit (N=2,802)	Not treated on a stroke unit (N=1,374)
Patient education about behaviour change for modifiable risk factors†	72%	75%	69%	66%	77%	62%
Discharged on antihypertensives (haemorrhagic stroke)‡	72%	72%	77%	63%	70%	75%
Discharged on statin, antihypertensive and antithrombotic medications (ischaemic stroke)‡	69%	68%	71%	66%	70%	65%
On oral anticoagulants for atrial fibrillation (ischaemic stroke)‡	74%	79%	66%	70%	77%	67%

*Only includes patients discharged from hospital
†Excludes patients who refused, patients with severe cognitive impairment or severe communication impairment, or where treatment was futile
‡Excludes patients where treatment was contraindicated, futile, or refused

Transition from hospital care

Effective discharge planning facilitates the transfer of the stroke survivor to the community by maximising independence, minimising social isolation and ensuring that the needs of the patient and carer are addressed.

Thirty per cent of patients were reported to have a carer. However, only 61% of carers received relevant training, and only 63% of carers received a support needs assessment

Almost one-third (31%) of patients did not have a care plan developed, and 38% of patients did not receive contact details of someone in the hospital for post-discharge questions (Table 30).

Of those patients not treated on a stroke unit, only about half received a care plan (56%) or contact details of someone in the hospital for post-discharge questions (51%).

Table 30. Discharge planning processes, by region and stroke unit access

	Australia (N=4,176)	Major Cities (N=2,498)	Inner Regional (N=1,233)	Outer Regional (N=445)	Treated on a stroke unit (N=2,802)	Not treated on a stroke unit (N=1,374)
Care plan developed with the team and the patient (or family)*	69%	74%	59%	63%	75%	56%
Patient involvement in care plan†	91%	92%	85%	95%	93%	86%
Family involvement in care plan†	64%	66%	57%	66%	64%	63%
Copy of discharge summary sent to the general practitioner and/or community providers‡	95%	96%	95%	92%	96%	93%
Patient or family received contact details provided of someone in hospital for post-discharge questions‡	62%	66%	57%	53%	67%	51%

*Excludes death, if transferred to inpatient rehabilitation, acute care or refused plan, or where not applicable
†If had care plan
‡Excludes deaths

New South Wales South Coast resident Lyn Larkins was 52 when she suffered a stroke. Before her stroke, Lyn had been neglecting her health for many years. Her cholesterol was high. She had out of control diabetes and was very overweight – a size 20. After the stroke she turned her health around. Changing the food she ate and educating herself about what was in the food was a big part of her recovery.

"I always thought the way I was before was the norm. Now that I eat well, exercise and feel wonderful, I think I should have made all of these changes years ago."

Lyn Larkins, stroke survivor.

Chapter 5: Changes over time

Changes in key performance indicators over time provide a useful comparator to assess improvements or otherwise in clinical practice.

The following table details selected indicators for 2015, 2017 and 2019. Care must be taken in directly comparing the results for some indicators as question wording and response options have changed.

A small increase in adherence has been seen for certain indicators such as discharged on lipid-lowering medication, behaviour change education for modifiable risk factors, occupational therapy and speech pathology in 48 hours. Other indicators such as physiotherapy within 48 hours, mood assessment, use of continence management plans, provision of a care plan and carer training have improved slightly more.

There are several indicators that have declined since 2017, such as access to stroke unit care, swallow screen or assessment, thrombolysis, and aspirin within 48 hours.

Table 31. Comparison of adherence to select indicators of care since 2015 (*Clinical Audit data only*)

Recommended care	2015	2017	2019
Received stroke unit care	67%	69%	67%
Swallow screen or swallow assessment performed before given oral intake (medications, food and fluids)	48%	57%	55%
Brain imaging within 24 hours*	90%	90%	90%
Thrombolysis in ischaemic stroke	7%	11%	10%
Received intravenous thrombolysis (all ischaemic stroke arrived within 4.5 hours)	18%	27%	26%
Aspirin within 48 hours if ischaemic stroke*	71%	71%	70%
Assessed by physiotherapy within 48 hours	68%	67%	73%
Assessed by occupational therapy within 48 hours*	55%	54%	57%
Assessed by speech pathologist within 48 hours*	68%	69%	70%
Mood assessed during admission	22%	22%	27%
Incontinent patients with continence management plan	35%	33%	37%
Discharged on antihypertensives (all stroke)	76%	77%	77%
Discharged on antithrombotics (ischaemic stroke)	97%	98%	98%
Discharged on lipid-lowering medication (ischaemic stroke)	83%	86%	88%
Received education about behaviour change for modifiable risk factors	65%	70%	72%
Care plan developed with the team and the patient (or family)	56%	65%	69%
Carer received relevant training	48%	57%	61%

*Comparisons with previous years:
Some 2015 time-related data has changed from the 2017 report.

