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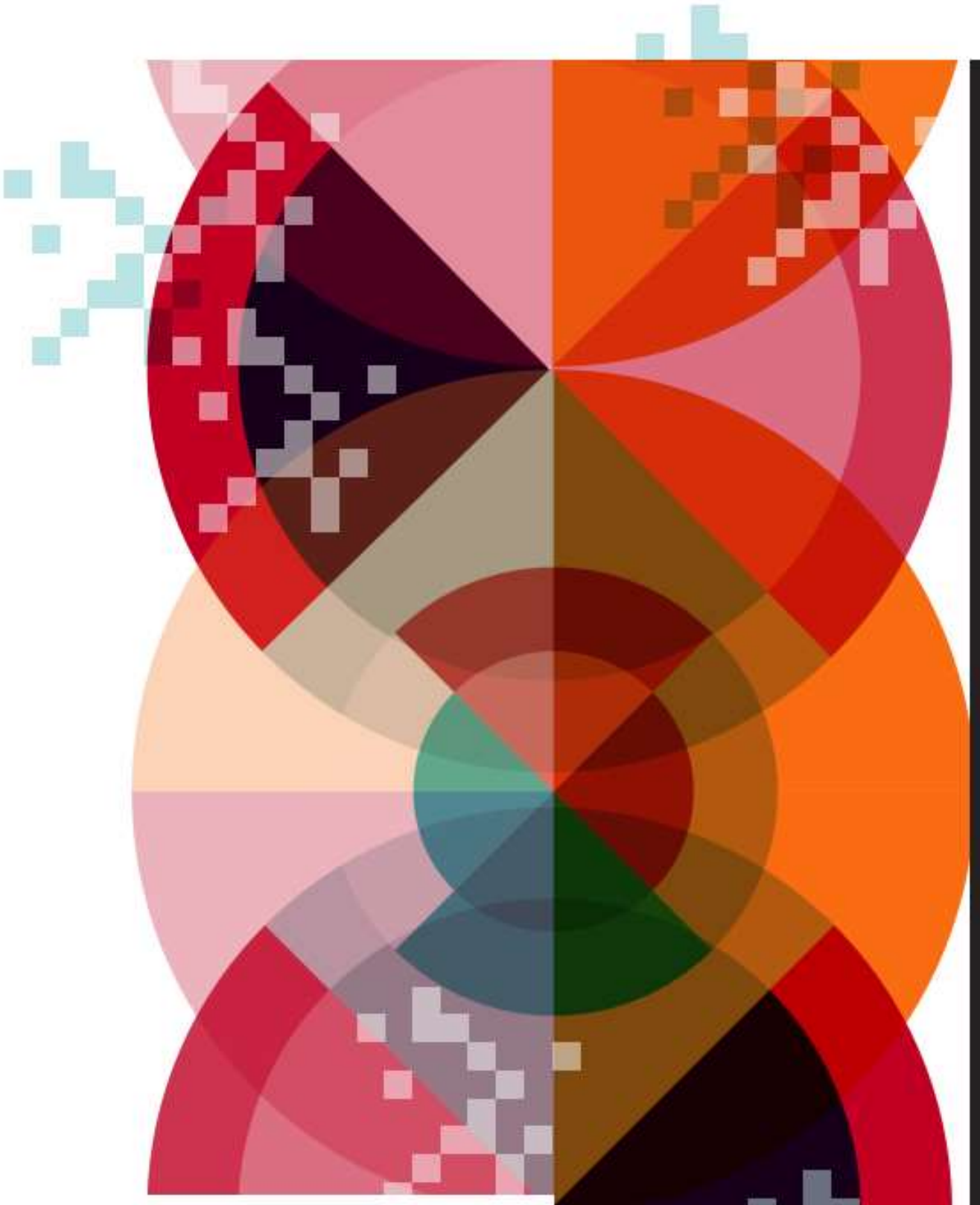

AUSCR
Australian Stroke Clinical Registry

ACUTE CARE PROVISION

This publication was produced on behalf of the Australian Stroke Clinical Registry (AuSCR) Consortium partners and was approved by the AuSCR Steering Committee.

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EXECUTIVE SUMMARY

The Australian Stroke Clinical Registry (AuSCR) provides a standardised approach for hospitals to monitor, review and improve stroke care in compliance with national acute stroke care standards.

AuSCR participation in 2019

- In 2019, 72 hospitals contributed data to the AuSCR (*40% from Victoria, 29% from Queensland, 19% from New South Wales, 4% each from Tasmania and South Australia and 3% from the Australian Capital Territory*).
- In 2019, two new optional datasets were available for hospitals to use from July 1st : the Fever, Sugar, Swallow (FeSS) dataset and the Emergency Department (ED) dataset, to document stroke treatment in the ED prior to transfer to another hospital for further acute stroke care.
- Information is presented on 20,044 episodes of admitted care for acute stroke or transient ischaemic attack (TIA) from 18,773 patients. Of these episodes, 988 were expanded to include additional information from the FeSS dataset by 17 hospitals in four states.
- In addition, information from 113 ED dataset episodes are included from 20 hospitals in three states.
- With the introduction of the ED dataset, new data analysis methods have been established for this annual report to link treatments for patients transferred between hospitals for the same stroke event. This change improves the accuracy of the attribution and timing of treatments to the appropriate hospital, such as the use of intravenous thrombolysis.

Hospital performance against clinical care standards

- The proportion of ischaemic strokes receiving thrombolysis was 11%, with 34% (1 in 3) of these patients receiving treatment in under 60 minutes.
- The proportion of patients receiving thrombolysis varied significantly by state and ranged from 9% (Queensland) to 13% (Victoria). Thrombolysis also varied significantly between metropolitan (12%) and inner/outer regional hospitals (9%). The proportion of patients receiving thrombolysis was also significantly greater at hospitals where endovascular clot retrieval was available (14%) compared to hospitals where this treatment was unavailable (9%).
- The median door-to-needle time for thrombolysis was 72 minutes. Regional hospitals were less likely to achieve door-to-needle times under 60 minutes for their thrombolysed patients when compared with those treated at metropolitan hospitals (regional 23% vs metropolitan 38%).
- A total of 1,220 patients at 14 hospitals received endovascular clot retrieval. The proportion of patients with ischaemic stroke receiving endovascular clot retrieval at hospitals providing this treatment was 21%. The median time from arrival to groin puncture was 78 minutes, and the median arrival to recanalisation time was 125 minutes.
- The proportion of patients treated in a stroke unit was 77%. However, women were 13% less likely to be treated in a stroke unit than men (95% CI: 6-20%).
- Hyperacute antithrombotic medication was provided to 69% of eligible patients.
- The proportion of patients mobilised on the same day/day after arrival, was 68.
- The proportion of patients who received a swallow screen or assessment within 4 hours of arrival was 27% with 58% of patients receiving a swallow screen or assessment prior to oral intake.

- Of those episodes where additional items to our standard swallow assessment/screen variables were captured for the FeSS dataset, 93% of patients had their temperature recorded at least four times on the day of admission. However, only 34% with a documented fever received paracetamol. Although the majority of patients (63%) also had their blood glucose level monitored at least four times on the day of admission, only 32% of those with an elevated blood glucose level received insulin within one hour of the result.
- With respect to the prescription of secondary prevention medications at discharge: 74% were discharged with antihypertensives; 91% with antithrombotics and; 78% with lipid lowering medications. Patients provided with all three medications at discharge were significantly more likely to be: aged ≥75 years; male (64% versus 59%), and be treated in a hospital in a regional area (68% versus 58%).
- The proportion of patients receiving a discharge care plan when discharged to the community setting was 68%.
- Overall, 1,682 (8%) of the 2019 AuSCR registrants died in hospital which was the same proportion reported in 2018.
- After discharge from acute care, 24% of patients went to in-patient rehabilitation services for ongoing treatment and 52% returned to their usual residence, with or without some form of support. Patients who received care in a stroke unit had 1.8 increased odds of being discharged to in-patient rehabilitation.
- The wide variability in performance between hospitals with respect to quality of care indicators, and hospitals that are outliers across multiple indicators, show there is still considerable work required to improve evidence-based care provision for patients with stroke.
- The AuSCR office continues to support sites to understand their data via webinars, training and individual correspondence.
- In 2020, the role of the newly formed AuSCR Clinical Quality Improvement Committee will be pivotal in supporting staff from participating hospitals to understand and use their data to drive improvements for stroke care and patient outcomes, nationally.

GOVERNANCE REPORT

The governance of the AuSCR adheres with the operating principles established by the Australian Commission for Safety and Quality in Healthcare.[1]

The AuSCR is governed by a Steering Committee chaired by Professor Sandy Middleton, and a Management Committee chaired by Professor Natasha Lannin. The day-to-day registry operations are managed centrally by staff at the Florey Institute of Neuroscience and Mental Health (The Florey), including the National Coordinator Dr Sibilah Breen. The Data Custodian is Professor Dominique Cadilhac (The Florey and Monash University). Subcommittees including the Research Task Group and clinical expert groups (including the Reperfusion and Telemedicine Subcommittee) provide input to registry policies and processes, including the secondary use of data. Members of the Steering Committee, Management Committee, Research Task Group and Reperfusion and Telemedicine Subcommittee voluntarily contribute their time to ensure the rigorous operation and ongoing development of the Registry (see Appendices A, B and C for additional details including funding). The success of the AuSCR is due to the efforts of many organisations and individuals (Appendix D), but we must particularly acknowledge the hospital staff who contribute to the AuSCR, as well as the patients, their carers and family members, without whom the registry could not exist. We also are grateful to the experienced statistical team from Monash University, overseen by A/Prof Kilkenny and Dr Kim, for their contributions to the analysis of AuSCR data in a de-identified format as they remain blinded to hospital names.

In 2019, we reached a major milestone with the celebration of ten years of continuous national data collection. Data from the AuSCR continues to have a vital role in quality improvement efforts at participating hospitals. To further support quality improvement initiatives, at the conclusion of 2019 a new Committee was formed, the AuSCR Clinical Quality Improvement Committee. Professor Geoff Cloud has been appointed the Clinical Chair of this Committee and we look forward to the involvement of this Committee in the support of improved stroke care.

The tenth anniversary year of the AuSCR also had many other exciting developments. We welcomed participation from hospitals in the Australian Capital Territory (ACT) and launched two new data collection programs on July 1st 2019: the Emergency Department (ED) program for patients presenting to the ED prior to transfer for ongoing acute management or intervention, and the Fever Sugar Swallow (FeSS) program.[2,3] Data from these programs will enable a more comprehensive capture of the quality of acute care provided for patients with stroke. In 2019, the Australian Stroke Coalition (ASC) endorsed the National Excellence Awards based on acute care data submitted to the AuSCR or the national stroke audit program (run by the Stroke Foundation). Award criteria, and recipients, are listed in Appendix E. Publications using AuSCR data, which are used to inform policy and clinical practice, are listed in Appendix F.

Nationally, the impact of the COVID-19 pandemic has been felt by AuSCR staff, participants and contributors, but most of all in Victoria. The registry successfully moved to a remote working model during the pandemic, however there may be impacts on the collection of patient-reported outcomes data at 90-180 days after stroke for admissions in the last quarter of 2019. Against the backdrop of universal COVID disruptions, this year we will release the AuSCR 2019 Annual Report in two volumes. The first volume includes our findings on acute care provision in 2019. The second volume will include patient outcomes data for 2019. In addition, we will be releasing a special report featuring 10-year longitudinal analyses of treatment and outcomes for stroke, alongside reports on the unintended consequences of the COVID-19 pandemic on stroke services, patient care and outcomes.

Professor Sandy Middleton
Chair, Steering Committee

Professor Natasha Lannin
Chair, Management Committee

Professor Dominique Cadilhac
Data Custodian

INTRODUCTION

The Australian Stroke Clinical Registry (AuSCR) is a collaborative national effort to monitor and support improvements to the quality of acute care for patients with stroke and transient ischaemic attack (TIA). Since 2009, the AuSCR has provided national data on consecutive patients admitted to hospital with acute stroke or TIA, which has been used to inform improvements to the health system.[4]

The AuSCR adheres to the national guidelines for best-practice in clinical quality registries,[1] and can be used by both public and private hospitals. Adult and paediatric cases are included. All participating hospitals are required to have ethics and hospital-specific governance approvals. As recommended for national registries, an 'opt-out' model for patient inclusion is used,[5] in addition to a waiver of consent for people who die while in hospital.

In the AuSCR, data are collected on the provision of evidence-based therapies, supplemented with clinical and demographic patient information, to provide an indication of the quality of acute stroke care received. Data are collected in the Australian Stroke Data Tool (AuSDaT) which is a harmonised online database platform enabling standardised and systematic data collection for multiple stroke data collection programs (Appendix G). The AuSDaT enables hospitals to select bundles of variables organised into data collection programs, to enable local quality of care monitoring and state and national comparisons.

AuSCR programs facilitate the collection of data for patients with stroke/TIA who are admitted to participating hospitals and also patients presenting to Emergency Departments (ED) prior to transfer for continued acute care at another hospital. This combination of programs enables the AuSCR to fully document the acute treatment pathway for patients with stroke or TIA. These programs also enable the collection of the original national minimum processes of care for assessing quality of care.[4]

In 2019, a total of seven AuSCR programs were available for participating hospitals to contribute data (Appendix G). Five programs enable data collection on eligible stroke/TIA patients who were admitted for care at participating hospitals. Two additional optional datasets enable data collection on the provision of acute care in the ED prior to transfer (ED dataset) and the Fever Sugar Swallow (FeSS) dataset which enabled the collection of fever and blood glucose monitoring and management data. Variables in the FeSS dataset supplement the swallow variables collected in other AuSCR programs (Appendix G, Appendix H).

Staff from participating hospitals enter these data either manually via the web tool, by using a data import process, or a combination of both. Each hospital has access to their own data and to real-time downloadable reports of summary data to enable regular reviews of hospital performance.

Patient-reported outcomes data are obtained via a questionnaire (including age-appropriate paediatric questions) at 90-180 days after admission. The AuSCR Office staff are responsible for following up registrants who have not: been reported as deceased; previously refused follow-up; or opted out of the registry. For registrants unable to be contacted, survival status is determined via annual data linkage with the National Death Index (NDI) made available by the Australian Institute of Health and Welfare.

As the registry has matured, the large amount of cumulative data available permits analyses that can inform Australian policy and planning in relation to a range of epidemiological or health system issues, including examination of particular patient sub-groups. In addition, approved third parties can access aggregated, anonymised data to address their own research questions, or to recruit registrants for studies (See Appendix I for a list of the 2019 applications to the AuSCR Research Task Group).

The data presented in this 2019 report provide insights into the care received, and the health outcomes, for 20,157 episodes of care for 18,733 patients from 72 Australian hospitals.

METHODS

ENSURING DATA QUALITY

From the outset, there have been consistent efforts to ensure complete and accurate data entry in the AuSCR. These quality assurance processes include:

- A comprehensive data dictionary with help notes to guide data entry (consistent with the National Stroke Data Dictionary).
- Database with built-in logic checks and variable limits to reduce the likelihood of data inaccuracies.
- Mandatory fields to reduce missing data.
- Fortnightly database maintenance undertaken by Senior Data Managers, including checks for duplicate entries using registrant identifiers (name, date of birth, Medicare number or hospital medical record number) and date of stroke onset, arrival, admission or discharge.
- The delivery of tailored training, specific to the AuSCR, for staff at newly participating hospitals and new staff at existing hospitals, completed in person or via videoconference.
- Resources available on the AuSCR website containing training videos and written information.
- Bi-annual Data Quality Reports fed back to hospital staff which identify missing and discrepant data.
- AuSCR Office staff conduct audits of a randomly selected sample of hospital medical records.
- Bi-annual case ascertainment assessments, completed by cross-checking the hospital discharge codes of all eligible admissions (based on the ICD-10 principal diagnosis codes for stroke/TIA) with the acute care episode data entered in the AuSCR.
- A detailed hospital user manual, and training administered by AuSCR staff, to ensure standardised data collection and interpretation.
- Fact sheets, webinars, regular electronic newsletters for dissemination of new information, reminders and updates.

The ***AuSCR 2019 Annual Data Quality Report*** is a summary of data quality for the final 2019 dataset (e.g. time to record creation; data completeness; case ascertainment). A copy of this report can be obtained from the AuSCR website at https://auscr.com.au/about/annual-reports/

OVERVIEW OF DATA ANALYSIS METHODS

The data presented in this report includes information on patients who presented to an ED prior to transfer and those who were admitted to participating hospitals between 1 January and 31 December 2019. Data entry for these acute stroke/TIA episodes, and the associated follow-up questionnaires was closed off, and data extracted, on 13 October 2020. Data cleaning and analysis was undertaken by authorised Monash University epidemiologists.

Hospital postcodes were mapped to the Australian Statistical Geography Standard (ASGS) Remoteness Structure (2016) available from the Australian Bureau of Statistics (see https://www.abs.gov.au/websitedbs/D3310114.nsf/home/remoteness+structure). The ASGS divides Australia into 5 classes of remoteness on the basis of a measure of relative access to services. For this report ASGS Category 1 was defined as a Major City of Australia and ASGS Categories 2 and 3 were defined as Inner Regional and Outer Regional Australia respectively. Descriptive information about paediatric cases (aged under 18 years) were not included in the overall patient characteristics, clinical and outcome data analyses.

For the first time, participating hospitals have contributed information to the AuSCR on the care provided to patients in the ED prior to transfer to another hospital for additional acute stroke care. With the availability of this new information, we have changed our analytical methods for calculating the proportions of patients treated with thrombolysis to improve accuracy. Briefly, this process involved appending the AuSCR ED and Acute datasets together and linking multiple episodes registered in the AuSCR for the same acute patient-event using a person-level identifier (a Statistical Linkage Key) and the date of stroke onset +/- 1 day. of the proportion of patients being treated with thrombolysis were calculated only for eligible episodes of ischaemic stroke where thrombolysis had not already been provided during an earlier episode of care for the same acute patient event. Episodes were also excluded from the calculation of thrombolysis if the date and time of thrombolysis provision was before the date and time of arrival to hospital, unless there was documented evidence that thrombolysis administration was initiated in the Melbourne Mobile Stroke Unit.

For all process of care analyses presented in this report, ***episodes with missing information are included in the denominator***, because, if the data were not provided, it was assumed that care related to that indicator was not offered. For the secondary prevention medications provided at discharge analyses, patients who were recorded as being contraindicated and those who died in hospital were excluded from the denominator. Other performance measures based on published standards such as door-to-scan, door-to-needle, door-to-puncture and door-to-revascularisation times were also calculated. These were calculated using dates and times of arrival to hospital and treatment.

In the case where a specific quality indicator for any individual hospital contained greater than 30% missing data, these hospitals were excluded from any subsequent analyses of the specific process of care. Time to thrombolysis, time to brain scan, time to swallow screen/assessment, and mobilisation variables were also excluded where 30% of data were missing. Missing data related to endovascular clot retrieval (ECR) variables were not excluded.

Benchmarks for AuSCR national clinical care indicators were calculated using a modified version of the Achievable Benchmark of Care (ABC™) method.[6,7] Only hospitals that had submitted at least 50 cases were eligible for inclusion. An Adjusted Performance Fraction (APF) score was then calculated for each hospital for the process of care indicators. This approach allowed adjustment for under or over inflation due to small numbers of episodes reported from some hospitals. The benchmarks were calculated as the mean APF scores of the top performing hospitals that represented at least 15% of the sample of eligible patients. We also report national averages and adherence achieved by the top performing hospitals from the sample of hospitals eligible to be included.

Volume 1 of the 2019 AuSCR Annual Report provides a summary of acute care received by eligible patients with stroke and TIA. Volume 2 of the 2019 AuSCR Annual report will include patient reported outcomes data collected at 90-180 days following admission for the 2019 dataset, in addition to survival and mortality analyses.

All AuSCR annual reports can be accessed at https://auscr.com.au/about/annual-reports/

UNDERSTANDING ADHERENCE TO QUALITY INDICATORS

The quality of care indicators collected by the AuSCR align with the current national clinical care standards for acute stroke.[8] Adherence to quality indicators by number of episodes registered in 2019 for each hospital are illustrated by funnel plots in this report. Funnel plots can be used to display deviations from the average achievement of quality of care.[9] Note that all of the funnel plots below exclude paediatric cases. Hospitals contributing fewer than 50 episodes of care are excluded from all funnel plots of quality indicators. Hospital data were also excluded from the funnel plot analyses if more than 30% of the data for the specific quality indicator was missing.

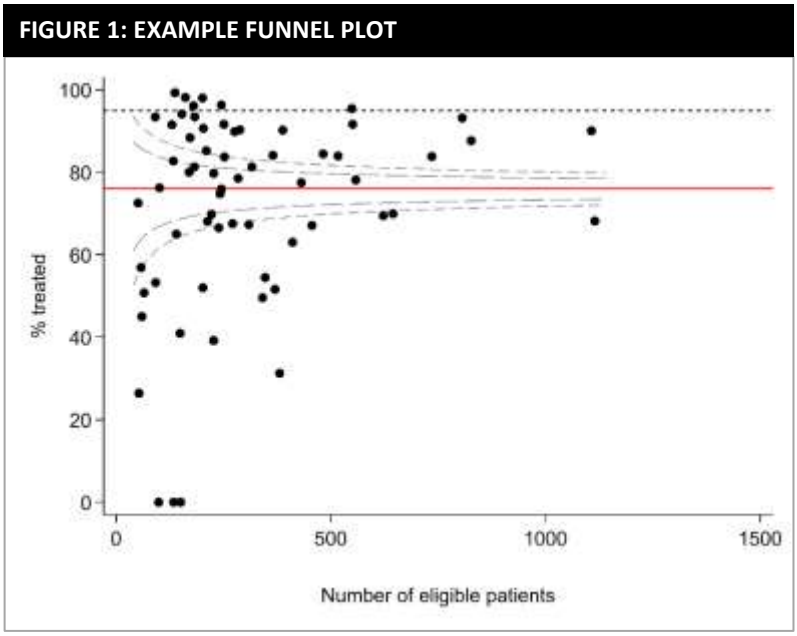
How to read the funnel plots

The horizontal axis depicts the size of the hospital in terms of the number of episodes e.g. the greater the number of episodes, the further to the right will be the representative dot. The vertical axis measures the adherence to quality indicators, expressed as a proportion (%). The horizontal solid centre line shows the overall (all hospitals combined) adherence, e.g. in Figure 1, the overall proportion of patients receiving the indicator was 75%.

The large dashed lines constitute the funnel based on the standard deviation (SD). These large dashed lines are the upper and lower control limits that represent the boundary between 'normal variation' (two SDs from the mean) and 'special cause variation' (three SDs from the mean). The small dashed line indicates the achievable performance benchmark. Hospitals above the three SD limits line may be considered as having 'good performance', while those below the three SD limits line may be considered as having 'poor performance', relative to the average performance of the hospitals included in the sample.

Care must be taken in interpreting these funnel plots when the data are skewed because the control limits rely on the assumption that the distribution follows a bell curve or '*normal distribution*'. Therefore, when there are small numbers of hospitals included, the funnel plots are less reliable, and should be interpreted with caution.

FIGURE 1: EXAMPLE FUNNEL PLOT



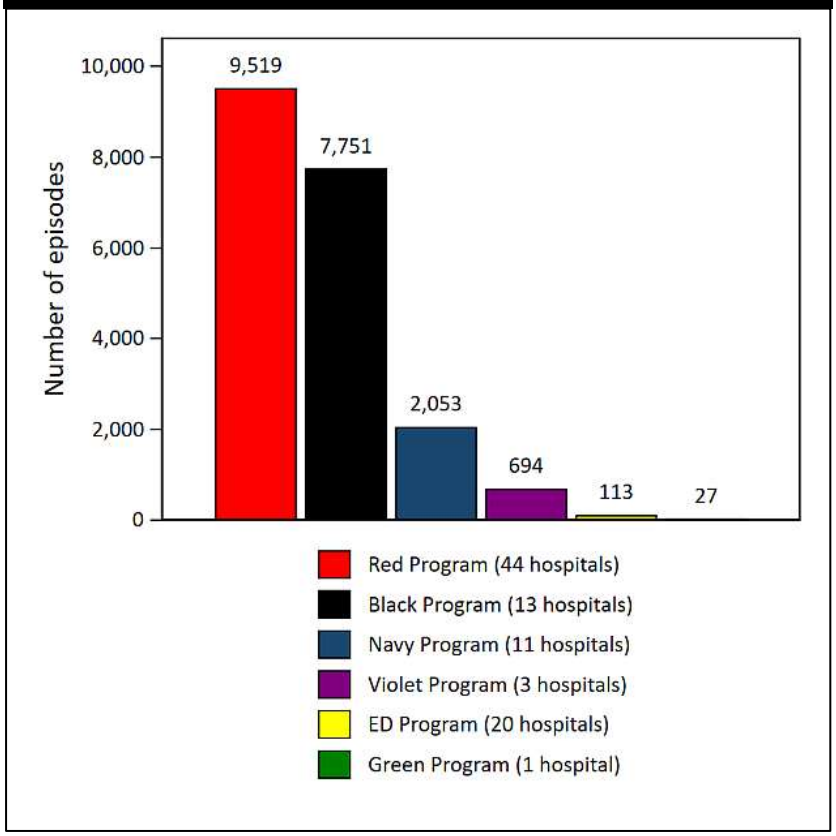
Each dot represents the mean adherence for an individual hospital.

CHARACTERISTICS OF HOSPITALS IN 2019

HOSPITALS

In 2019, 72 hospitals provided data for 20,044 episodes of admitted care and 113 emergency department episodes (Figure 2). The majority of hospitals (n=44) used the Red data collection program (demographics, indicators of evidence-based care, hospital outcomes and discharge data, additional variables related to provision of intravenous thrombolysis), while another 13 hospitals used the Black data collection program (the same as the Red program plus ECR variables; Appendix H). In New South Wales (NSW), 11 hospitals used the Navy program and three used the Violet program, which contained additional state specific variables as well as Red and Black program variables. One paediatric hospital used the Green program which is a minimum dataset of demographics and core processes of care.

FIGURE 2: NUMBER OF EPISODES ENTERED IN 2019, BY DATA COLLECTION PROGRAM



The characteristics of the 72 participating hospitals in 2019 are shown in Table 1. In2019, there were two hospitals located in the Australian Capital Territory (ACT), 14 in NSW, 21 in Queensland (QLD), 29 in Victoria (VIC), and three each in Tasmania (TAS) and South Australia (SA). Of the 72 hospitals, one was a private hospital located in QLD and one was a children's hospital in VIC. There were 38 hospitals located in a major city. Overall, 66 participating hospitals had a stroke unit and 65 provided thrombolytic therapy using intravenous tissue plasminogen activator (tPA). Ten hospitals registered 500 or more episodes of stroke/TIA during 2019. Twenty hospitals contributed to the ED dataset (17 regional and 3 metropolitan hospitals) and 17 hospitals contributed to the FeSS dataset.

TABLE 1: CHARACTERISTICS OF ALL PARTICIPATING AUSCR HOSPITALS

		2019					
	Total	***ACT***	***NSW***	***QLD***	***SA***	***TAS***	***VIC***
Number of hospitals	72	*2*	*14*	*21*	*3*	*3*	*29*
Annual number of episodes in the AuSCR*							
<75 episodes	14	*1*	*3*	*2*	*0*	*0*	*8*
75-349 episodes	39	*1*	*9*	*13*	*1*	*2*	*13*
350-499 episodes	9	*0*	*1*	*3*	*1*	*1*	*3*
≥500 episodes	10	*0*	*1*	*3*	*1*	*0*	*5*
Location#							
Major city	38	*2*	*8*	*13*	*3*	*0*	*12*
Inner Regional	26	*0*	*6*	*6*	*0*	*2*	*12*
Outer Regional	8	*0*	*0*	*2*	*0*	*1*	*5*
Stroke unit	66	*2*	*14*	*21*	*3*	*2*	*24*
Used telemedicine	56	*2*	*8*	*19*	*3*	*3*	*21*
Intravenous thrombolysis provided	65	*1*	*14*	*18*	*3*	*2*	*27*
Endovascular Clot Retrieval provided	14	*1*	*3*	*3*	*1*	*1*	*5*
Contributed to the Emergency Department dataset	20	*0*	*6*	*0*	*0*	*1*	*13*
Contributed to the Fever Sugar Swallow dataset	17	*0*	*4*	*2*	*0*	*2*	*9*

**Hospital categories as per the definitions used by the Stroke Foundation of Australia acute clinical audit reports*

#*Location categorised using Australian Statistical Geography Standard Remoteness Structure 2016 (ASGS): Major city = category 1, Inner Regional = 2 and Outer Regional =3*

NUMBER OF PATIENTS AND EPISODES IN 2019

In 2019, there were 18,733 patients registered in the AuSCR (Table 2). During a calendar year, patients may have multiple admissions for stroke or TIA that are eligible for inclusion in the AuSCR. In 2019, there were 20,157 episodes of acute hospital care for the 18,733 patients, of which 19,488 represented a unique stroke or TIA admission. A total of 20,115 episodes of care were captured in the AuSCR in 2019 for 18,692 adult patients.

The median number of episodes per hospital was 224 (Q1 to Q3: 98 to 375.5). The minimum number of episodes registered for any particular hospital was seven at a metropolitan hospital in NSW and the maximum number of episodes registered was at a metropolitan hospital in SA (n=1,193).

TABLE 2: NUMBER OF HOSPITALS, PATIENTS AND EPISODES IN 2019

	All episodes	Adult episodes
Number of episodes	**20,157**	**20,115**
ED episode dataset	**113**	**110**
Admitted episode dataset	**20,044**	**20,005**
Number of patients	**18,733**	**18,692**
Number of unique acute stroke/TIA events recorded in 2019	**19,488**	**19,446**

CHARACTERISTICS OF REGISTRANTS IN 2019

REGISTRANT CHARACTERISTICS

Table 3 provides the baseline characteristics of patients and information related to their first episode of care registered in the AuSCR. Adult and paediatric cases of stroke are presented separately. Ten hospitals admitted paediatric cases (patients aged <18 years) in 2019.

Among the 18,692 adult registrants, the most common country of birth was Australia (71%) followed by the United Kingdom (6%). The remainder were from a range of mainly European or Asian nations. There were 359 adult patients (2%) who identified as having an Aboriginal or Torres Strait Islander background. The majority of the registered adult patients spoke English (92%). The adult registrants had a mean age of 73 years, and 8,157 (45%) were female.

TABLE 3: BASELINE CHARACTERISTICS (ADULTS AND PAEDIATRICS)

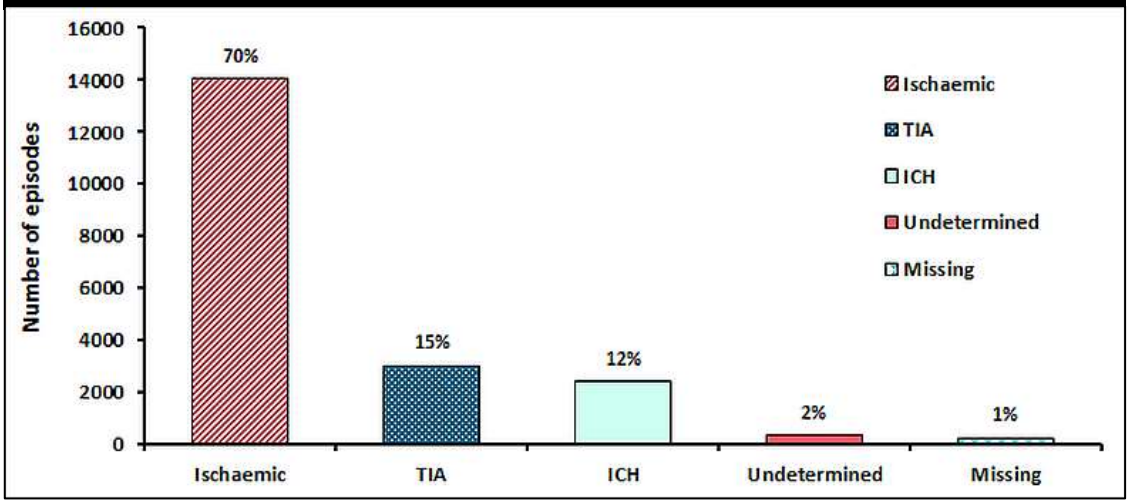
Patients	**Adults (N=18,692)**	**Paediatrics (N=41)**
Episodes	**20,115**	**42**
Age in years, mean (SD)	73 (14)	7 (6)
Age in years, median (Q1 to Q3)	75 (65 to 84)	8 (1 to 13)
Female, n (%)	8,157 (45)	19 (46)
Country of birth, n (%)		
Australia	11,702 (71)	39 (98)
United Kingdom	1,010 (6)	0 (0)
Italy	489 (3)	0 (0)
Other European countries	1,442 (9)	0 (0)
Asia	932 (6)	1 (3)
Others	889 (5)	0 (0)
Aboriginal and/or Torres Strait Islander, n (%)	359 (2)	3 (7)
English spoken, n (%)	14,692 (92)	29 (78)

SD: standard deviation
Q1: 25th percentile
Q3: 75th percentile

CLINICAL CHARACTERISTICS

Of the 20,115 adult episodes, clinicians indicated that there were 14,068 ischaemic strokes, 2,408 intracerebral haemorrhages (ICH), 3,047 TIAs and 365 episodes of undetermined stroke type. There were 227 episodes where the stroke type was missing (Figure 3). Of the episodes with a missing or undetermined stroke type for the clinical diagnosis, ICD-10 codes were provided for 470 episodes, which comprised ischaemic stroke (n=150), ICH (n=25), TIA (n=69). And undetermined stroke type (n=226).

FIGURE 3: DISTRIBUTION OF STROKE SUB-TYPES, BASED ON CLINICAL DIAGNOSIS



ICH: intracerebral haemorrhage
TIA: transient ischaemic attack

STROKE SEVERITY

Patients' ability to walk on admission was recorded in 18,752 episodes (93% of the 2019 cohort), of which 43% were documented as having been able to walk on admission. A National Institutes of Health Stroke Scale (NIHSS) score at the time of presentation to hospital was recorded for 11,293 episodes (56% of the 2019 cohort), of which 7% had a severe stroke (NIHSS ≥21).

Patients with a diagnosis of ischaemic stroke had the lowest proportion of missing NIHSS scores (38%). There were six episodes (3%) with a missing stroke type for which a NIHSS score was recorded. Of the episodes receiving thrombolysis, a NIHSS score was missing for 10%. Episodes treated in a stroke unit had a greater proportion of NIHSS scores recorded than those treated in alternate ward settings (64% vs 38%, p<0.001).

Excluding those with TIA, there were 9,348 episodes with data for both of the stroke severity variables recorded (Table 4). The greatest proportion of patients who were not able to walk on admission had a NIHSS score between 5 and 15, indicating a moderate stroke (45%). Of those who were able to walk on admission, the majority (62%) had a NIHSS score of 1 to 4, indicating a minor stroke.

TABLE 4: NIHSS AND ABILITY TO WALK ON ADMISSION

	Ability to walk on admission	
National Institutes of Health Stroke Scale (NIHSS) categories	**No n (%)**	**Yes n (%)**
No stroke symptoms (0)	173 (3)	667 (18)
Minor stroke (1-4)	1,488 (26)	2,283 (62)
Moderate stroke (5-15)	2,513 (45)	670 (18)
Moderate to severe stroke (16-20)	738 (13)	48 (1)
Severe stroke (21-42)	733 (13)	35 (1)
Total N	**5,645**	**3,703**

Excludes episodes of TIA

ACUTE CARE DATA

OVERALL ADHERENCE TO QUALITY INDICATORS

Arrival within 4.5 hours of symptom onset

For episodes with a date and time of stroke onset and arrival to hospital (N=17,579), 8,101 (46%) arrived to hospital within 4.5 hours of symptom onset. A smaller proportion of patients with ischaemic stroke (42%) arrived to hospital within 4.5 hours of symptom onset compared to ICH (45%), undetermined (49%) or TIA (62%; p<0.001).

Arrival by ambulance

Method of arrival to the emergency department was collected for 19,075 episodes. Of these, 14,620 (77%) were transported by ambulance. The majority (80%) of patients who were transferred from another hospital arrived by ambulance. A greater proportion of patients who arrived by ambulance arrived within 4.5 hours of symptom onset than those patients who arrived by other modes of transport (51% vs 30%, p<0.001). The proportion of patients who arrived by ambulance was smallest for TIAs (70%), and greatest for ICH (84%).

Patient transfers

There were 3,429 episodes (17%) where patients were documented as being transferred from another hospital. Of these, 521 were transferred from another hospital participating in the AuSCR and both episodes were recorded in the AuSCR. The reason for transfer was collected for hospitals participating in the AuSCR Black and Violet data collection programs (Appendix G). Transfer for thrombolysis was indicated for 21 patients (8 QLD; 6 SA; 5 VIC; 1 ACT; 1 TAS) and transfer for endovascular clot retrieval was indicated for 626 patients (380 VIC; 149 QLD; 48 NSW; 33 SA; 10 ACT; 6 TAS).