Chapter 6: Discussion and recommendations

The National Stroke Audit – Acute Services Report 2019 provides a robust snapshot of current inpatient acute services for stroke in Australia. Importantly, the results are presented according to the Clinical Guidelines for Stroke Management 2017 and the Australian Commission on Safety and Quality in Healthcare's (ACSQHC) Acute Stroke Clinical Care Standards, and progress since the last National Stroke Audit can be described.

We hope that the information provided in this report helps to guide areas for quality improvement activity and to improve patient outcomes. Services are encouraged to assess their stroke services' performance by comparing themselves to the national, state and annual admission-specific averages presented.

Delivering optimal stroke services equitably across Australia remains a challenge, with variable access to best practice stroke services.

In the Organisational Survey there was an increase in the number of elements met from the Acute Stroke Services Framework 2019, with the largest proportion of services meeting 16 of the 20 elements (average of 15). Large services provide care to most people with acute stroke, so it is of concern that only 9 hospitals among the 24 hospitals admitting 500 or more patients with stroke over the past 12 months were found to have met all 20 elements of the Framework. Furthermore, 16 services (all small to medium annual stroke numbers) met fewer than half Framework elements (10).

All efforts should be made to improve patient access to evidence-based acute stroke care in Australia, especially for the large services that offer endovascular stroke therapy.

System-wide coordination of services

State-wide coordination is recommended to ensure efficient and equitable access to acute stroke services. Results of this audit highlight that more needs to be done across all jurisdictions to ensure better coordination of services. States with coordinated services (such as Victoria and South Australia) are providing a high level of access to reperfusion treatment.

It is imperative that those responsible for statewide health system delivery work with the relevant pre-hospital emergency services to ensure a consistent approach to accessing stroke-capable centres in their jurisdiction. This should include statewide protocols for transfer of suspected acute stroke patients to the initial hospital, secondary transfers for additional treatment and subsequent repatriation transfers for further acute, rehabilitation or palliative care services. Emergency services may employ a dedicated statewide stroke coordinator to ensure appropriate policies and processes are developed and monitored in cooperation with the health system. Comprehensive stroke centres may also be involved in leading regional or area health service level planning and coordination of stroke services.

In regional and rural areas, the use of telemedicine is strongly recommended to provide specialist assessment and management support to general hospital centres within agreed systems of care. Telemedicine support can also assist in deciding whether to transfer patients for a higher level of care and to receive interventions including endovascular therapy.

Telestroke is also applicable for stroke assessments including rehabilitation, remote therapy provision, and education and support following hospital discharge, reducing the need for patients and their families to travel long distances.

Time-critical therapy access

Acute stroke services should provide access to time-critical therapies, such as the reperfusion therapies thrombolysis and thrombectomy. More services are offering thrombolysis (82% vs 72% in 2017), but the national thrombolysis rate has failed to improve and was 10% in this cohort (11% in 2017). Data from the Australian Stroke Clinical Registry (AuSCR) was 13% for 2018. Differences between AuSCR and this audit would be due to slightly different hospital participation and longer timeframes (all of 2018 for the AuSCR data compared to the last half of 2018 for this audit).[11] Additionally, 31 services reported thrombolysing fewer than 10 patients in the past 12 months, and another 3 services reported having not thrombolysed any patient in the last 12 months. Services that undertake larger numbers of IV thrombolysis have been found to have improved hospital efficiencies (door-to-needle times) and lower complications,[12] so it is important to support smaller services particularly in regional centres, ideally by telestroke services.

Door-to-needle time remains a challenge, with only 32% of those who received thrombolysis being treated within 60 minutes of hospital arrival (30% in 2017). Similarly, among the hospitals that contribute to the AuSCR 34% of patients received thrombolysis within 60 minutes of arrival. This remains significantly lower than hospitals in England and USA.[13,14]

Access to endovascular interventions has risen dramatically over the last few years, as reported in the Organisational Survey. While this is encouraging, it is imperative that all patients in all regions in Australia have a clear access pathway to be transferred for endovascular stroke therapy if clinically indicated. States with organised systems of care (including telestroke and referral pathways) have the highest level of reperfusion therapy.

The Framework recommends that endovascular stroke services be available 24/7, however of the 19 services that reported thrombectomy services 6 service (32%) did not provide 24/7 access. State access to thrombectomy services also varied, with TAS and the NT having no thrombectomy services, and the ACT not having the service available 24/7. Efforts need to continue to ensure there is equitable access to sustainable services across the country.

Stroke neurology teams are only found in 50% of stroke unit services, and an increase in specialist staff is needed, particularly outside of large cities.

Stroke unit access and care

Access to stroke unit care has not improved since the last audit in 2017 (67% vs 69%). This is disappointing considering the focused attention in many states. Access in QLD is higher than in NSW and VIC, with several smaller states achieving good results. Data from the AuSCR found 75% of patients received stroke unit care, 2% more than in the previous year.11 This higher rate is obviously influenced by strong participation from QLD hospitals.

Stroke unit availability across the country varies from 55% in WA to 100% in the ACT, as well as from 94% in metropolitan areas to only 33% in outer regional areas. One quarter of services reported not having a stroke unit, including 13 hospitals that reported admitting over 75 stroke patients annually.