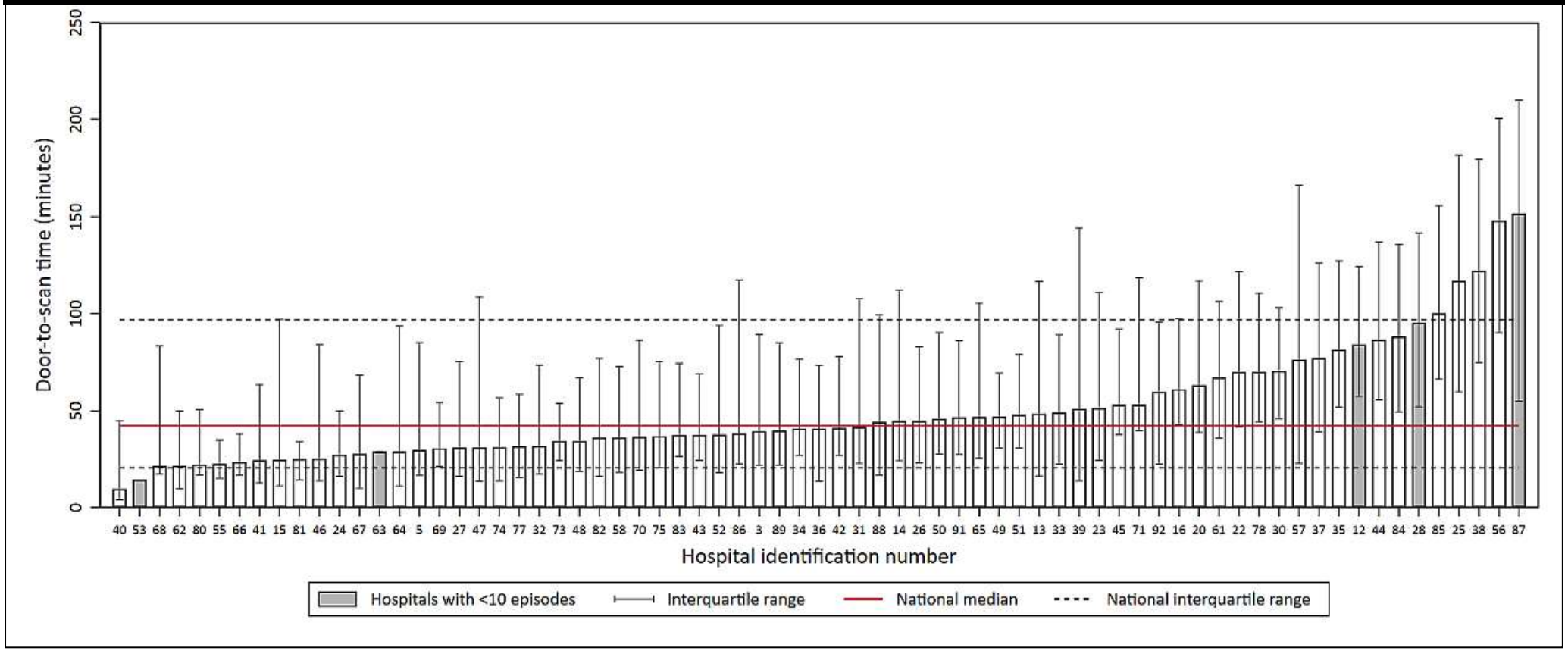
In-patient strokes

There were 691 episodes (4%) that occurred while patients were already in hospital for another condition. The proportion of in-patient strokes varied from 0% to 9% between hospitals. The majority of the in-patient episodes were ischaemic (n=568, 82%) and most in-patient strokes (n=208, 31%) occurred among patients aged between 75 and 84 years.

Brain scans

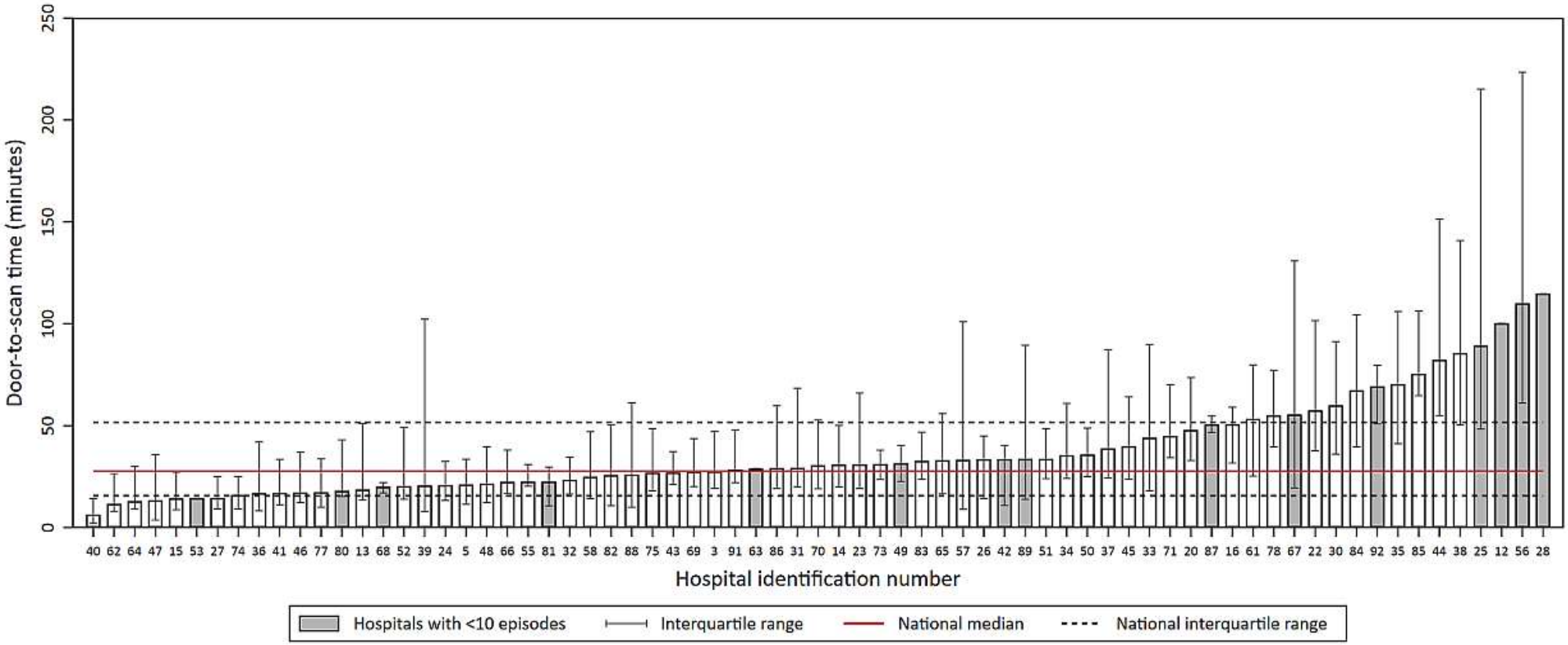
In the hospitals collecting data on the provision of brain scans (n=67), there was evidence that 99% of patients were provided a brain scan. Fewer episodes of undetermined stroke received a brain scan (95%) compared to other stroke types where the majority (>99%) of episodes received a brain scan. Of those who received a brain scan after arrival to hospital, there were 18,193 episodes where a date and time of the brain scan was recorded. Of these, 1,478 episodes received a brain scan prior to transfer to another hospital. The median time from hospital arrival to first brain scan was 42 minutes, with eleven hospitals achieving a median time less than or equal to 25 minutes (Figure 4). The median time to brain scan after arrival to hospital was 28 minutes for patients with ischaemic stroke who arrived within 4.5 hours of symptom onset (Figure 5).

FIGURE 4: MEDIAN DOOR-TO-SCAN TIME, BY HOSPITAL



Data for episodes where a brain scan was provided after 270 minutes of arrival are excluded
Number of episodes with door-to-scan times by hospital range from 1 to 852

FIGURE 5: MEDIAN DOOR-TO-SCAN TIME (ISCHAEMIC STROKE ONLY) ARRIVING WITHIN 4.5 HOURS OF ONSET, BY HOSPITAL



Data for episodes where a brain scan was provided after 270 minutes of arrival are excluded
Number of episodes with door-to-scan times by hospital range from 1 to 491

Thrombolysis treatment delivery

In 2019, thrombolysis was calculated only for episodes of ischaemic stroke where thrombolysis had not already been provided prior to hospital arrival, unless there was documented evidence that thrombolysis administration was initiated in the Melbourne Mobile Stroke Unit. Of the eligible episodes of ischaemic stroke (N=13,645), 1,506 (11%) were provided with thrombolysis treatment (Figure 6). Of these, 182 episodes received thrombolysis for the first time after transfer from another hospital. Overall rates of thrombolysis varied significantly by state (p<0.001): 13% (VIC); 12% (NSW); 11% (ACT); 10% (SA); 10% (TAS); and 9% (QLD). Thrombolysis treatments were also significantly higher (p<0.001) in hospitals located in major cities (12%) compared to those located in inner regional (9%) or outer regional Australia (9%). Hospitals providing endovascular reperfusion therapy also had a higher proportion of patients provided with thrombolysis (14%; p<0.001) compared to hospitals which did not offer this therapy (9%).

Of the 5,053 eligible patients with ischaemic stroke who arrived within 4.5 hours of symptom onset, 26% were provided with thrombolysis. Of the 1,463 episodes with a date and time recorded for the provision of thrombolysis that was not administered prior to hospital arrival, 34% had a door-to-needle time under 60 minutes. The median door-to-needle time was 72 minutes and median onset-to-needle time was 154 minutes. There was no difference in the median onset-to-needle time between patients who were directly admitted and those transferred from another hospital (155 vs 149 minutes; p=0.05). For those provided with thrombolysis, the median door-to-scan time was 21 minutes.

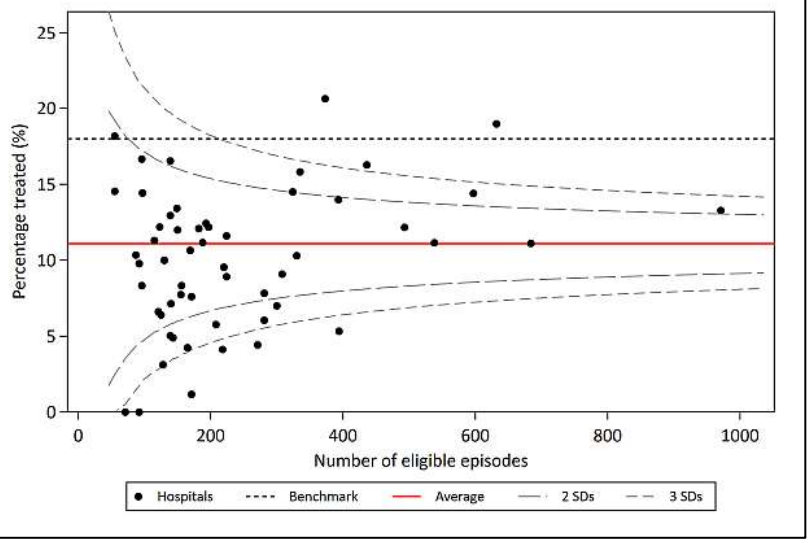
At a hospital level, nine hospitals had a median door-to-needle time of 60 minutes or less (Figure 7). Patients who were treated in an inner or outer regional hospital were less likely to have a door-to-needle time under 60 minutes compared to patients treated at a metropolitan hospital (23% vs 38%; p<0.001).

THROMBOLYSIS BENCHMARKS*†

- The achievable benchmark for receiving intravenous thrombolysis (if an ischaemic stroke) was 18% and the average adherence was 11% (Figure 6).
- The achievable benchmark for door-to-needle time within 60 minutes was 66% and the average adherence was 34%.

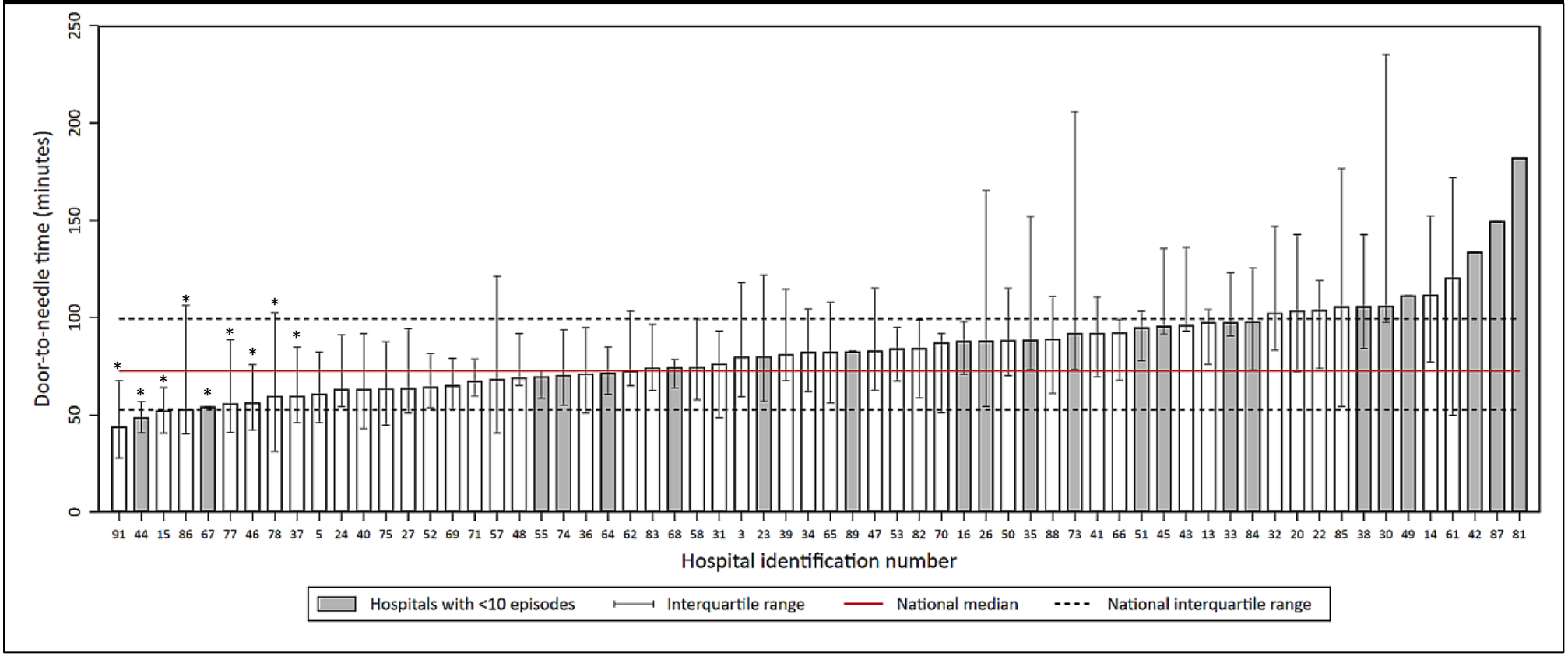
**Benchmark based on a modified ABC™ method using data from hospitals with at least 50 eligible episodes.*
† Adherence and benchmarks related to thrombolysis exclude episodes of ischaemic stroke where thrombolysis had already been provided prior to arrival to hospital, unless there was documented evidence that thrombolysis administration was initiated in the Melbourne mobile stroke unit

FIGURE 6: RECEIVED INTRAVENOUS THROMBOLYSIS, BY HOSPITAL



Each dot represents the mean adherence for an individual hospital.

FIGURE 7: DOOR-TO-NEEDLE TIMES, BY HOSPITAL



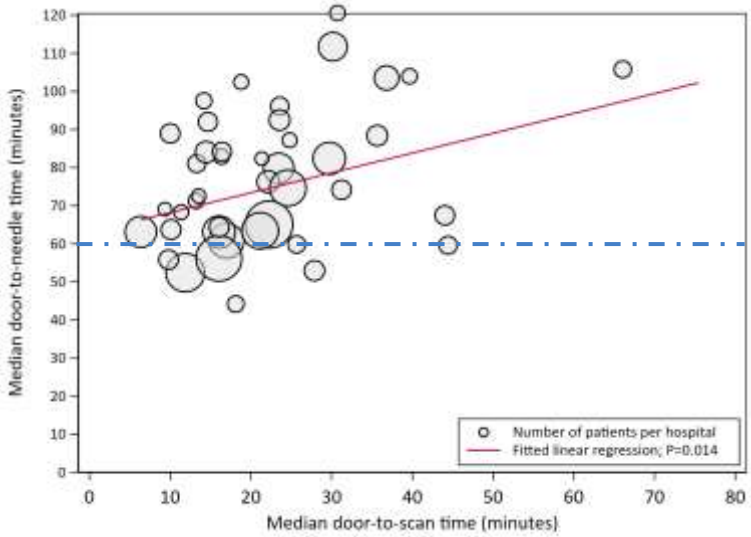
** Median door-to-needle time of 60 minutes or less*

Data for episodes where thrombolysis was provided prior to arrival or after 270 minutes of arrival are excluded.

Number of episodes with door-to-needle times by hospital range from 1 to 125.

The relationship between door-to-scan times and door-to-needle times for hospitals providing thrombolysis to ten or more patients is illustrated in Figure 8. In unadjusted linear regression analysis, each one-minute reduction in door to scan time was associated with a 0.6-minute faster provision of thrombolysis among hospitals (p=0.014). However, faster door-to-scan times only partially explain the observed variation in door-to-needle times. Other patient, clinical or system factors are also contributing to the speed of thrombolysis delivery and need to be understood in terms of why many hospitals fail to treat the majority of patients under 60 minutes from arrival (*indicated by the number of hospitals, denoted by a bubble, above the blue dashed line in Figure 8*).

FIGURE 8: RELATIONSHIP BETWEEN MEDIAN DOOR-TO-SCAN TIME AND MEDIAN DOOR-TO-NEEDLE TIME



Number of episodes with both door-to-scan times and door-to-needle times by hospital range from 10-129.

The size of the markers in the bubble plot represent the number of patients provided with thrombolysis relative to other hospitals in the bubble plot.