The median time from hospital arrival to admission to a stroke unit was 7.6 hours (7.4 in 2017) and only 67% of patients received care on a stroke unit during their acute admission (69% in 2017). Of these patients, only 41% received at least 90% of their care on a stroke unit (45% in 2017). Increasing admission rates to a stroke unit is the factor likely to have the single biggest impact on stroke morbidity, due to the many facets of coordinated and improved care that result.

Routine use of guidelines, care plans and protocols were reported more at services with stroke units (67%) than services without a stroke unit (31%). Patients admitted to a stroke unit received better treatment rates for key issues such as swallow screening and assessment (more patients on a stroke unit were screened within 24 hours of admission), malnutrition screening (77% compared with 54%), an incontinence management plan (38% compared with 34%), and mood assessment (30% compared with 20%). Patients treated on a stroke unit were also more likely to be mobilised during admission than those patients not treated on a stroke unit.

It is therefore critical that all efforts to improve stroke unit access are undertaken.

TIA services

The vast majority (85%) of services report a defined process, policy or pathway for TIA patients. While the early risk of stroke after TIA is slightly lower than previously reported and different models exist across Australia (admission, TIA clinics), access to outpatient TIA clinics was reported to be 3 days on average which is longer than timeframes recommended for specialist assessment. TIA clinics were more common in large volume services (350–499 admissions) but less common in very large services (500+ annual admissions). Adequate workforce to manage rapid TIA services needs to be considered across all services.

Access to rehabilitation

Assessment for rehabilitation was undertaken in only 61% of patients. Of those assessed, 72% of patients had a need for ongoing rehabilitation identified and 93% of these patients were referred for ongoing rehabilitation. When there is such a high need it is concerning that 41% of patients miss out on an initial rehabilitation assessment. Patients not treated on a stroke unit were less likely to commence rehabilitation within 48 hours of initial assessment, receive treatment based on identified rehabilitation goals, or have an assessment for rehabilitation.

Early rehabilitation and appropriate assessment of ongoing rehabilitation needs is a critical component of best practice stroke care. Services must also coordinate with rehabilitation services to facilitate seamless transfer of care for people with stroke. A greater focus on identifying and addressing patient rehabilitation needs is required.

Secondary prevention

At the point of discharge from the service, 28% of patients did not receive advice about risk factor modification, 28% of patients with intracerebral haemorrhage were not prescribed antihypertensives, 26% of ischaemic stroke patients with atrial fibrillation were not prescribed anticoagulants, and 31% of ischaemic stroke patients were not prescribed triple therapy (statin, antihypertensive and antithrombotic medications).

There is much variability across the country in terms of patient education on risk factors and behaviour change for modifiable risk factors: a low of 57–60% of patients are receiving this education in the VIC and TAS, compared with a high of 93% in ACT. The proportion of patients discharged on appropriate medications for secondary stroke prevention also varies around the country, and there is great variability for stroke type (ischaemic or haemorrhagic).

Given the proven effects of secondary prevention strategies in reducing recurrent stroke risk, these gaps in care have significant implications for individuals and the healthcare system. Review of processes to ensure appropriate risk factor education and medication prescription is warranted.

Support for transition from hospital

Stroke survivors and their carers and families report that the transition from hospital after stroke is a critical point in their recovery; and comprehensive planning to facilitate this is important. Small improvements for related indicators are reported in this audit. Despite this, only 61% of carers received relevant training, and only 63% of carers received a support needs assessment. Almost one third (31%) of patients did not have a care plan developed, and 38% of patients did not receive contact details of someone in the hospital for post-discharge questions. Of those patients not treated on a stroke unit, only just over half received a care plan or contact details of someone in the hospital for post-discharge questions, again reinforcing the importance on getting more people into stroke unit care.

Given the complexity of stroke, care plans provide an essential service and are recommended for all patients.

Quality improvement and data collection

Although 88% of the services reported staff access to a program of continuing education on the management of stroke, there was variability across the states and territories, ranging from 67% in TAS to 100% in the ACT and NT.

Staff in metropolitan locations were more likely to have opportunities for professional development (95%) than those staff located in outer regional areas (73%).

The National Stroke Audit promotes the delivery of evidence-based stroke care by providing longitudinal data on resources and clinical performance, with national and state comparative data, as well as metropolitan/regional, public/private, stroke unit/no stroke unit, and admission volume breakdowns. The National Stroke Audit has provided strong impetus to improve stroke systems of care and increase individual patient care, however ideally all services need to participate for continuous assessment and benchmarking.

Specialist staffing

Stroke care coordinators (SCCs) were at 67% of services. While the role of SCCs may not be the same in all services, 24 hospitals (20%) that did not have an SCC reported a specialist nurse (Clinical Nurse Consultant, nurse practitioner and/or Clinical Nurse Specialist) actively involved in the management of patients with stroke. The majority of the SCCs were based in major cities locations (72%), with a lower representation in regional areas (inner regional, 65%; outer regional, 47%).