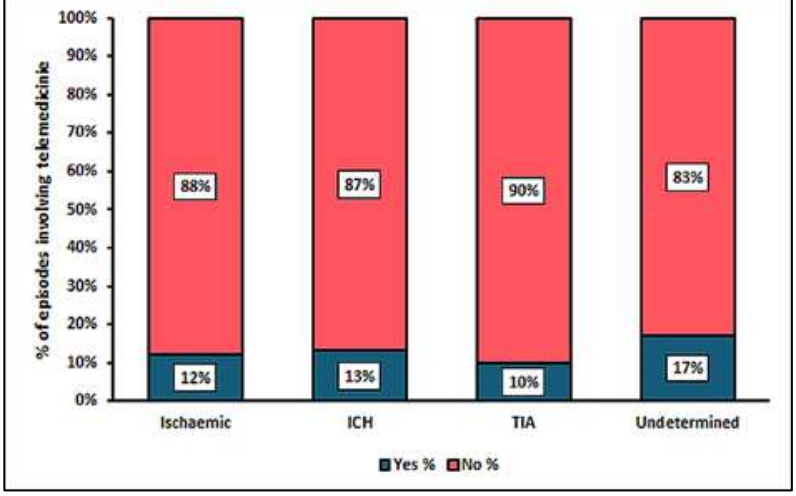
Quality of care target

Involvement of telemedicine in acute stroke care

Telemedicine consultations were provided at 56 hospitals (21 VIC; 19 QLD; 8 NSW; 3 SA; 3 TAS; and 2 ACT). At these 56 hospitals, information on the involvement of telemedicine was available for 14,657 episodes, of which 2,369 (16%) telemedicine consultations were conducted.

There were 1,696 patients with ischaemic stroke who received a telemedicine consultation (Figure 9). Of the patients who had not already received thrombolysis during an earlier episode (N=1,618), 289 patients (18%) received a telemedicine consultation and were provided with thrombolysis. The median door-to-needle time for these cases was 88 minutes (Q1 to Q3: 67 to 113). Five hospitals had a median door-to-needle time of 60 minutes or less when telemedicine was used.

FIGURE 9: CLINICAL DIAGNOSIS OF PATIENTS PROVIDED WITH A TELEMEDICINE CONSULTATION

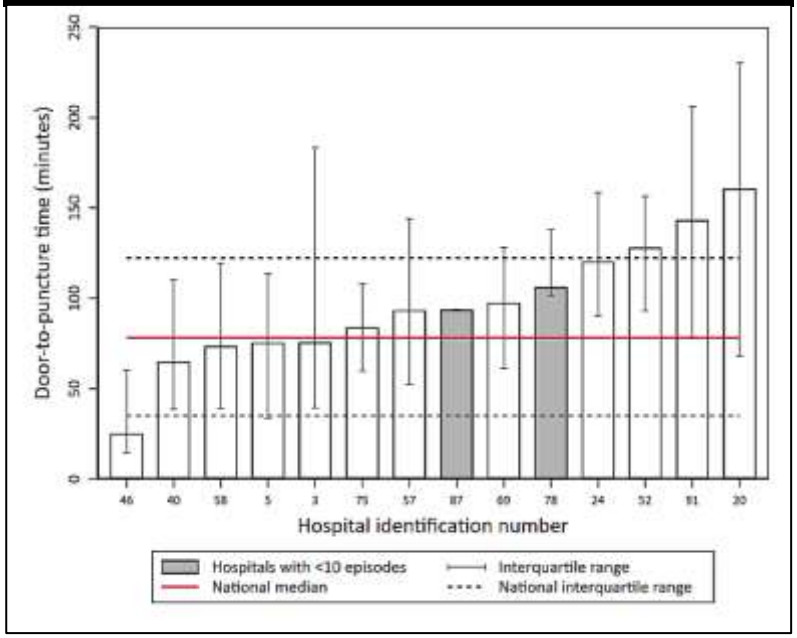


ICH: intracerebral haemorrhage
TIA: transient ischaemic attack

Endovascular clot retrieval (ECR)

There were 1,220 patients with ischaemic stroke who received ECR at 14 hospitals (5 in VIC, 3 in NSW, 3 in QLD, 1 in ACT, 1 in SA and 1 in TAS). For the episodes where times of both arrival and treatment were collected, median time from arrival to groin puncture was 78 minutes (Figure 10) and median arrival to recanalisation time was 125 minutes (Figure 11). For patients transferred from another hospital, the median onset to groin puncture time was significantly longer at 280 minutes compared to direct presentations (198 minutes; p<0.001). In contrast, for transferred patients the median time from arrival to groin puncture was 71 minutes faster when compared to direct presentations (32 minutes vs 103 minutes; p<0.001).

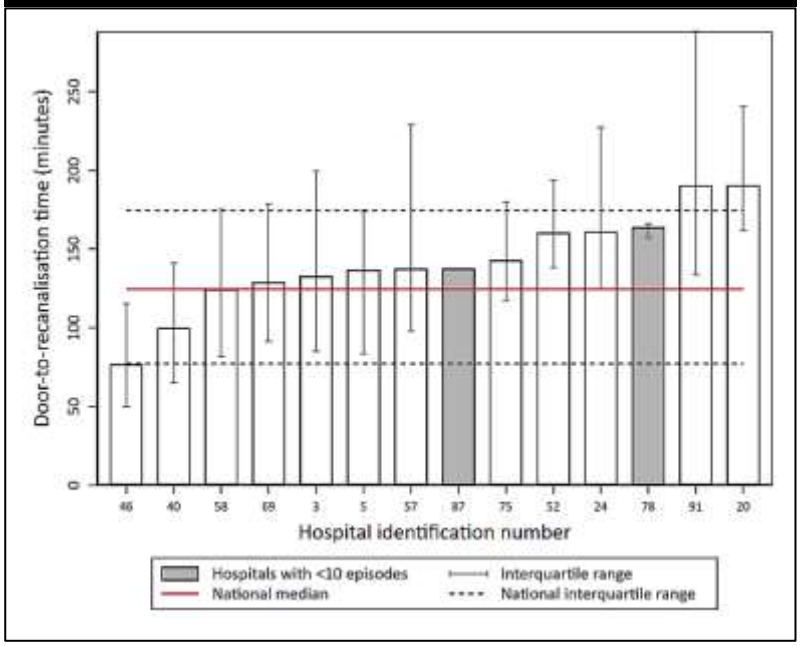
FIGURE 10: DOOR-TO-PUNCTURE TIME FOR PATIENTS RECEIVING ECR, BY HOSPITAL



Data for episodes where door-to-puncture time was greater than 720 minutes were excluded.

Number of episodes with door-to-puncture time by hospital range from 1 to 218.

FIGURE 11: DOOR-TO-RECANALISATION TIME FOR PATIENTS RECEIVING ECR, BY HOSPITAL



Data for episodes where door-to-puncture time was greater than 720 minutes were excluded.

Number of episodes with door-to-recanalisation time by hospital range from 1 to 223.

ECR BENCHMARK*

- The achievable benchmark for receiving ECR (if an ischaemic stroke) was 31% with seven hospitals contributing to the benchmark. The average adherence was 21% across all hospitals who delivered ECR services.

**Benchmark based on a modified ABC^{TM} method using data from hospitals with at least 50 eligible episodes*.

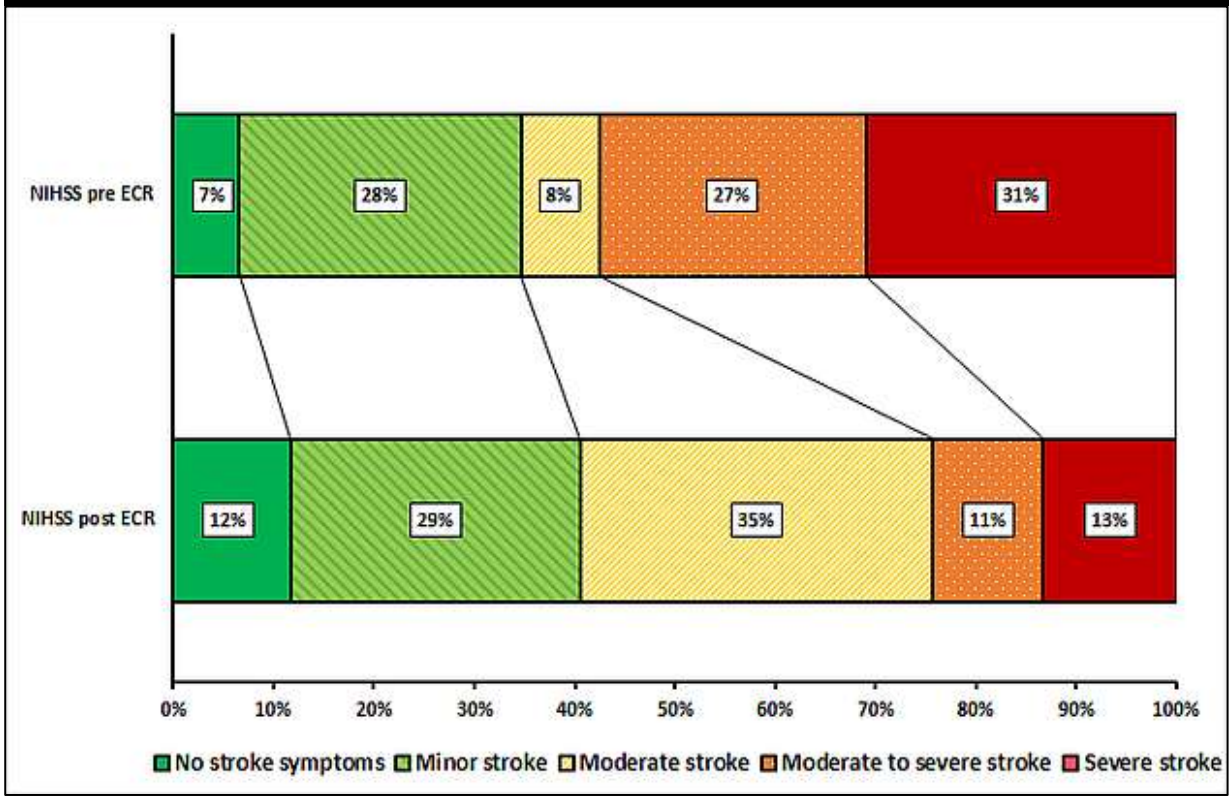
National Institutes of Health Stroke Scale (NIHSS) before and after ECR

Stroke severity is able to be objectively assessed using the NIHSS. The NIHSS score is also used to assess eligibility for some treatments, as well as to examine the effectiveness of treatments.

Data quality for the completeness of pre- and post-ECR NIHSS variable was generally poor, with the majority of records either missing data or reported as unknown (see AuSCR 2019 Annual Data Quality Report available at https://auscr.com.au/about/annual-reports/).

Of the 1,220 patients provided with ECR, 805 had a NIHSS score pre-ECR recorded (66% complete) and 767 had a NIHSS score post-ECR recorded (63% complete). A summary of NIHSS scores before and after ECR are provided in Figure 12.

FIGURE 12: NIHSS SCORES BEFORE AND AFTER ECR



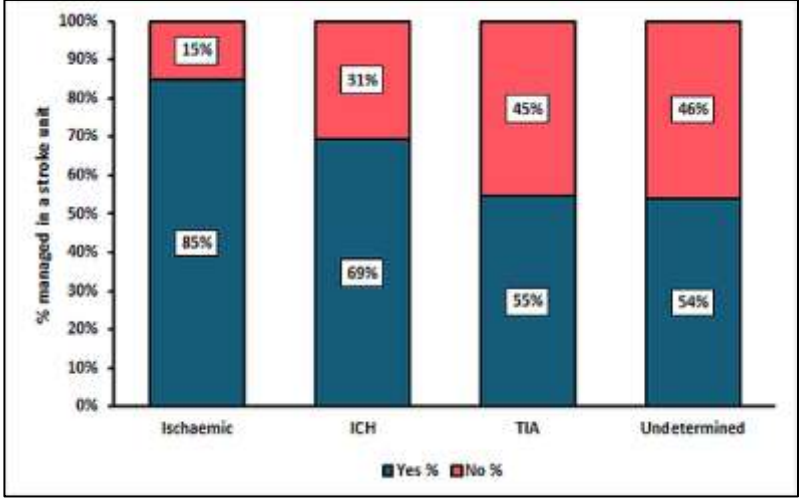
Key to NIHSS scores
0: No stroke symptoms
1-4: Minor stroke
5-15: Moderate stroke
16-20: Moderate to severe stroke
21-42: Severe stroke

NIHSS: National Institute of Health Stroke Scale
ECR: endovascular clot retrieval

Stroke unit care

Approximately three quarters of all episodes (77%) were treated in a stroke unit. Of the patients with ischaemic stroke, 85% were treated in a stroke unit, compared to 69% of those with ICH, 55% of those with TIA and 54% of those with undetermined stroke type (Figure 13). Patients who experienced a stroke or TIA while already in hospital for a different condition (i.e. an in-patient episode) were treated in a stroke unit less often than those who presented from the community (56% vs 79%, p<0.001). Overall a smaller proportion of women were managed in a stroke unit compared to men (44% vs 56%; p<0.001). After controlling for differences in age, stroke type, stroke severity, in-hospital stroke and hospital transfers, women were 13% less likely to have been managed in a stroke unit than men (95% CI: 6-20%).

FIGURE 13: TREATED IN A STROKE UNIT, STRATIFIED BY STROKE TYPE



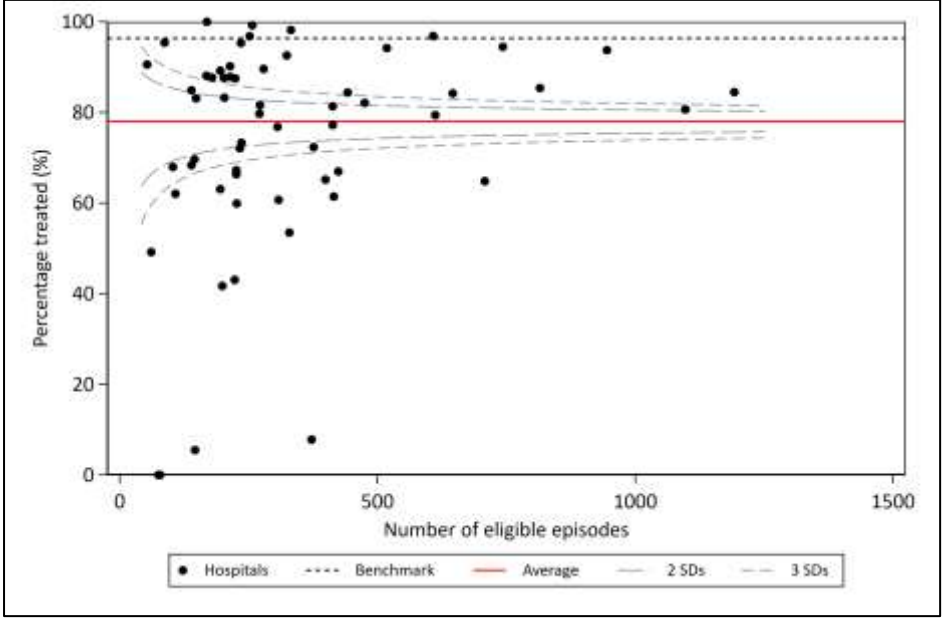
ICH: intracerebral haemorrhage
TIA: transient ischaemic attack

TREATMENT IN A STROKE UNIT BENCHMARK*†

- The achievable benchmark for receiving care in a stroke unit was 96% and the average adherence was 77% (Figure 14).

**Benchmark based on a modified ABC™ method using data from hospitals with at least 50 eligible episodes.*
† Adherence and benchmarks related to stroke unit care exclude ED episodes.

FIGURE 14: TREATMENT IN A STROKE UNIT, BY HOSPITAL



Each dot represents the mean adherence for an individual hospital.

OTHER ACUTE ASSESSMENT AND MANAGEMENT PRACTICES

Hyperacute antithrombotic therapy

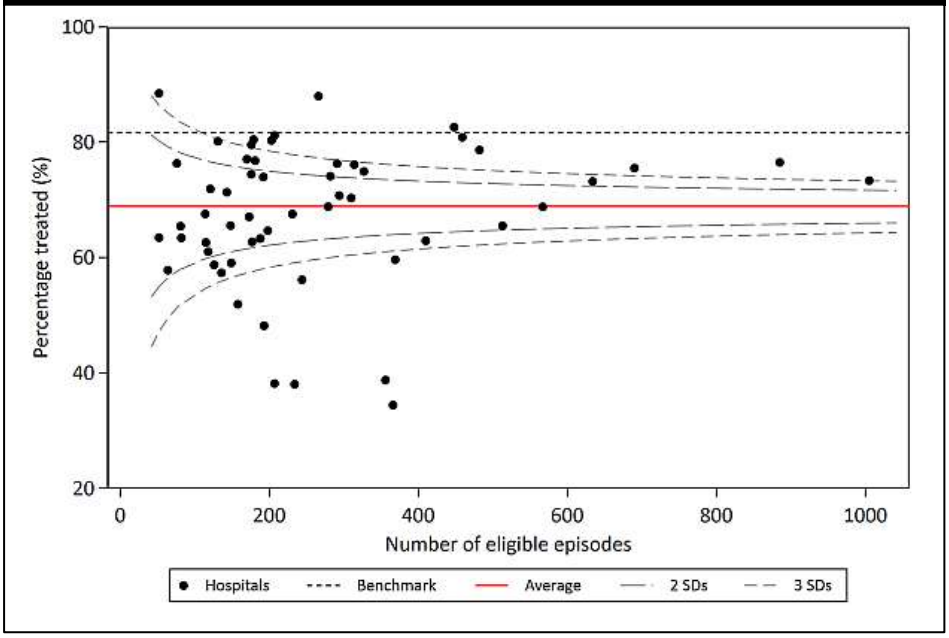
Due to changes in the clinical guidelines for stroke management, we are reporting a combined measure for the hyperacute provision of any antithrombotic agent, instead of the provision of antiplatelet (aspirin) therapy use only. After excluding contraindicated cases and episodes of intracerebral haemorrhage, hyperacute antithrombotic therapy was provided within 48 hours of stroke onset in 69% of episodes (Figure 15, Table 5).

HYPERACUTE ANTITHROMBOTIC THERAPY BENCHMARK*†

- The achievable benchmark for hyperacute antithrombotic therapy, was 82% and the average adherence was 69% (Figure 15).

** Benchmark based on a modified ABC™ method using data from hospitals with at least 50 eligible episodes.*
† Adherence and benchmarks related to hyperacute antithrombotic therapy exclude episodes of intracerebral haemorrhage, episodes with contraindications, and ED episodes.

FIGURE 15: HYPERACUTE ANTITHROMBOTIC THERAPY, BY HOSPITAL



Each dot represents the mean adherence for an individual hospital.

Mobilisation

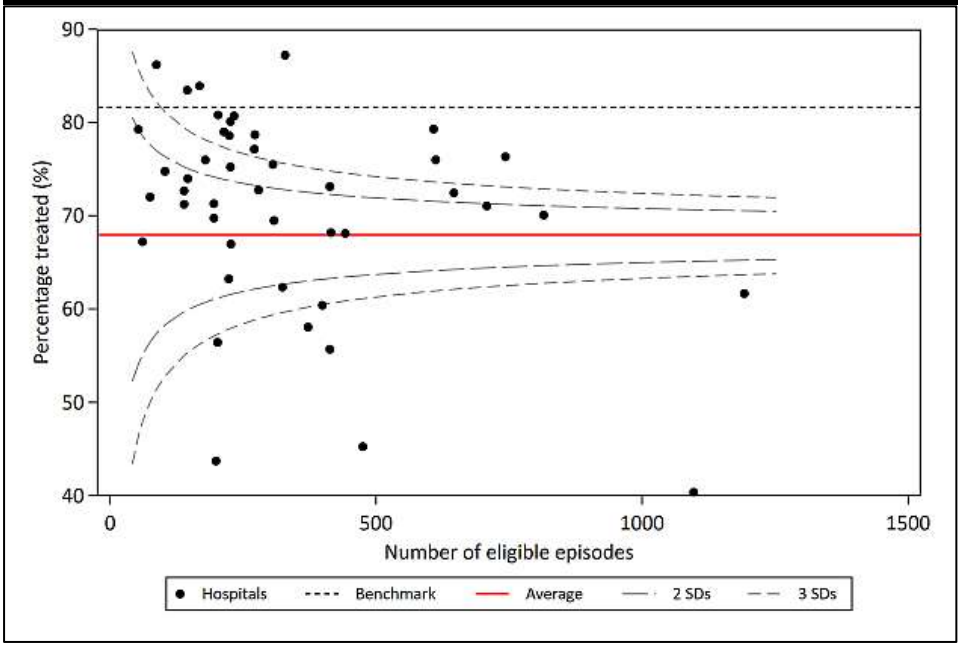
Of the patients treated at a hospital participating in either the AuSCR Red or Black programs, 85% were mobilised during their episode of care with the majority of patients (68%) mobilised on the same day, or the day after, arrival to hospital (Figure 16, Table 5).

MOBILISATION ON SAME DAY OR DAY AFTER ARRIVAL BENCHMARK*†

- The achievable benchmark for mobilisation on the same day, or day after hospital arrival, was 81% and the average adherence was 68% (Figure 16).

**Benchmark based on a modified ABC™ method using data from hospitals with at least 50 eligible episodes.*
† Adherence and benchmarks for mobilisation relate only to hospitals participating in AuSCR Red or Black programs.

FIGURE 16: MOBILISATION ON SAME DAY OR DAY AFTER ARRIVAL, BY HOSPITAL



Each dot represents the mean adherence for an individual hospital.

Swallow screen and assessment

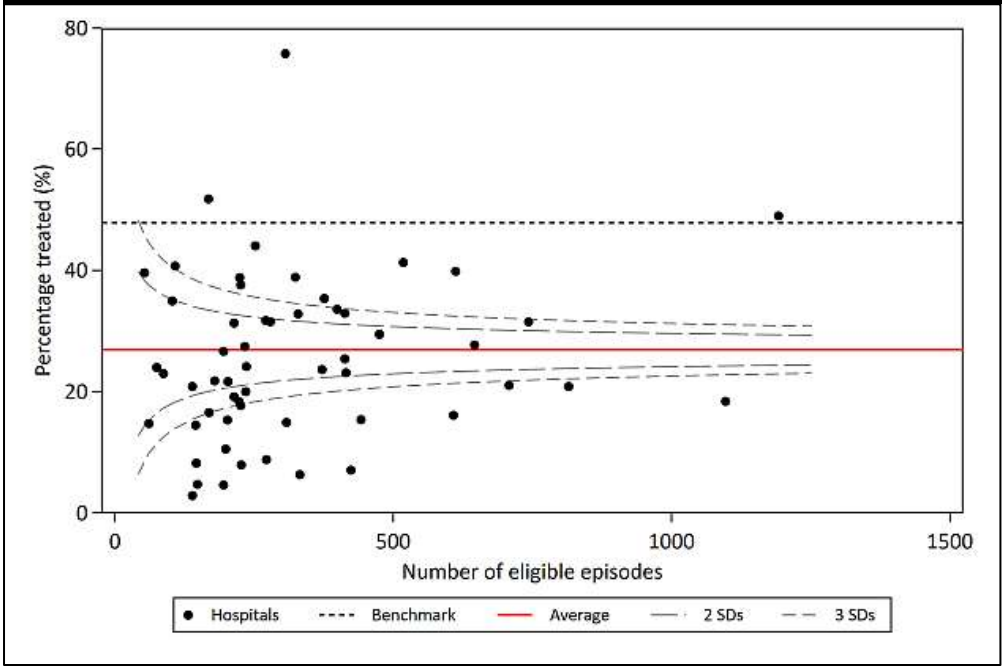
A formal swallow screen was undertaken in approximately half (55%) of all episodes, whereas a swallow assessment conducted by a speech pathologist was completed in 69% of episodes in 2019 (Figures 17 and 18, Table 5). Overall, a swallow screen or assessment was conducted within four hours of arrival to hospital for 27% of episodes. A swallow screen or assessment that occurred *prior* to oral intake was documented in 58% of episodes. These measures are also considered within the full FeSS set of indicators (see next section for fever and glucose monitoring).

SWALLOW SCREEN AND ASSESSMENT BENCHMARKS*

- The achievable benchmark for a swallow screen or assessment within 4 hours of arrival, was 48% and the average adherence was 27% (Figure 17).
- The achievable benchmark for a swallow screen or assessment prior to oral intake, was 84% and the average adherence was 58% (Figure 18).

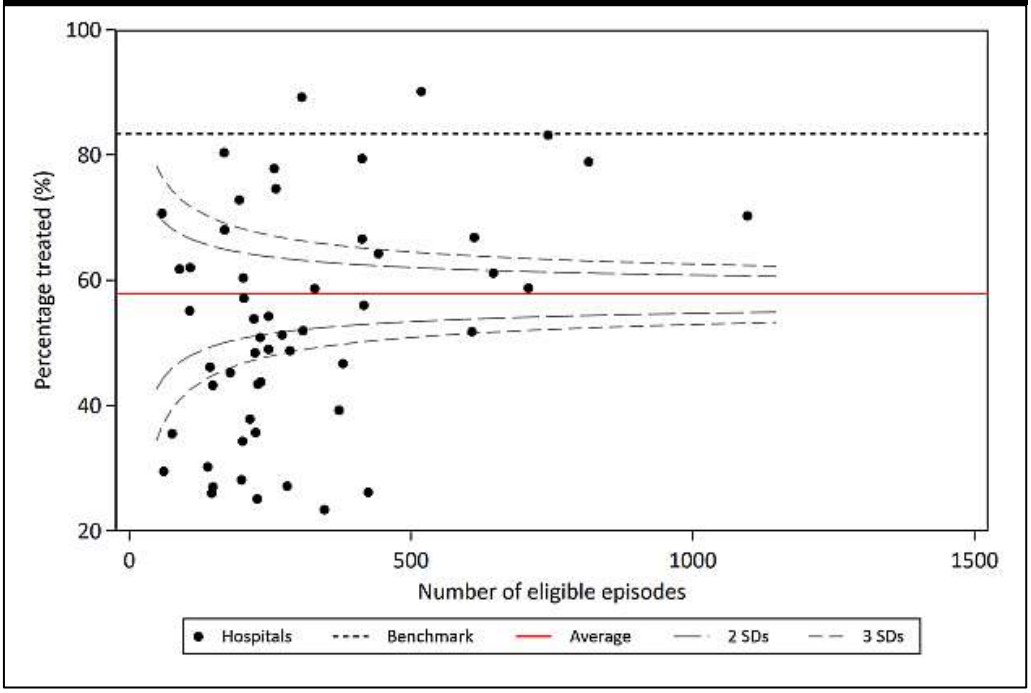
** Benchmark based on a modified ABC™ method using data from hospitals with at least 50 eligible episodes*

FIGURE 17: SWALLOW SCREEN OR ASSESSMENT WITHIN 4 HOURS OF ARRIVAL, BY HOSPITAL



Each dot represents the mean adherence for an individual hospital.

FIGURE 18: SWALLOW SCREEN OR ASSESSMENT PRIOR TO ORAL INTAKE, BY HOSPITAL



Each dot represents the mean adherence for an individual hospital.

Monitoring and management of fever and blood glucose

In 2019, 17 hospitals participated in the collection of additional variables (the FeSS dataset), which included the documentation of fever and hyperglycaemia in addition to swallow (Appendix H). A total of 988 records were completed in the FeSS dataset in 2019 (Table 6). The majority of patients (93%) had a temperature recorded at least 4 times on the day of admission. Of the 123 patients with a documented fever (temperature ≥37.5°C) within 72 hours of admission, 34% were administered paracetamol.

The majority (63%) of the 988 episodes with FeSS data available had blood glucose levels recorded at least 4 times on the first day of the ward admission. Of those that were tested for blood glucose levels (N=988), 16% recorded levels above 10mmols/L. Of those that recorded an elevated blood glucose level (N=154), approximately one third (32%) were administered insulin within the first hour of the measured elevation.

TABLE 5: STROKE EVALUATION AND THERAPY BY STROKE TYPE

Hospital stroke care	All episodes	Ischaemic	ICH	TIA	Undetermined
Antithrombotic therapy within 48 hours of stroke onset*	69%	68%	N/A	75%	55%
Mobilised during episode	85%	89%	63%	91%	75%
Mobilised same day or day after arrival	68%	69%	41%	87%	61%
If unable to walk independently, patient mobilised during episode	79%	84%	55%	90%	58%
If unable to walk independently, patient mobilised same day or day after arrival	56%	60%	32%	82%	39%
Swallow screen conducted	55%	59%	42%	50%	47%
Screened within 4 hours of arrival	23%	25%	16%	23%	17%
Screened within 24 hours of arrival	49%	53%	36%	47%	38%
Swallow assessment conducted	69%	77%	60%	46%	58%
Assessed within 4 hours of arrival	7%	7%	5%	6%	6%
Assessed within 24 hours of arrival	43%	47%	35%	32%	35%
Swallow screen or assessment within 4 hours of arrival	27%	29%	19%	27%	20%
Swallow screen or assessment prior to oral intake	58%	63%	57%	43%	45%

* *Excludes intracerebral haemorrhage, contraindicated and those provided with another antithrombotic medication*
ICH: intracerebral haemorrhage
TIA: transient ischaemic attack
N/A: not applicable

TABLE 6: MONITORING AND MANAGEMENT OF FEVER AND BLOOD GLUCOSE

Fever and Blood Glucose	All episodes N= 988
Temperature recorded at least 4 times on day one of ward admission	93%
Patient developed a fever of ≥37.5C in the first 72 hours following admission	12%
Where fever was present, paracetamol was administered within one hour of the first elevated temperature measurement	34%
Finger prick blood glucose documented at least 4 times on day one of ward admission	63%
Patient developed blood glucose level above 10 mmols/L	16%
Where patient developed blood glucose level above 10 mmols/L, insulin was administered within the first hour of elevated blood glucose measurement	32%

DISCHARGE MEDICATIONS FOR STROKE PREVENTION

Overall, among those who were alive at discharge, 74% were discharged on an antihypertensive medication. Among those with an ICH, 77% were discharged on an antihypertensive medication. Antithrombotic medications were prescribed at discharge for 91% of patients with an ischaemic stroke or TIA, and lipid-lowering medications were prescribed for 78% of these patients at discharge (Table 7). Of the patients with ischaemic stroke, 63% were discharged on a combination of antihypertensive, antithrombotic and lipid-lowering medications. Patients who were discharged on a combination of medications were more likely to be aged ≥75 years (62% versus 60%; p=0.011), male (64% versus 59%; p<0.001), or treated in a regional hospital (68% versus 58%; p<0.001), compared to those not provided with all three medications.

TABLE 7: DISCHARGE MEDICATIONS, BY STROKE TYPE

Medication on discharge	All episodes	Ischaemic	ICH	Transient ischaemic attack
Discharged on an antihypertensive medication*	74%	76%	77%	70%
Discharged on an antithrombotic medication*†	91%	93%	N/A	91%
Discharged on a lipid-lowering medication*†	78%	79%	N/A	78%
Discharged on a combination of secondary prevention medications*†^	61%	63%	N/A	60%

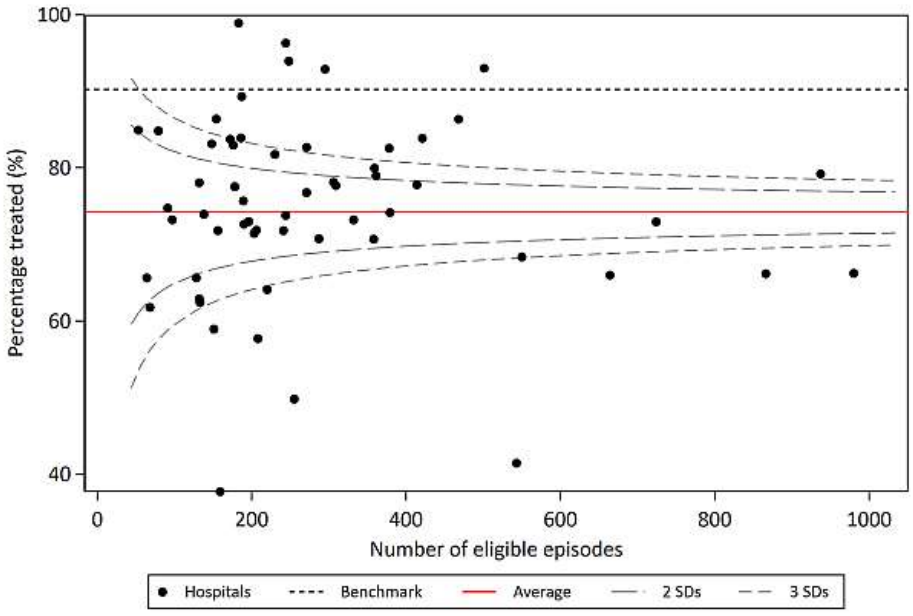
** Excludes episodes with documented contraindications, in-hospital deaths and episodes recorded in the ED dataset*
† Excludes intracerebral haemorrhage
^ A combination of antihypertensive, antithrombotic and lipid-lowering medications
ICH: intracerebral haemorrhage
TIA: transient ischaemic attack
N/A: not applicable

DISCHARGE MEDICATION BENCHMARKS*†

- The achievable benchmark for discharge on an antihypertensive medication was 90% and the average adherence was 74% (Figure 19).
- The achievable benchmark for discharge on an antithrombotic medication was 99% and the average adherence was 91% (Figure 20).
- The achievable benchmark for discharge on a lipid-lowering medication was 93% and the average adherence was 78% (Figure 21).

** Benchmarks based on a modified ABC™ method using data from hospitals with at least 50 eligible episodes.*
† Adherence and benchmarks related to the provision of secondary prevention medications at discharge exclude episodes with documented contraindications, episodes resulting in death while in hospital, and episodes treated in the emergency department prior to transfer to another hospital. Adherence and benchmarks related to antithrombotic and lipid-lowering medications also exclude patients with ICH.

FIGURE 19: DISCHARGED ON ANTIHYPERTENSIVE MEDICATIONS, BY HOSPITAL



Each dot represents the mean adherence for an individual hospital.

FIGURE 20: DISCHARGED ON ANTITHROMBOTIC MEDICATIONS, BY HOSPITAL

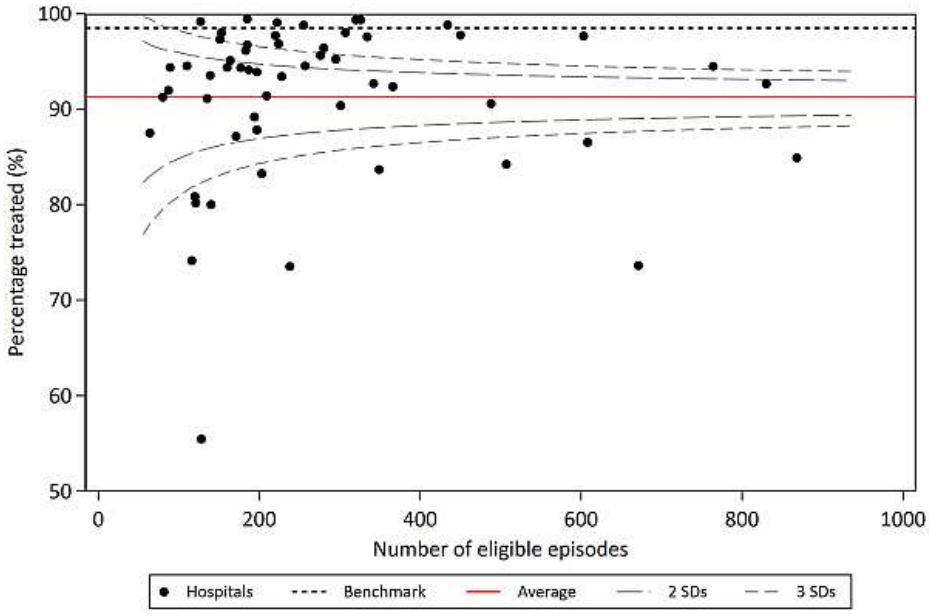
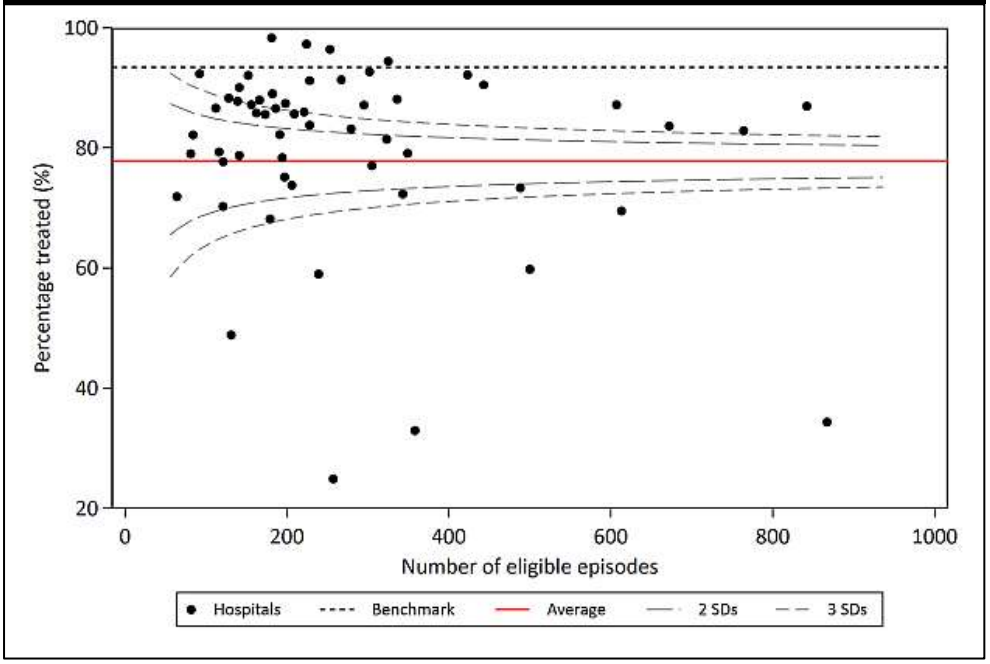