The benefits of stroke unit care revolve around efficient management from a range of stroke specialists, who work closely together and with the patient to maximise care. The presence of a defined SCC role has been found to improve clinical processes of care and reduce the length of stay in services with a stroke unit.[15] Therefore, this coordination role appears critical to the benefits found in stroke unit care. Further work is required to understand the roles and responsibilities of SCCs to ensure they maximise the benefits of stroke unit care.

Medical leadership specific to stroke is also suboptimum. While stroke specialisation for acute stroke care is commonly a neurologist, it may also be done by geriatricians or, in rare cases, general physicians. This audit has found a need for greater stroke specialist staffing to ensure all aspects of care (from hyperacute management to TIA services, secondary prevention and discharge care planning) is provided by doctors who specialise in stroke care.

6.1 Strengths and limitations of the data

The National Stroke Audit – Acute Services provides a cross-sectional overview of acute stroke services in Australia. It included the following actions to minimise data issues:

- Potential reporting biases were minimised by a thorough process of standardised training and ongoing support throughout the audit process.
- A comprehensive data dictionary was provided as an aid for both the Organisational Survey and Clinical Audit to increase inter-rater reliability. Each service also conducted a reliability check, in which data from 3–5 cases was entered by two auditors.
- Programmed logic checks were built into the AuSDaT to verify data at the point of entry, and all participants received their data for verification.
- In addition, the National Stroke Audit Project Team was able to monitor data entry to follow up on missing data where they were critical to analysis.
- To minimise interpretation bias, data was analysed by an independent organisation.

The total patient cohort for this year's National Stroke Audit was similar to 2017 and provides over 10% of reported admissions for an acute stroke cycle:

- 35,213 stroke admissions reported in 2019; 31,952 stroke admissions reported in 2017; 29,712 stroke admissions reported in 2015.
- Slightly fewer episodes audited (4,176) for this year's Clinical Audit, compared to 4,192 in 2017 and 4,087 patient case notes entered in the 2015 Clinical Audit.

This sizeable sample ensures this year's data, and subsequently our recommendations, are as robust and meaningful as possible.

However, the data must be interpreted with caution for several reasons:

- Participation in the National Stroke Audit is voluntary, and the data are self-reported and may be subject to reporting bias, or misinterpretation of the question (response bias).

- Documentation issues should be considered; recording of data for the Clinical Audit assumes that, if a process was not documented, it was not performed, which may not always be the case. This is highlighted when data from the Organisational Survey and Clinical Audit provide conflicting information. However, because documentation of care is a medico-legal responsibility and proof that care was delivered, care could not be assumed in the absence of documentation. Better documentation will provide the ability to gather more robust data for monitoring stroke care and should be factored into quality improvement activities.
- Accuracy of responses in the Organisational Survey may depend on the respondent's knowledge of their hospital's stroke services.
- The state network Framework response is not robust data as no documentation was provided to support the answers to the Framework questions.
- The National Stroke Audit is undertaken once every two years and the patient cohort sample size was relatively small in several of the participating services. Application of exclusion criteria and missing data further reduced the sample size for some indicator level analyses.

6.2 Recommendations

a. Stroke unit care access must improve. Several medium to large volume centres do not meet the minimum criteria for stroke unit care – this must be corrected. Furthermore, system wide improvements are needed to ensure state-wide agreed pre-hospital and inter-hospital transfers occur. Finally, hospitals meeting stroke unit criteria must have bed management practices that ensure those with stroke are actually cared for on the stroke unit for 90% of their acute stay.

b. Access to reperfusion therapy must increase. Greater access to endovascular clot retrieval should be achieved, and focused attention is needed to improve IV thrombolysis rates that have stagnated and remain well behind international benchmarks. Telestroke support is recommended to improve care outside large city areas. Marked disparities persist in different locations, and states must take a system-wide approach to ensure better access to reperfusion across each jurisdiction.

Improvement in hospital efficiency related to reperfusion therapy is a major priority. Door-to-needle times for thrombolysis remain virtually unchanged and are well behind international benchmarks. Related to this, there is a need to improve access to rapid and advanced brain imaging, especially given recent trials expanding reperfusion time windows.

c. TIA services must be improved to ensure rapid, specialist assessment and initiation of therapy to reduce the risk of future strokes.

d. Stroke coordinators and medical leads are recommended for all dedicated stroke services. Having more of these staff will improve service coordination (e.g. access to stroke unit care, improved reperfusion therapy and appropriate TIA services).

e. Services must assess and support carers better to ensure they are prepared before the person with stroke leaves hospital.

f. Further efforts are required to ensure all patients receive lifestyle advice and appropriate medications to prevent further vascular events.

“It is quite amazing to think of how far I have come since my stroke. The health professionals who supported me were wonderful and I am so grateful.

My life is busy, but I take care of myself. I am on blood pressure medication to prevent a second stroke and I have made some lifestyle changes.”

Emily Korir, stroke survivor.