FIGURE 21: DISCHARGED ON LIPID-LOWERING MEDICATIONS, BY HOSPITAL

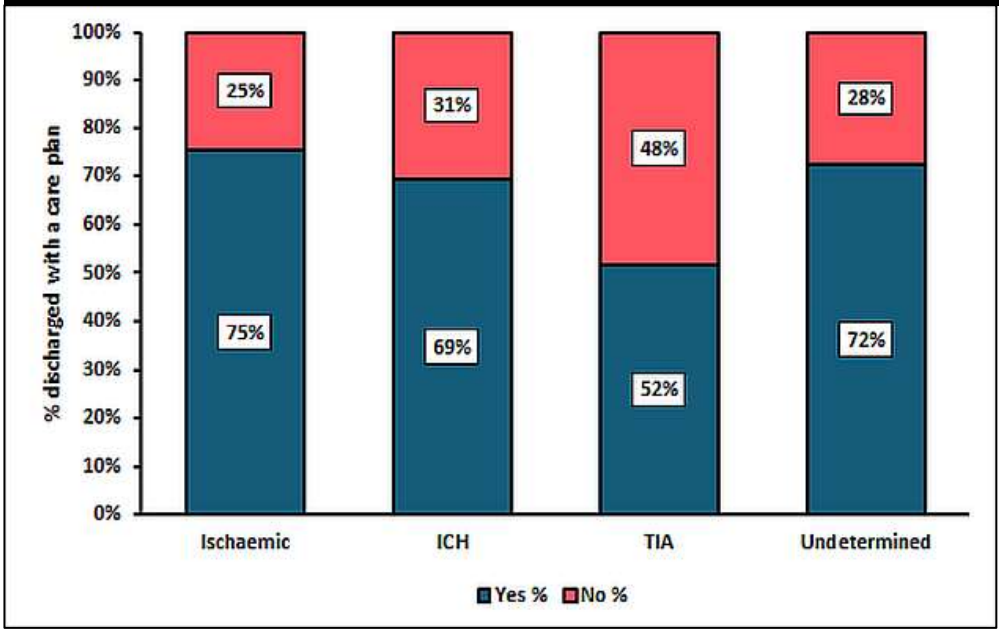


Each dot represents the mean adherence for an individual hospital.

TRANSITION FROM HOSPITAL CARE

Among the 9,826 episodes that were discharged home, or to a residential aged care facility, 68% received a discharge care plan. Of the patients with ischaemic stroke, 75% were provided a care plan at discharge, compared with 69% of those with ICH, 52% of those with TIA and 72% of those with an undetermined stroke type (Figure 22).

FIGURE 22: DISCHARGED TO THE COMMUNITY WITH A CARE PLAN, BY STROKE TYPE

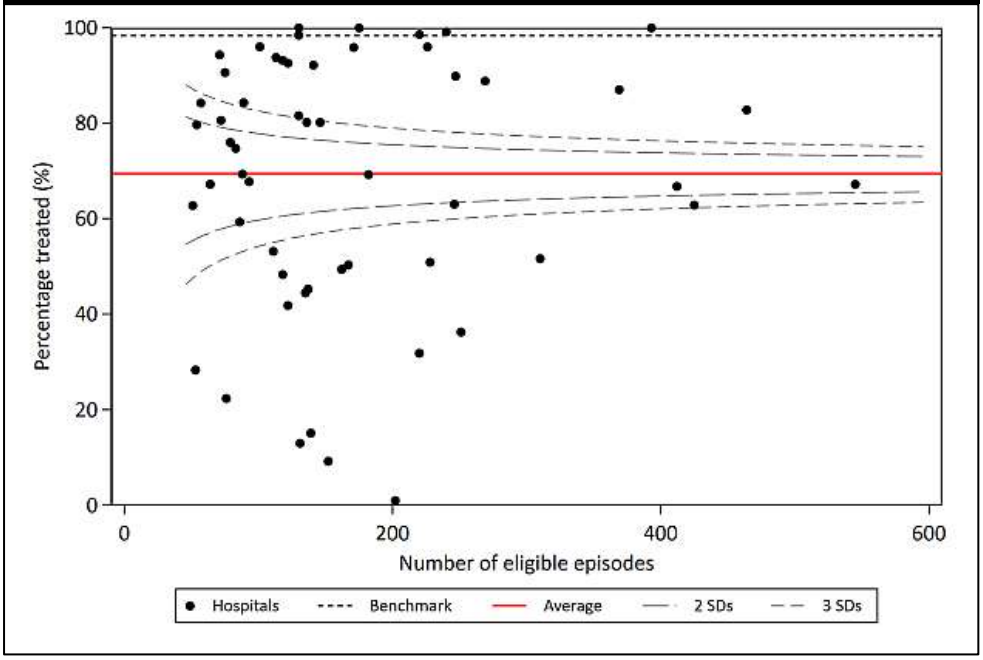


ICH: intracerebral haemorrhage
TIA: transient ischaemic attack

PROVISION OF A DISCHARGE CARE PLAN BENCHMARK*

- The achievable benchmark for the provision of a discharge care plan was 98% and the average adherence was 68% (Figure 23).

FIGURE 23: CARE PLAN PROVIDED IF DISCHARGED HOME OR TO RESIDENTIAL AGED CARE, BY HOSPITAL



Each dot represents the mean adherence for an individual hospital.

HOSPITAL OUTCOME MEASURES

Hospital outcome measures include length of stay, discharge destination and discharge status for admitted patients.

IN HOSPITAL DEATHS

Among the 20,005 admitted adult episodes, 1682 (8%) patients died while in hospital. In-hospital mortality for admitted patients was similar between men and women (p=0.09). However, case fatality was significantly greater for patients with ICH compared to those with ischaemic stroke, undetermined stroke type and TIA (p<0.001). There were no paediatric in-hospital deaths reported.

LENGTH OF STAY

Of the 18,323 admitted episodes that were discharged, 17,923 had information provided on length of stay. Of these episodes, 838 (5%) stayed 21 days or more. The median length of stay was four days (Q1 to Q3: 2 to 7 days; Table 8). Patients with TIA more often had a shorter length of stay (less than five days) compared to patients with stroke (90% TIA, 51% stroke, p<0.001).

There was a statistically significant difference between the length of stay for episodes treated in a stroke unit (median 4 days, Q1 to Q3: 2 to 8 days) and those not treated in a stroke unit (median 2 days, Q1 to Q3: 1 to 5 days, p<0.001).

The median length of stay was longer for patients who experienced a stroke or TIA while already in hospital for a different condition (in-patient episode median 11 days; Q1 to Q3: 6 to 19 days) compared to those presenting from a community setting (median 4 days; Q1 to Q3: 2 to 7 days; p<0.001).

TABLE 8: MEDIAN LENGTH OF STAY

	Median length of stay in days (Q1, Q3)
All discharged episodes	4 (2, 7)
Ischaemic	4 (2, 8)
Intracerebral haemorrhage	6 (3, 12)
Transient ischaemic attack	1 (1,3)
Undetermined	2 (1, 5)
Treated in a stroke unit	
Yes	4 (2, 8)
No	2 (1,5)

Q1: 25th percentile and Q3: 75th percentile

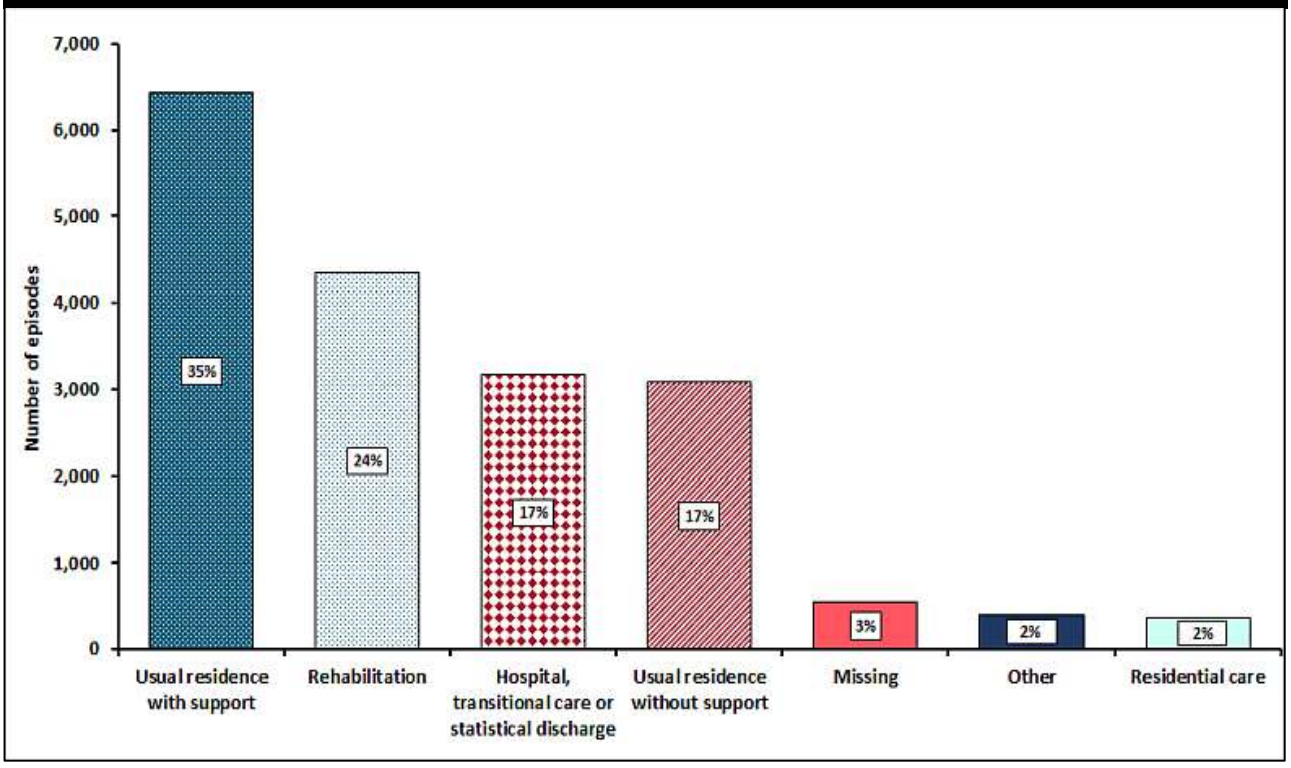
DISCHARGE DESTINATION

In 2019, excluding in-hospital deaths, approximately half of the episodes of care resulted in patients being discharged to their usual residence (n=9518; 52%), with the majority of these patients requiring support (Figure 24). The definition of support provided within a usual residence may include regular care and assistance by health professionals, council services or volunteers including a spouse or family members who may, or may not, be living in the same residence.

Patients managed in a stroke unit had 1.8 times increased odds of being discharged to an in-patient rehabilitation facility compared to those patients not managed in a stroke unit (adjusted odds ratio 1.85, 95% confidence interval 1.64–2.08, p<0.001). These data were adjusted for patient age, sex, type of stroke, ability to walk on admission, in-hospital onset status and hospital transfer status. Patients treated in a stroke unit were more often discharged to in-patient rehabilitation than those not treated in a stroke unit, regardless of whether or not they were able to walk on admission (36% vs 21% unable to walk on admission, p<0.001; 17% vs 6% able to walk on admission, p<0.001). For patients who had a NIHSS recorded, patients treated in a stroke unit were more often discharged to in-patient rehabilitation than those who were not treated in a stroke unit, irrespective of the severity of the stroke indicated by their NIHSS on presentation. Therefore, selection bias, equity considerations and preferences for who accesses inpatient rehabilitation when not treated in stroke units need to be explored.

Most patients with TIA (89%, n=2,696) were discharged home; 2% (n=63) to a rehabilitation setting and the remainder went to residential aged care, transitional care services or other hospitals. It is unclear whether this group of patients had already been living in residential aged care prior to their TIA event or had other co-morbidities, or complications while in hospital, which may have influenced their discharge destination.

FIGURE 24: DISCHARGE DESTINATION, INCLUDING MULTIPLE EPISODES



n=18,323 episodes
Excludes paediatric cases and episodes of care resulting in death while in hospital

DISCUSSION

In the 2019 AuSCR Annual Report, we present information on 20,157 episodes of stroke and TIA collected at 72 hospitals across six states and territories.

Following several years of rapid growth, the number of participating hospitals, and the number of episodes of stroke documented, were similar in 2019 and 2018. In 2019, we saw three new hospitals contribute data to the AuSCR, whereas two other hospitals discontinued contribution. For the first time, we have presented data from two hospitals in the ACT that commenced participation in late 2019 and were funded by ACT Health. The signing of a contract with WA Health also means that we can look forward to the inclusion of data from hospitals located in WA in our 2020 Annual Report. More importantly this will mean that the AuSCR will cover acute care provision, and outcomes for patients with stroke, across seven states and territories.

In this report, we have also presented data from two new optional datasets where data collection commenced in July 2019. The ED dataset, although still in the very early stages of use, will provide much needed data on the provision of care for patients with stroke presenting to EDs, prior to transfer to other hospitals for additional acute care. The uptake of the FeSS dataset was very encouraging in 2019 with the additional variables relating to fever and blood glucose monitoring and control being completed for almost 1000 episodes of care. We look forward to recording many more episodes in 2020 for both of these new datasets. Following the execution of a Deed of Variation with Queensland Health, it will now also be possible for these datasets to be collected by Queensland hospitals in 2020.

Acute care for stroke

In 2019 there was very little change at a national level in the proportion of patients receiving the quality of care indicators for stroke when compared with data presented in the AuSCR 2018 Annual Report.[10] However, great variability *between hospitals* in the provision of clinical care indicators was still apparent, in particular for care in a stroke unit, swallow screening and assessment, and provision of a discharge care plan. Of additional concern are hospitals who are outliers on *several* quality of care metrics in 2019, and who should be the focus of future AuSCR support, including from the Clinical Quality Improvement Committee.

Despite little change in the proportion of patients receiving stroke unit care in 2019, we identified that women were 13% less likely to receive care in a stroke unit. This was significant even when analyses were adjusted for differences in age, stroke type, stroke severity, in-hospital stroke and hospital transfers Given the established relationship between stroke unit care and better patient outcomes [11,12], this disparity in care requires further examination.

Door-to-brain scan time continued to be highly variable between hospitals in 2019. [10] A significant relationship between door-to-brain scan and door-to-needle time for thrombolysis was identified. These delays in the provision of brain scans may be one factor contributing to the relatively slow median door-to-needle times observed when Australian hospitals are compared with those in the United Kingdom and the United States of America.[13-16] In addition, we found that even when hospitals had quicker door-to-brain scan times, many still did not achieve thrombolysis treatment times under 60 minutes from patient arrival to hospital. Therefore, other factors need to be explored to understand the causes of longer door-to-needle times for thrombolysis.

A small decrease in the overall proportion of patients with ischaemic stroke receiving thrombolysis was noted in 2019 (dropping 3% from 2018).[10] This correlates with community perceptions of decreased use of thrombolysis and also data reported from the 2019 Stroke Foundation Audit.[17] Although we cannot comprehensively exclude the possibility that the small decrease may be partly due to our new analysis methods of linking episodes of care for the same stroke event in the case of patient transfers, we believe that this is unlikely. When modelling the new

episode linkage methods with 2019 data, we observed that the figures reported in this current report aligned with the values from our previously reported calculation technique, which either included, or excluded, transfers from thrombolysis provision rates, and which likely represented an overestimate and underestimate of proportions, respectively.

Of ongoing concern in 2019 was that less than one third (27%) of patients received a swallow screen or assessment within four hours of hospital arrival. These data indicate that there is significant room for improvement. Encouragingly, in 2019 there was an 11% increase in swallow screening or assessment prior to oral intake when compared with 2018,[10] with the majority of patients (58%) being screened. While the assessment of fever was very good overall (93%), the initiation of appropriate treatment following a temperature of ≥37.5°C only occurred in one third of episodes where this information was collected. The recommended screening for blood glucose levels was only completed in approximately two thirds of patients, with the subsequent provision of insulin occurring in only one third of patients with an elevated blood glucose level within one hour. These findings further support the rationale for the establishment of the new FeSS dataset. With evidence that these care processes are amenable to change in the ED environment,[2,3] we encourage hospitals to use this dataset to drive quality improvement in the future.

A positive finding from 2019 data was that 68% of patients discharged to the community received a discharge care plan, an increase of six percent from the AuSCR 2018 dataset.[10] This observation is important as the provision of a comprehensive care plan is linked to improved outcomes for patients with stroke. [11,12] However, it is not only the proportion of patients receiving a care plan at discharge that is an important consideration, but also the content of these plans. The AuSCR office continues to be active in reviewing the standards of discharge care plans with participating hospitals during medical record audits conducted for data quality purposes. For more information about data quality of the 2019 dataset please refer to the AuSCR 2019 Data Quality Report which is available at: https://auscr.com.au/about/annual-reports/

A further improvement in the 2019 dataset was the increased proportion of eligible patients who received all three secondary prevention medications at discharge (61%) when compared to 2018 (54%). Of interest is that provision of all three medications remains significantly higher in regional hospitals and for older males. Given the importance of these medications to patient outcomes,[11,12] overall rates and disparities between different patient groups needs to be addressed.