Appendix 1: Audit program methods

Development of the National Stroke Audit questions

The National Stroke Audit was first developed under the guidance of a National Advisory Committee including national representation from medical, nursing, allied health and clinical research groups.[16]

Some items contained in the National Stroke Audit have been refined over time based on feedback from previous years and changes in national reporting standards or the clinical guidelines. However, most items have remained consistent from year to year to allow comparisons over time. Data collected include:

- Demographic characteristics
- History of risk factors
- Stroke severity measures
- 30+ evidence-based processes of care
- In-hospital outcomes.

Organisational Survey

Data collected through the Organisational Survey enables reporting of services against each required element outlined in the Framework. The Organisational Survey questions have been reviewed based on the Framework and comments received from previous National Stroke Audits. All feedback has been discussed and changes approved by the Stroke Foundation Clinical Council.

The recently updated national *Acute Stroke Services Framework 2019* makes recommendations about statewide systems of care as well as hospital-level procedures. In addition, the state clinical networks were asked to complete a spreadsheet with four organisational questions related to system-wide services.

Clinical Audit

The Clinical Audit involves a systematic process of abstracting data from patient medical records. The data collected through the Clinical Audit are designed to report on adherence to recommendations outlined in the *Clinical Guidelines for Stroke Management 2017*. The Clinical Audit questions have been reviewed to correspond with the *Clinical Guidelines for Stroke Management 2017* and adjusted based on comments received from previous National Stroke Audits. All feedback has been discussed and changes approved by the Stroke Foundation Clinical Council. Audit results are also presented based on the ACSQHC *Acute Stroke Clinical Care Standard* with associated indicators.

To ensure standardised data collection and reporting in Australia, the National Stroke Data Dictionary (NSDD)[17] is used for the National Stroke Audit. The NSDD is regularly reviewed and updated in accordance with the AuSDaT *National Stroke Data Dictionary Operational Policy*.[18] The ACSQHC indicators were reported using the definitions included in the ACSQHC Standard (http://www.safetyandquality.gov.au/our-work/clinical-care-standards/acute-stroke-clinical-care-standard/).

In feedback from previous audits, auditors requested that the volume of data collected be reduced. This year participating services that collect data for the AuSCR were able to use data entered in AuSCR for the National Stroke Audit. Western Australia also created an in-house data collection system that allowed relevant data to be imported for use in the National Stroke Audit. Both systems reduced the burden of data entry for services participating in the National Stroke Audit.

Definitions of the indicators reported (including numerators and denominators, and exclusion criteria) are available in the report supplement at https://informme.org.au/stroke-data.

Recruitment

Any service admitting at least 40 patients with acute stroke was eligible to participate in the Organisational Survey component. Services admitting 40 or more patients with stroke per year were invited to participate in the Clinical Audit. Smaller services were able to participate in the Clinical Audit but were not actively recruited. Eligible services were identified through previous participation in the National Stroke Audit, partnerships with state-based clinical networks and relationships with key health providers.

Services were recruited between December 2018 and February 2019, in which chief executives and the main contacts from both public and private services were sent a letter of invitation. Services were asked to complete and return a consent form to confirm participation. Services were also requested to give permission for the Stroke Foundation to share summarised data with relevant state-based clinical networks or Departments of Health, to promote transparency and facilitate support for quality improvement. Each participating service nominated a coordinator to receive all correspondence during the National Stroke Audit period. This coordinator was responsible for data completion and data quality at their service.

Training

The AuSDaT was used for the 2019 National Stroke Audit. This is a purposefully designed, integrated, web-based data collection and management platform. The audit program transitioned from the Stroke Foundation online system to the AuSDaT in 2015 and it has been designed to reduce the data entry burden and time for data collection. All auditors were required to complete standardised training regarding the AuSDaT, and the NSDD was made available to give a rationale for each question as well as definitions and help notes. The Stroke Foundation project team were always available for questions leading up to, and during, the data collection period. For more information regarding AuSDaT, please refer to the Australian Stroke Coalition website https://strokefoundation.org.au/Australian%20Stroke%20Coalition/AusDAT

Data collection

All respondents from participating services completed the Organisational Survey via the AuSDaT between 18 February and 22 March 2019. The full list of Organisational Survey questions is presented online in the report supplement (www.informme.org.au/stroke-data).

The state clinical networks were asked to complete the spreadsheet of statewide system questions between 9 April and 3 May 2019.

Between 18 February and 31 May 2019, those services participating in the Clinical Audit completed a retrospective case note audit of up to 40 consecutive stroke admissions to their service. To minimise selection bias, data for the first 40 consecutive acute stroke admissions over a pre-defined time period were extracted. For most of these episodes, admission and discharge dates fell between 1 July and 31 December 2018.

Patients with an ICD-10 code of I61.0–I61.9 (intracerebral haemorrhage), I63.0–I63.9 (cerebral infarction), I64 (stroke not specified as haemorrhagic or infarction) and I62.9 (intracerebral haemorrhage unspecified) were eligible for inclusion. The specificity for diagnosing stroke (any type) using these ICD-10 codes is greater than 95%.[19] The full list of Clinical Audit questions is presented online in the report supplement (www.informme.org.au/stroke-data).

Auditors at participating services were required to log in to enter and access data on the AuSDaT. Security and confidentiality were maintained by each auditor having an individual account, with email and password specific to the auditor. No patient-identifying data were collected by the Stroke Foundation. However, to facilitate data checking and quality as part of verification processes, services were asked to keep a list of the cases they entered for their own records.

Data quality checks

The AuSDaT contains pre-defined data fields with inbuilt programmed logic checks. Manual reliability checks are also performed via re-auditing of 3–5 cases by another auditor.

This helps to ensure data is being reliably collected by identifying whether a case note audited independently by two people provides the same responses. A total of 371 reliability records were completed. Coordinators were also asked to check their service data at completion of the data collection period, to maximise the accuracy of the data and minimise missing items. The results of this data quality procedure are not reported here, but the information gathered will be used to refine future National Stroke Audits.

Data verification

A new process to ensure the accuracy of the Organisational Survey component of the Acute Audit was initiated this year. Previously, the service coordinators were asked to review the survey collaboratively with their team but, this year, in addition, it was requested that the completed survey be reviewed by the most senior staff member on the stroke unit (stroke unit head or medical lead, or for smaller services without a stroke unit this might be the director of medicine or director of nursing). This process was introduced to ensure the reliability of answers in the Organisational Survey.

Auditors were able to change their entered Clinical Audit data up until 31 May 2019, at which point all data were locked. Programmed logic checks of the data were then conducted and used to validate data from the Organisational Survey and the Clinical Audit. Queries were sent back to services where assumptions about true values could not be made. Where data appeared incorrect, further changes were permitted. The final, cleaned data were then used for the analysis process.

Data analysis

Staff from the Translational Public Health and Evaluation Division, Monash University, independently analysed the anonymised data. Names of services were excluded from the data submitted to Monash University; only the site identification number was provided.

The data were analysed using computer software including Stata 15.0 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC) and Excel (Microsoft Excel 2016). The data were exported from the AuSDaT as an Excel spreadsheet and transferred into Stata.

All Organisational Survey and Clinical Audit data were aggregated to provide national estimates. Subcategories for analyses included breakdown by state, regional status, public/private status, admission volume and presence of a stroke unit. The few patients with stroke type recorded as TIA were analysed as having ischaemic stroke, due to these patients often being clinically managed in a comparative manner to patients with minor ischaemic stroke.

For medical history and impairment data, only valid responses (e.g. Yes/No) were included in the analysis. 'Not documented' responses to these questions were reported separately and were excluded from the denominator. Data relating to processes of care, e.g. received advice about risk factor modification, 'not documented' and 'unknown' responses, were assumed to be negative (e.g. a care process not provided) and were included in the denominator.

Adherence to processes of care was generally calculated on the entire sample. When reporting adherence to care, 'Known N' refers to all eligible patients. In some instances, eligibility criteria for processes of care were specified. For example, adherence to the process of care relating to the use of antithrombotics on discharge was calculated only for patients presenting with ischaemic stroke who were discharged.

To minimise data being excluded, cases with known dates but unknown times for processes of care had an assumed time of 00:00 allocated to them. For patients suffering an in-hospital stroke, stroke onset date and time were used for date and time of ED presentation. Derived variables relating to outcomes of care, such as length of stay, were calculated based on admission and discharge dates.

The median (50th percentile) and first (Q1) and third (Q3) quartiles (25th percentile and 75th percentile) were reported for skewed (e.g. data not normally distributed) continuous data from questions such as the number of stroke admissions each year.

The Achievable Benchmark of Care (ABC™) methodology was used to create benchmarks for several nationally relevant indicators based on the average performance of the top 15% of hospitals for each indicator.[9]

Acute Service Regional Classifications

Classification of participating services as metropolitan/major cities or regional/rural was based on the Accessibility and Remoteness Index of Australia (ARIA+)

https://www.abs.gov.au/websitedbs/D3310114.nsf/home/remoteness+structure

Defining remoteness areas

The Australian Statistical Geography Standard (ASGS) defines Remoteness Areas into five classes of relative remoteness across Australia.

These five classes of remoteness are:

- Major Cities of Australia
- Inner Regional Australia
- Outer Regional Australia
- Remote Australia
- Very Remote Australia

The five classes of remoteness are determined using a process that allows statistical data to be classified in a consistent way with which users can analyse changes in data for different remoteness categories over time. The audit only used three classes of remoteness (Major Cities of Australia, Inner Regional Australia, Outer Regional Australia) as none of the participating hospitals are classified as Remote Australia or Very Remote Australia.