It is also important to acknowledge the challenges of the COVID-19 pandemic for AuSCR operations in Victoria where the AuSCR office is located. During the extensive community lockdowns in 2020, the registry continued to operate remotely, with only a skeleton staff onsite to support the administration of patient follow-up surveys at 90-180 days. As a result, all aspects of usual AuSCR business operations were impacted, including the collection and analysis of 2019 acute and follow-up data. As a consequence of COVID-19 related delays, the 2019 AuSCR Annual Report has been presented in two volumes: the current volume on acute care provision and an accompanying second volume with a focus on patient outcomes data. Despite the significant disruptions due to the COVID-19 pandemic, all eligible patient follow-ups were attempted as per standard AuSCR office practices in early 2020. However, we cannot yet determine any impacts on follow-up response rates at the time of writing this current report. Any potential impacts would have occurred for admissions recorded in the last quarter of 2019, who would have been followed up in the first three to six months of 2020. These data will be presented in the second volume of the 2019 Annual Report.

Conclusion

Disparities related to the quality of stroke care between hospitals, different states, metropolitan and regional areas and between genders were identified in the 2019 dataset. The wide variability in performance between hospitals with respect to quality of care indicators, and hospitals that are outliers across multiple indicators, show there is still considerable work required to improve evidence-based care provision for patients with stroke. These consistently observed differences underpin the need for a clinical quality registry, such as the AuSCR, to continue to

facilitate the continuous collection and analysis of national stroke data. The AuSCR office continues to support sites to understand their data via webinars, training tools and individual correspondence. The role of the newly formed AuSCR Clinical Quality Improvement Committee is also pivotal in supporting staff from participating hospitals to understand and use their data to drive improvements for stroke care and patient outcomes, nationally.

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APPENDIX A: AUSCR GOVERNANCE AND COLLABORATIONS

The AuSCR initiative is undertaken by a consortium of two leading academic research institutes, The Florey Institute of Neuroscience and Mental Health (Stroke Division; AuSCR Data Custodian) and The George Institute for Global Health, and two leading non-government organisations, the Stroke Foundation and the Stroke Society of Australasia (SSA). Collectively, these organisations represent a broad section of the Australian clinical and scientific stroke community. Significant sanction from clinicians and professional associations for the AuSCR initiative has occurred through the AuSCR Consortium partners and the Australian Stroke Coalition (ASC), a network of clinicians and professional associations: (www.australianstrokecoalition.com.au).

The AuSCR Steering Committee provides: governance; maintains the confidence of all parties involved; and contributes to strategic direction. Professor Sandy Middleton continued to be the Chairperson in 2019. The Management Committee includes representatives from the consortium partner organisations, all members having clinical backgrounds in medicine, nursing or allied health. The Management Committee is responsible for the day-to-day operation of the AuSCR, with oversight from the Steering Committee, and works with the AuSCR Office to manage the ongoing operations of the registry. Professor Natasha Lannin was Acting Chair for most meetings subsequent to Professor Craig Anderson's relocation to China (See Appendix B for committee membership lists).

There has been valued support from the Victorian Stroke Clinical Network (VSCN), currently via Safer Care Victoria (SCV) and the Victorian Agency for Health Information (VAHI), and since mid-2015, Queensland Health through a joint project (QSQIP) with the Stroke Foundation. In addition, partnership with the Agency for Clinical Innovation (ACI) in New South Wales and with ACT Health through a joint project with the Stroke Foundation are highly valued.

Collaborations are continuing with staff from the Australian Institute of Health and Welfare, the Population Health Research Network and data linkage units based in health departments within various states (VIC, WA, QLD and NSW) to work through the processes to enable linkage of the AuSCR data with government data such as the NDI and state-level admitted episode datasets and emergency department admissions.

In Victoria, we have continued our collaboration with the Victorian Stroke Telemedicine (VST) program. This approach is mutually beneficial since the VST is required to report to government funders on the rates of intravenous thrombolysis use, and the AuSCR provides a system that can be embedded as part of routine health care monitoring to reliably obtain these data.

In 2019, we were supported by Amgen, Bristol Myers Squibb and Medtronic in conducting a national workshop on stroke data and quality that was co-convened with the Stroke Foundation and the ACI. Such events provide additional opportunities for clinicians and academics to be involved in translational activities to further enhance stroke care and outcomes.

A significant continuing collaboration has been that of working closely with the Stroke Foundation and the ASC to refine the AuSDaT to achieve our common goal of a more efficient, standardised approach to facilitate stroke data collection in Australia.

APPENDIX B: COMMITTEE MEMBERSHIP

AuSCR Steering Committee membership 2019

Prof Sandy Middleton (Chair)	**Director, Nursing Research Institute, St Vincent's Health Australia (Sydney) & Australian Catholic University [NSW]**
Prof Craig Anderson	Executive Director, The George Institute, China & Professor of Neurology and Epidemiology, Faculty of Medicine, UNSW Sydney [NSW]
Ms Toni Aslett	Executive Director, Stroke Services, Stroke Foundation [VIC]
Prof Julie Bernhardt	Head, Stroke Division, Florey Institute of Neuroscience and Mental Health [VIC]
Prof Christopher Bladin	Director, Victorian Stroke Telemedicine Program, The Florey Institute of Neuroscience and Mental Health & Neurologist Eastern Health [VIC]
Mr Greg Cadigan	Project Manager, Queensland Statewide Stroke Clinical Network [QLD]
Prof Dominique Cadilhac	Head, Public Health, Stroke Division, Florey Institute of Neuroscience and Mental Health & Head, Translational Public Health Division, Stroke and Ageing Research, Monash University [VIC]
Dr Helen Castley	Neurologist, Royal Hobart Hospital & Co-chair, Clinical Advisory Group (Neurology & Stroke) [TAS]
Prof Geoffrey Donnan	Professor of Neurology, The University of Melbourne [VIC]
Dr Andrew Evans	Geriatrician & Stroke Physician, Westmead Hospital [NSW]
Dr Rohan Grimley	Conjoint Senior Lecturer Sunshine Coast Clinical School & Chair, Queensland State-wide Stroke Clinical Network [QLD]
A/Prof Peter Hand	Neurologist, Royal Melbourne Hospital & Clinical Lead, Victorian Stroke Clinical Network [VIC]
A/Prof Susan Hillier	Dean, Research (and Research Education), Division of Health Sciences, University of South Australia [SA]
Prof Richard Lindley	Professorial Fellow, The George Institute for Global Health & Professor of Geriatric Medicine, Sydney Medical School, University of Sydney [NSW]
A/Prof Mark Mackay	Paediatric Neurologist, Royal Children's Hospital, Melbourne [VIC]
Prof John McNeil	Head, Department of Epidemiology and Preventive Medicine, Monash University [VIC]
Ms Jennifer Muller	Chair, Consumer Council, Stroke Foundation [QLD]
A/Prof Michael Pollack	Chair, Hunter Stroke Service [NSW]
Mr Mark Simcocks	Consumer Representative, Self-employed [VIC]
Ms Frances Simmonds	Director, Australasian Rehabilitation Outcomes Centre, University of Wollongong [NSW]
Prof Amanda Thrift	Head, Epidemiology and Prevention Division, Stroke and Ageing Research, Monash University [VIC]
Dr Andrew Wesseldine	Geriatrician and Stroke Physician, St John of God Subiaco & State Stroke Director [WA]

APPENDIX B (CONTINUED): COMMITTEE MEMBERSHIP

AuSCR Management Committee membership 2019

Prof Natasha Lannin (Chair)	**Group Leader, Brain Recovery and Rehabilitation Group, Monash University [VIC]**
Prof Craig Anderson	Executive Director, The George Institute, China & Professor of Neurology and Epidemiology, Faculty of Medicine, UNSW Sydney [NSW]
Prof Dominique Cadilhac	Head, Public Health, Stroke Division, Florey Institute of Neuroscience and Mental Health & Head, Translational Public Health Division, Stroke and Ageing Research, Monash University [VIC]
Prof Helen Dewey	Director of Neurosciences, Eastern Health & Professor, Eastern Health Clinical School, Monash University [VIC]
Prof Geoffrey Donnan	Director, Florey Institute of Neuroscience and Mental Health [VIC]
Prof Steven Faux	Director, Rehabilitation Unit, St Vincent's Hospital, Sydney [NSW]
Dr Rohan Grimley	Conjoint Senior Lecturer, Sunshine Coast Clinical School & Clinical Chair, Queensland Statewide Stroke Clinical Network [QLD]
A/Prof Peter Hand	Neurologist, Royal Melbourne Hospital & Clinical Lead, Victorian Stroke Clinical Network [VIC]
Mr Kelvin Hill	National Manager, Clinical Services, Stroke Foundation [VIC]
Mr Brett Jones	Stroke Liaison Nurse, Canberra Hospital [ACT]
Dr Monique Kilkenny	Head, National Stroke Data Linkage Program, Monash University [VIC]
Prof Chris Levi	Director of Clinical Research and Translation - Research Innovation and Partnerships & Co-Director of Acute Stroke Services, John Hunter Hospital [NSW]

AuSCR Research Task Group membership 2019

The primary purpose of the Research Task Group is to ensure appropriate use and protection of the Australian Stroke Clinical Registry data when it is to be used for research purposes by third parties.

A/Prof Sue Evans (Co-Chair)	**Head of the Clinical Registry Unit & Associate Director of the Centre of Research Excellence in Patient Safety Medicine, Nursing & Health Services, Monash University [VIC]**
Dr Darshan Ghia (Co-Chair)	Consultant Neurologist and Head of Stroke Unit, Fiona Stanley Hospital [WA]
A/Prof Coralie English	Senior Research Affiliate, NHMRC Centre for Research Excellence in Stroke Rehabilitation and Recovery, Priority Research Centre for Neuroscience and Mental Health, Hunter Medical Research Institute [NSW]
Prof John McNeil	Head, Department of Epidemiology and Preventive Medicine, Monash University [VIC]
A/Prof Erin Godecke	Senior Research Fellow (Speech Pathology), School of Medical & Health Sciences, Edith Cowan University [WA]
Dr Benjamin Clissold	Head, In-patient Services (Neurosciences), Barwon Health & Stroke Neurologist, University Hospital Geelong and Monash Medical Centre [VIC]
Dr Philip Choi	Consultant Neurologist, Department of Neurosciences, Eastern Health [VIC]
Prof Suzanne Kuys	National Head, School of Physiotherapy, Australian Catholic University & Principal Research Fellow, Queensland Health [QLD]
Prof Bernard Yan	Neurointerventionist and Neurologist, Royal Melbourne Hospital [VIC]

APPENDIX B (CONTINUED): COMMITTEE MEMBERSHIP

AuSCR Reperfusion and Telemedicine Subcommittee membership 2019

A/Prof Bruce Campbell (Co-Chair)	**Head, Hyperacute Stroke, Royal Melbourne Hospital [VIC]**
Prof Peter Mitchell (Co-Chair)	**Head, Statewide Endovascular Clot Retrieval Service [VIC]**
Prof Christopher Bladin	Director, Victorian Stroke Telemedicine Program, The Florey Institute of Neuroscience and Mental Health & Neurologist Eastern Health [VIC]
Prof Ken Butcher	Director, Clinical Neurosciences, Prince of Wales Hospital [NSW]
Prof Dominique Cadilhac	Head, Public Health, Stroke Division, Florey Institute of Neuroscience and Mental Health & Head, Translational Public Health Division, Stroke and Ageing Research, Monash University [VIC]
Dr Andrew Cheung	Managing Director, Sydney Neurointerventional Specialists [NSW]
Prof Alan Coulthard	Interventional Neuroradiologist, Royal Brisbane and Women's Hospital [QLD]
A/Prof Peter Hand	Neurologist, Royal Melbourne Hospital [VIC]
A/Prof Tim Kleinig	Head, Neurology, Royal Adelaide Hospital [SA]
A/Prof Henry Ma	Neurologist, Monash Medical Centre & Adjunct Senior Lecturer, Stroke and Ageing Research Group, Southern Clinical School, Monash University [VIC]
Dr Ferdi Miteff	Neurologist, Royal North Shore Hospital [NSW]
Prof Mark Parsons	Honorary Neurologist, Royal Melbourne Hospital [VIC]
Dr Rebecca Scroop	Interventional Neuroradiologist, Royal Adelaide Hospital [SA]
Dr Brendan Steinfort	Director of Clinical training for Radiology, Royal North Shore Hospital, [NSW]
Dr Jason Wenderoth	Director of Neurointervention, Prince of Wales and Liverpool Hospitals, [NSW]
Dr Andrew Wong	Neurologist, Royal Brisbane and Women's Hospital [QLD]
Prof Bernard Yan	Neurointerventionist and Neurologist, Royal Melbourne Hospital [VIC]

APPENDIX C: FUNDING 2019

In 2019, the AuSCR Office was supported by funding and in-kind support from the following sources:

- The Florey Institute of Neuroscience and Mental Health
- Industry partners including Ambulance Victoria, University of South Australia, Amgen, Medtronic and Bristol Myers Squibb
- Joint initiatives with the Stroke Foundation funded by Queensland Health,ACT Health and Tasmania Health
- Safer Care Victoria and the Victorian Agency for Health Information
- The Agency for Clinical Innovation in New South Wales
- The NHMRC, which provides salary via fellowship awards for senior researchers which has assisted in containing staff costs
- Members of the Management Committee and Steering Committee and Research Task Group provide their time 'in-kind'

ORGANISATION	AMOUNT
State Governments	$841,858
The Florey	$22,986
Non-government organisations	$24,600
Industry	$99,912
Hospital opt-in payment	$0
Consumer donations	$0
Other*	$103,650
TOTAL	$1,093,006

**Includes income from projects approved by the Research Task Group to access the AuSCR data/registrants.*

APPENDIX D: ACKNOWLEDGEMENTS

Ongoing contributions to the AuSCR

We gratefully acknowledge contributions made by:

- The AuSCR staff at the Florey Institute of Neuroscience and Mental Health (The Florey): Julie Morrison, Emma Tod, Natalie Wilson, Kate Paice, Karen Barclay Moss, Jot Ghuliani, Helen Carter, Adele Gibbs, Violet Marion, Nancy Pompeani, Olivia Ryan, Claire Weickhardt, Shaun Hancock, Rumer Kennedy and Lilian Braighi Carvalho;
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- Tasmania Health for support of the AuSCR in Tasmania via a joint project with the Stroke Foundation;
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- The Australian Institute of Health and Welfare for their role in linking the AuSCR data to the National Death Index.

Contributions to the annual report

The Florey AuSCR Office

Dr Sibilah Breen, the AuSCR National Coordinator, was responsible for overall coordination of the AuSCR program and support to participating hospitals and other AuSCR program staff and collaborators.

Sam Shehata and Marcus Lester, the AuSCR and AuSDaT Senior Data Managers, have been essential in maintaining the integrity of the database, facilitating data quality checks and providing information for the completeness of data, opt-out and case ascertainment tables.

Monash University

Dr Joosup Kim, Lachlan Dalli and Associate Professor Monique Kilkenny (Stroke and Ageing Research Centre, Monash University) developed and conducted the AuSCR data analyses for this report and as required throughout 2019. We are most appreciative of their contributions. The majority of analyses presented in this report were undertaken by Dr Joosup Kim, Research Fellow, and Lachlan Dalli, Research Assistant and PhD candidate, under the supervision of Professor Dominique Cadilhac using de-identified data supplied securely by Marcus Lester.

APPENDIX D (CONTINUED): ACKNOWLEDGEMENTS

This report would not have been possible without the efforts of doctors, nurses, allied health professionals, ward clerks and other staff from participating hospitals who have contributed data to the AuSCR. Lead clinical and data collection staff for each hospital participating in the AuSCR during 2019 are gratefully acknowledged below.

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NSW	
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Lismore Base Hospital	Stephen Moore; Kim Hoffman
Nepean Hospital	Salman Khan; Susan Lane
Orange Base Hospital	Fiona Ryan
Port Macquarie Hospital	Kim Parrey; Michelle Coad
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Royal North Shore Hospital	Martin Krause; Carin Bertmar
Royal Prince Alfred Hospital	Craig Anderson; Nadia Burkolter
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Wagga Wagga Rural Referral Hospital	Martin Jude; Katherine Mohr
Westmead Hospital	Andrew Evans; Jacqueline Watson
Wollongong Hospital	John Carmody; Karen Fuller; Toni Wonson
QLD	
Bundaberg Base Hospital	Michele Gardner; Peter Wood; Sonia Dann; Helen Eaves
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Queen Elizabeth II Jubilee Hospital	Amanda Siller; Jerry Wong; Evelyn Anino
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Redland Hospital	Joel Iedema
Robina Hospital	Meng Tan; Haylee Berrill
Rockhampton Hospital	Leanne Whiley
Royal Brisbane and Women's Hospital	Andrew Wong; Melissa Wood; Michelle Webb
Sunshine Coast University Hospital	Rohan Grimley; Donna Rowley
Toowoomba Hospital	Nisal Gange; Timothy Richardson
Townsville Hospital	Richard White; Sheryl Juliano
Wesley Hospital	Noel Saines; Raewyn Beu

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SA

Flinders Medical Centre	Matt Willcourt; Michelle Bronca
Lyell McEwin Hospital	Andrew Moey; Angela Sayas
Royal Adelaide Hospital	Tim Kleinig; Lizzie Dodd

TAS

Launceston General Hospital	Dinesh Tryambake; Carolyn Harrison
North West Regional Hospital	Maxine Munting; Nellie Cole
Royal Hobart Hospital	Helen Castley; Deirdre Broadby

VIC

Albury Wodonga Health - Albury	Vanessa Crosby
Albury Wodonga Health - Wodonga	Vanessa Crosby
Alfred Hospital	Jorge Zavala; Carla Borg Caruana, Belinda Green, Geoff Cloud
Austin Hospital	Vincent Thijs; Renae Gamble; Kristen Rowe
Bairnsdale Regional Health Service	Kushantha Gunarathne; Nelly Counihan; Laura Macdonald
Ballarat Health Services	Thomas Kraemer; Casey Hair
Bass Coast Health	Cath Jones; Chris Burns
Bendigo Health	David Rosaia; Tessa Coupland; Erin Ray
Box Hill Hospital	Helen Dewey; Tanya Frost
Central Gippsland Health Service	Krishna Mandaleson; Anne van Berkel
Echuca Hospital	Lauren Arthurson
Goulburn Valley Health	Melanie Brown
Hamilton Base Hospital	Louise Starkie
Latrobe Regional Hospital	Janet May
Maroondah Hospital	Helen Dewey; Tanya Frost
Mildura Base Hospital	Mandie Hayes; Ros Roberts
Monash Medical Centre	Henry Ma; Jodi Lynch
Northeast Health Wangaratta	Rebecca Weir; Lyn Malone
Peninsula Health - Frankston Hospital	Ernie Butler; Margaret Stevenson; Kanaga Lagma
Royal Children's Hospital	Mark Mackay; Belinda Stojanovski
Royal Melbourne Hospital	Mark Parsons; Lauren Pesavento; Smisha Thomas
St Vincent's Hospital Melbourne	Lauren Sanders; Patrick Scarff
Sunshine Hospital - Western Health	Tissa Wijeratne; Liz Mackey
Swan Hill District Health	Trish Oxley; Emma Harding
The Northern Hospital	Douglas Crompton; Anne Rodda
University Hospital Geelong	Ben Clissold; Heather Smith
Warrnambool Base Hospital	Anna Clissold; Patrick Groot
West Gippsland Hospital	Brett Forge; Lorraine Keene; Amanda Lewis; Ashley Murray
Wimmera Base Hospital	Chris Ebersohn; Kerri Chamberlain; Nina Roberts

APPENDIX E: ASC AWARD CRITERIA AND RECIPIENTS

To be eligible for the AuSCR awards, participating hospitals were judged on nine processes of care collected within the AuSCR in 2018. These processes of care included:

- Care in a stroke unit
- Thrombolysis provision for ischaemic stroke
- Thrombolysis provision within 60 minutes for ischaemic stroke
- Provision of ECR for ischaemic stroke
- Mobilised on the same day or day following stroke
- Provision of antithrombotics on discharge for ischaemic stroke (where not contraindicated)
- Provision of antihypertensives on discharge (where not contraindicated)
- Provision of lipid lowering medication on discharge (where not contraindicated)
- Provision of a discharge care plan where discharged to the community

A composite score based on these nine processes of care was calculated by dividing the number of relevant clinical episodes for each episode by the sum of eligible indicators. To be eligible for an award the overall composite score for each hospital was required to be greater than or equal to 0.70 and have an overall rate of case ascertainment greater than or equal to 70%.