Relative remoteness is measured in an objective way using the Accessibility and Remoteness Index of Australia (ARIA+), which is developed by the Hugo Centre for Migration and Population Research at the University of Adelaide. ARIA+ is derived by measuring the road distance from a point to the nearest urban centres and localities in five separate population ranges. For more information on how ARIA+ is created see the University of Adelaide website at https://www.adelaide.edu.au/hugo-centre/services/aria

The University of Adelaide supplies ARIA+ to the ABS as a one-kilometre grid that covers all of geographic Australia. Each grid point contains a value representing its relative remoteness, derived using the methodology described in the link above. The resulting average score determines which remoteness category is allocated to each ASGS Statistical Area Level 1 (SA1); these categories are shown in Table 39 below.

Table 39: 2016 Remoteness Area Category Names for Australia and SA1 Average ARIA+ Value

Remoteness Area Category	Remoteness Area Name	SA1 Average ARIA+ Value Ranges
0	Major Cities of Australia	0 to 0.2
1	Inner Regional Australia	greater than 0.2 and less than or equal to 2.4
2	Outer Regional Australia	greater than 2.4 and less than or equal to 5.92
3	Remote Australia	greater than 5.92 and less than or equal to 10.53
4	Very Remote Australia	greater than 10.53

The urban centres and localities referenced in the above criteria are defined according to the ABS publication Australian Statistical Geography Standard (ASGS) Volume 4 - Significant Urban Areas, Urban Centres and Localities, Section of State, July 2016 (cat no. 1270.0.55.004) released in October 2017.

Supplementary information

In addition to this report, a supplement containing details of questions from the Organisational Survey and Clinical Audit is available at www.informme.org.au/stroke-data.

Site-specific feedback

Feedback to participants is an essential component of the National Stroke Audit program, considering the evidence that audit and feedback can influence and change clinical practice.5 Each participating service receives a site-specific report highlighting their performance, so that informed decisions can be made to improve patient care and outcomes. In addition, all participating services have access to their own results at www.informme.org.au. They are also able to benchmark their 2019 performance against similar services across Australia for continuous quality improvement purposes.

Appendix 2: Participating services in Australia

We would like to thank everyone involved at all participating acute services for their support and hard work on the *National Stroke Audit Acute Services 2019*.

ACT	Calvary Public Hospital	Kristine Caprecho
	The Canberra Hospital	Brett Jones
NSW	Armidale Hospital	Jaclyn Birnie
	Bankstown Lidcombe Hospital	Angela Firtko
		Christine Fuller
		Carol Castillejo
	Batemans Bay Hospital	Leanne Ovington
		Rebekah O'Reilly
	Bathurst Health Service	Fiona Ryan
	Belmont Hospital	Kerry Boyle
	Blacktown Hospital	Camelia Burdusel
	Bowral Hospital	Angela Firtko
		Carol Castillejo
	Broken Hill Hospital	Kathryn Wallace
		Nicholas Minns
	Calvary Mater Newcastle Hospital	Sally Ormond
	Campbelltown Hospital	Angela Firtko
		Carol Castillejo
		Beverley Macdonald
	Coffs Harbour Hospital	Amanda Buzio
	Concord Hospital	Rebecca Phair
	Dubbo Hospital	Debra Sloane
	Fairfield Hospital	Angela Firtko
		Carol Castillejo
		Belinda Boylson
	Gosford Hospital	Katie Ercan
		Rhonda O'Neil

NSW	Grafton Base Hospital	Lisa Jarvis
		Sharon Wright
	Griffith Hospital	Lorraine Maxwell
	Hornsby Ku-ring-gai Hospital	Malcolm Kanard
	John Hunter Hospital	Angela Royan
		Annalese Johnson
	Lismore Hospital	Kim Hoffman
	Liverpool Hospital	Angela Firtko
		Carol Castillejo
		Jasmeen Khan
	Maitland Hospital	Dianne Wood
	Manning Hospital	Fiona Minett
	Moruya Hospital	Leanne Ovington
		Michelle Allan
	Nepean Hospital	Susan Lane
	Orange Health Service	Fiona Ryan
	Port Macquarie Hospital	Michelle Coad
		Kim Parrey
	Prince of Wales Hospital	Alanah Bailey
		Christopher Taylor
	Royal North Shore Hospital	Sheila Jala
		Elizabeth O'Brien
		Susan Day
	Royal Prince Alfred Hospital	Kylie Tastula
	Ryde Hospital	Sandra Lever
	Shoalhaven Hospital	Donna Jay
	St George Hospital NSW	Krystle Franklin
	St Vincent's Hospital NSW	Kirsty Page
	St Vincent's Private Sydney	Paru Rangarajan
		Tracey Anderson
	Sutherland Hospital	Christine Turner
		Dandan Zhao
	Sydney Adventist Hospital	Evelyn Chiriseri
	Tamworth Hospital	Rachel Peake
	The Tweed Hospital	Kelly Andersen
	Wagga Wagga Hospital	Katherine Mohr
		Ricky Tasker
	Westmead Hospital	Andrew Evans
		Jacqueline Watson

	Wollongong Hospital	Toni Wonson
	Wyong Hospital	Rhonda O'Neil
		Jeffrey King
NT	Royal Darwin Hospital	Alvaro Cervera
		Howard Flavell
QLD	Bundaberg Base Hospital	Sonia Dann
	Caboolture Hospital	Jonnel Boco
	Cairns Hospital	Dijana Cukanovic-Krebs
		Elise Bertram
	Gladstone Hospital	Julia McRae
	Gold Coast University Hospital	Haylee Berrill
	Gympie Hospital	Rebecca Sjodin
	Hervey Bay Hospital	Pauline Blaney
		Jodie Rae
		Amanda Dyson-Windle
	Innisfail Hospital	Amber Overton
	Ipswich Hospital	Juan Rois Gnecco
		Linda Edwards
	Logan Hospital	Nicola Hall
	Mackay Base Hospital	Anne Hooper
	Mater Adult Hospital	Marie Mccaig
		Ashley Mcguire
	Princess Alexandra Hospital	Katherine Jaques
		Darshan Shah
		Helen Brown
	The Prince Charles Hospital	Caitlin Kearney
		Lisa Donaghy
	Queen Elizabeth II Jubilee Hospital	Jerry Wong
	Redcliffe Hospital	Tanya Williams
	Redland Hospital	Sagarika Attudawage
	Rockhampton Hospital	Leanne Whiley
		Annette Horton
		Katie Miller
	Royal Brisbane and Women's Hospital	Kana Appadurai
		Melissa Wood
	Toowoomba Hospital	Lynette Klein
		Timothy Richardson

	The Townsville Hospital	Sheryl Juliano
		Linda Roper
		Linda Norrie
		Ian Meade
	Warwick Hospital	Jane Fraser
	The Wesley Hospital	Raewyn Beu
		Jodie Shephard
SA	Flinders Medical Centre	Michelle Hutchinson
		Jo James
	Gawler Health Service	Sheryl Jerico
	Lyell McEwin Hospital	Michelle Whitehead
		Matt Barrett
		Angela Sayas
	Mount Gambier and Districts Health Service	Pam Schubert
		Michelle Curtis
	Riverland Regional Health Service - Berri Campus	Bridgette McKenzie
	Royal Adelaide Hospital	Carole Hampton
	Whyalla Hospital	Susan Watkins
TAS	Launceston General Hospital	Carolyn Harrison
		Annette Viney
		Lisa Bonde
	North West Regional Hospital	Maxine Munting
	Royal Hobart Hospital	Anne Temblett
		Helen Castley
VIC	Albury Wodonga Health - Albury Campus	Vanessa Crosby
		Kate Wiesner
	Albury Wodonga Health - Wodonga Campus	Vanessa Crosby
		Kate Wiesner
	The Alfred	Jorge Zavala
	Angliss Hospital	David Lau
		Tanya Frost
	Austin Hospital	Alexandra Warwick
	Bairnsdale Regional Health Service	Suzanne Mcarthur
	Ballarat Health Services	Casey Hair
	University Hospital Geelong	Natasha Selenitsch
		Heather Smith

	Bass Coast Health	Cath Jones
	The Bendigo Health	Tessa Coupland
		Erin Ray
	Box Hill Hospital	Tanya Frost
	Cabrini Health	Suzy Goodman
		Sophie Jennings
	Central Gippsland Health Service	Sue Roberts
		Jessica Waldron
	Echuca Regional Health	Lauren Arthurson
	Epworth HealthCare Richmond	Sally Dixon
	Goulburn Valley Hospital	Melanie Brown
		Anne Robinson
	Hamilton Base Hospital	Megan Layley
		Brigietta Herbertson
	Latrobe Regional Hospital	Janet May
	Maroondah Hospital	Tanya Frost
	Mildura Base Hospital	Ros Roberts
	Monash Medical Centre	Jodi Lynch
		Valerie Adanko
	Northeast Health Wangaratta	Lyn Malone
		Rebecca Weir
	Frankston Hospital	Margaret Stevenson
		Kanaga Lagma
		Jane Roberts
	Royal Melbourne Hospital	Lauren Pesavento
	St Vincent's Hospital Victoria	Karen Borschmann
		Patrick Scarff
		Fiona McKinnon
	Sunshine Hospital	Liz Mackey
		Jennifer Goff
	The Northern Hospital	Anne Rodda
	South West Healthcare - Warrnambool Base Hospital	Patrick Groot
	Wimmera Base Hospital	Nina Roberts

WA	Albany Hospital	Bronte Lloyd
		Leanne Hodges
	Bunbury Hospital	Karen Gifford
		Renee Dehring
		Michaela Eaton
	Busselton Health Campus	Karen Gifford
	Fiona Stanley Hospital	Darshan Ghia
		Gill Edmonds
	Geraldton Hospital	Liza Doble
		Megan Grazziadelli
	Joondalup Health Campus	Michelle Young
	Kalgoorlie Hospital	Rochelle Harling
	Rockingham General Hospital	Helen Thomas
		Katrina Taylforth
	Royal Perth Hospital	Thu-Huong Pham
		Kala Fernandez
	Sir Charles Gairdner Hospital	Roger Shreeve
		Belinda Saint
	St John of God Midland Public Hospital	Tim Bates

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