Awards were possible in two categories:

- **EXCELLENCE**: composite score of greater than 0.8
- **MERIT**: composite score of greater than 0.7

The following hospitals received awards for data collected in the 2018 calendar year

EXCELLENCE AWARDS: Caboolture Hospital (QLD), Queen Elizabeth II Jubilee Hospital (QLD), Rockhampton Hospital (QLD), Lismore Hospital (NSW) and Blacktown Hospital (NSW).

MERIT AWARDS: Warrnambool Hospital (VIC), Box Hill Hospital (VIC), Gold Coast University Hospital (QLD), Townsville Hospital (QLD), Bendigo Hospital (VIC), Ipswich Hospital (QLD), Cairns Hospital (QLD), Goulburn Valley Hospital (VIC), Mackay Hospital (QLD), Ballarat Hospital (VIC) and Barwon Hospital (VIC).

HONOURABLE MENTIONS were also given to the following hospitals who had a composite score of greater than 0.7 BUT who had not submitted data to the AuSCR to enable case ascertainment calculations OR who had a rate of case ascertainment less than 70%: Wagga Wagga Hospital (NSW), Toowoomba Hospital (QLD), St Vincent's Hospital (NSW), Gympie Hospital (QLD), Port Macquarie Hospital (NSW), Wesley Private Hospital (QLD), Prince Charles Hospital (QLD), Redland Hospital (QLD), Albury Hospital (VIC), Mildura Hospital (VIC), Launceston Hospital (TAS), Wimmera Hospital (VIC) and Sunshine Coast University Hospital (QLD).

An additional category of **MERIT AWARDS** was also awarded to hospitals who had contributed to the achievable benchmark for thrombolysis in less than 60 mins and with a case ascertainment of over 70%. These hospitals included Royal North Shore Hospital (NSW), Princess Alexandra Hospital (QLD) and Box Hill Hospital (VIC). An additional **HONOURABLE MENTION** was given to the Royal Melbourne Hospital (VIC) who did not supply data for case ascertainment.

APPENDIX F: PUBLICATIONS AND PRESENTATIONS

Journal Publications

Andrew NE, Kim J, Cadilhac DA, Sundararajan V, Thrift AG, et al. Protocol for evaluation of enhanced models of primary care in the management of stroke and other chronic disease (PRECISE): A data linkage healthcare evaluation study. International Journal of Population Data Science. 2019; 4(1), 1-14. DOI:10.23889/ijpds.v4i1.1097

Andrew NE, Middleton S, Grimley R, Anderson CS, Donnan GA, et al. Hospital organizational context and delivery of evidence-based stroke care: a cross-sectional study. Implementation Science. 2019; 14:6:1-12. DOI:10.1186/s13012-018-0849-z

Barclay-Moss K, Lannin NA, Grabsch B, Kilkenny MF, Cadilhac D. Stroke survivor follow-up in a national registry: lessons learnt from respondents who completed telephone interviews. International Journal of Stroke. 2019;14(2):112-114. DOI:10.1177/1747493018806190

Cadilhac DA, Grimley R, Kilkenny MF, Andrew N, Lannin NA, et al. Multicenter, Prospective, Controlled, Before-and-After, Quality Improvement Study (Stroke123) of Acute Stroke Care. Stroke. 2019; 50(6):1525-1530. DOI:10.1161/STROKEAHA.118.023075

Cadilhac DA, Kilkenny MF, Lannin NA, Dewey HM, Levi CR, et al. Outcomes for patients with in-hospital stroke treated in stroke units versus ordinary wards: a retrospective observational study. Journal of Stroke and Cerebrovascular Diseases. 2019; 28(5):1302-1310. DOI:10.1016/j.jstrokecerebrovasdis.2019.01.026

Dalli LL, Kim J, Thrift AG, Andrew NE, Lannin NA, et al. Disparities in Antihypertensive Prescribing After Stroke: Linked Data From the Australian Stroke Clinical Registry. Stroke. 2019; 50(12):3592-3599. DOI:10.1161/STROKEAHA.119.026823.

Kilkenny, MF, Grimley, R & Lannin, NA. Quality of life and age following stroke. Aging. 2019; 11(3), p845-846. DOI:10.18632/aging.101797

Kilkenny MF, Kim J, Andrew NE, Sundararajan V, Thrift AG, et al. Maximising use of data and avoiding data waste: a validation study in stroke research. MJA. 2019; 210(1):27-31. DOI:10.5694/mja2.12029

Kilkenny MF, Lannin NA, Levi C, Faux SG, Dewey HM, et al. Weekend hospital discharge is associated with sub-optimal care and outcomes: an observational Australian Stroke Clinical Registry study. International Journal of Stroke. 2019; 14(4):430-438. DOI:10.1177/1747493018806165

Phan HT, Gall SL, Blizzard CL, Lannin NA, Thrift AG, et al. Sex differences in care and long-term mortality after stroke: Australian Stroke Clinical Registry (AuSCR). Journal of Women's Health. 2019; 28(5):712-720. DOI:10.1089/jwh.2018.7171

Annual Report Publication

Breen S, Cadilhac DA, Lannin NA, Kim J, Dalli L, Anderson CS, Kilkenny M, Faux S, Dewey H, Hill K, Donnan G, Grimley R, Campbell B, Mitchell P, Middleton S on behalf of the AuSCR Consortium. The Australian Stroke Clinical Registry Annual Report 2019. The Florey Institute of Neuroscience and Mental Health; December 2020, Report No. 11, 53 pages.

APPENDIX F (CONTINUED): PUBLICATIONS AND PRESENTATIONS

Conference presentations

Andrew, NA. Uptake of enhanced primary care items in the long-term management of survivors of stroke: A data linkage study. 29th Annual Scientific Meeting of the Stroke Society of Australasia September 13th, Canberra, ACT.

Andrew NA. Progressing national stroke data linkage: feasibility and quality of linkages between stroke registry data and Medicare and Pharmaceutical claims data 29th Annual Scientific Meeting of the Stroke Society of Australasia September 13th, Canberra, ACT.

Cadilhac DA. 10 Years Old: The Australian Stroke Clinical Registry. [Oral presentation selected from abstract]. Smart Strokes Conference, 8-9th August, Hunter Valley, NSW

Cadilhac DA. Using data linkage for the economic evaluation of the Melbourne Mobile Stroke Unit. 8th Annual NHMRC Symposium on Research Translation, 20th November, Melbourne, VIC.

Kilkenny MF. One-year adherence to secondary prevention medications after stroke: linked data from the Australian Stroke Clinical Registry and Pharmaceutical Benefits Scheme. 29th Annual Scientific Meeting of the Stroke Society of Australasia September 13th, Canberra, ACT.

Kilkenny MF. Maximising the use of linked national registry, Medicare and pharmaceutical benefits scheme data for understanding factors related to use of secondary prevention medication after stroke. 8th Annual NHMRC, Symposium on Research Translation, November 20th, Melbourne, VIC.

Kilkenny MF. National Stroke Registry Data Linkage Program: essential infrastructure to inform health care policy and practice. 8th Annual NHMRC, Symposium on Research Translation, November 20th, Melbourne, VIC.

Kilkenny MF. Utilisation and discontinuation patterns and factors associated with secondary prevention medication after stroke. Health Services and Policy Research Conference, 4-6 December, Auckland, New Zealand.

Ryan, O. Factors associated with stroke coding quality: comparison of stroke registry and administrative data. Health Information Management Association of Australia and National Centre for Classification in Health (HIMAA/NCCH), 36th National Conference, 23rd October, Sydney, NSW.

Invited presentations

Cadilhac DA. Stroke epidemiology – global statistics and trends. (Session: GLOBAL PERSPECTIVES ON STROKE). 5th European Stroke Organisation conference, Milan, 22-24th May.

Cadilhac DA. Australian Stroke Clinical Registry update. Queensland Stroke Services Clinical Network Forum, Brisbane, June 2019.

Cadilhac DA. Clinical trial and registries. Innovating Clinical Trials, Think Tank, Melbourne, July 2019.

Cadilhac DA. STROKE: Hospital care and Outcomes. Visiting Professor, ZhuHai Campus, Zunyi Medical University, CHINA, October 2019.

Cadilhac D.A. How local services contribute to system level change with AuSCR data. (STREAM B: Stroke Rehabilitation – Acute and Sub-Acute). The Third Western Australia Stroke Symposium, The University Club of Western Australia, Perth, 19th October.

APPENDIX F (CONTINUED): PUBLICATIONS AND PRESENTATIONS

Cadilhac DA. How to use stroke data to translate best care into practice: from a clinical and health system perspective. The Third Western Australia Stroke Symposium, The University Club of Western Australia, Perth, 20th October.

Cadilhac D.A. Understanding the Data! What do I need to know about stats? ASNEN Stroke Nurse Leaders Symposium, Mercure North Melbourne, 25th October.

Cadilhac DA. Innovations for capture and use of AuSCR data. The 7th Annual National Stroke Data and Quality Improvement Workshop, November 28th Sydney.

Kilkenny, MF. Working with Registry data - tips and pitfalls for the researcher [Researcher Workshop – Using Administrative and Linked Data Sets in Research]. Psycho-oncology Co-operative Research Group (PoCoG) and Primary Care Collaborative Cancer Clinical Trials Group (PC4). Peter MacCallum Cancer Centre, April 2019, Melbourne, VIC.

Kilkenny, M.F. Understanding statistics and interpreting data reports using examples from the national registry and audit programs in stroke. Smart Strokes Conference, 8-9th August, Hunter Valley, NSW.

Kilkenny, M.F. Towards an integrated national data platform for stroke. Population Health Research Network, 'Webinar Wednesday' Series, 25th September [online].

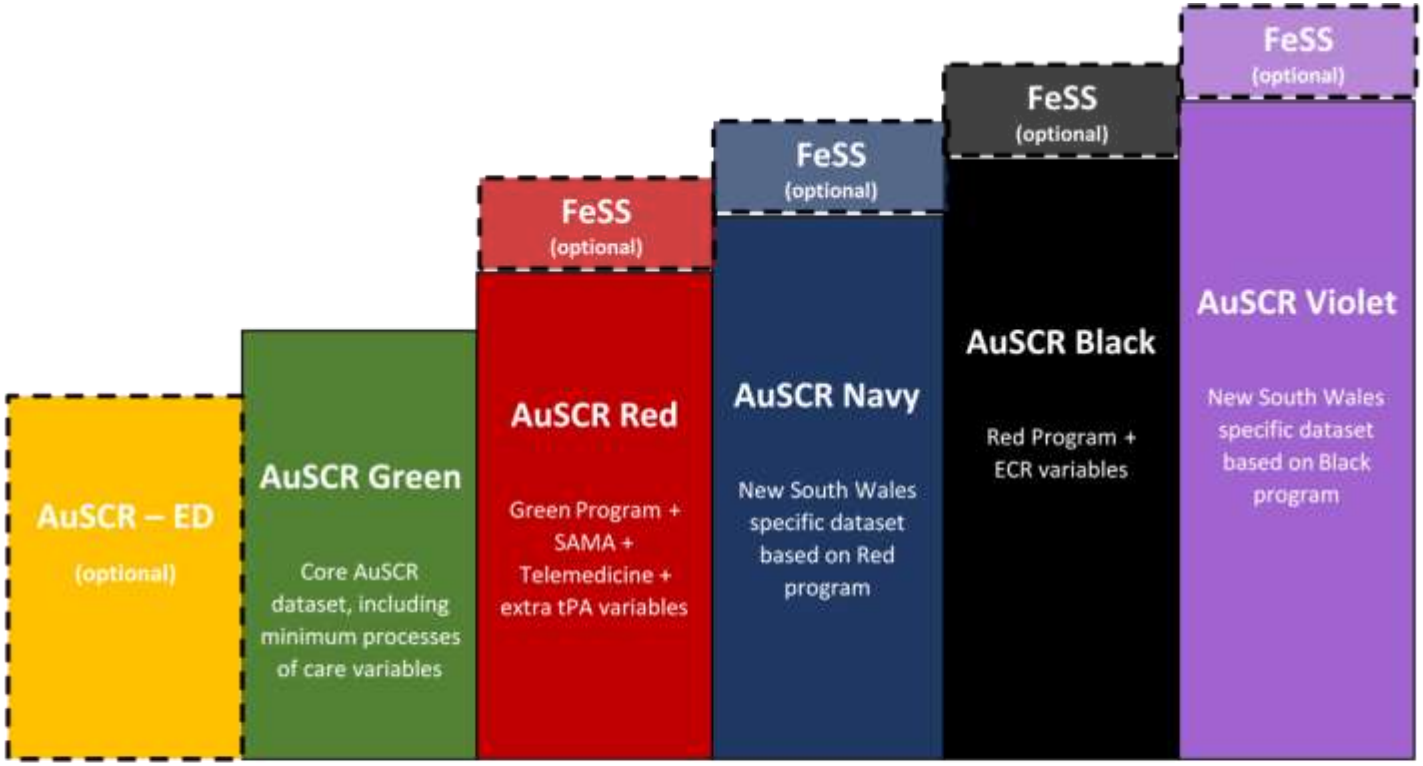
Kilkenny, MF. Australia Stroke Data Linkage Program. Visiting Professor, ZhuHai Campus, Zunyi Medical University, CHINA, October 2019

Kilkenny MF. Australian Stroke Clinical Registry – value of linking clinical registry data with administrative health data. Queensland Health Data Linkage Symposium, 13th November, Brisbane, QLD.

Kilkenny, MF. Use of big data to improve outcomes in stroke. Health Services and Policy Research Conference, 4-6 December, Auckland, NZ.

APPENDIX G: AUSCR PROGRAM BUNDLES

In 2019, a total of seven AuSCR data collection programs were available, with the Red and Black programs most commonly used nationally. The Navy and Violet programs were only used in NSW, whereas the Green program was only used at a small regional hospital in Tasmania and a Victorian Children's hospital.



Identifying information	Clinical processes	Hospital outcomes data	Timeliness of care delivery	Risk adjustment
• Date of birth • Gender • Contact details (including next of kin) • Hospital name	• Use of tPA • Access to a stroke unit • Discharge antihypertensives • Discharge care plan	• Date of discharge or death • Discharge destination	• Arrival by ambulance • Date/time of stroke onset • Date/time of ED arrival • Date/time of admission • Transfer from other hospital	• ICD-10 codes • Ethnicity • Ability to walk on admission • First ever stroke status • Inpatient stroke • NIHSS on presentation

tPA: thrombolysis **SAMA**: Swallow screen, hyperacute Aspirin, Mobilisation, Antithrombotics **ECR**: Endovascular Clot Retrieval **FeSS**: Fever, Sugar, Swallow

APPENDIX H: AUSCR VARIABLES

Identifying information

- Name
- Date of birth
- Sex
- Address
- Telephone number/s
- Hospital name
- Medicare number
- Hospital UR number
- Contact details for next of kin and alternative contact

Patient/episode characteristics

- Country of birth
- Language spoken
- Interpreter needed
- Aboriginal and Torres Strait Islander status
- Type and cause of stroke
- Date and time of stroke onset
- *Validated stroke screen and type*
- Date and time of arrival at ED
- Date and time of admission
- In-patient stroke status
- Transferred from another hospital status
- Ability to walk independently on admission
- First-ever (incident) stroke event status
- National Institutes of Health Stroke Scale (NIHSS) Score on presentation
- Arrived by ambulance
- *Transfer to other wards*
- History of known risk factors
- *Dependency prior to admission*

Indicators of evidence-based care

- Treatment in a stroke unit
- Date and time of first brain scan
- Use of tPA if an ischaemic stroke
- Discharged on an antihypertensive agent
- Care plan provided at discharge (any documentation in the medical record)
- Telemedicine consultation
- Date and time of thrombolysis
- Adverse event related to thrombolysis
- Swallow screen and formal speech pathologist assessment
- Aspirin administration, <48 hours
- Mobilisation during admission
- *Mood assessment*
- Discharged on antithrombotic medication
- Discharged on lipid-lowering drugs

Allied health management

- *Patient seen by a physiotherapist, occupational therapist, speech pathologist, social work, dietitian*
- *Commencement of rehabilitation therapy*

Communication and support for patient and family/carer

- *Carer receiving relevant training and support needs assessment*

Complications during hospital admission

- *Aspiration pneumonia, deep vein thrombosis, falls, pulmonary embolism, symptomatic haemorrhagic transformation, new onset atrial fibrillation, stroke progression, urinary tract infection*

Further rehabilitation

- *Rehabilitation plan documented*
- *Rehabilitation referral made*

Endovascular clot retrieval (ECR) variables

- Date and time of subsequent brain scan
- Provision of ECR, including date and time
- NIHSS: before ECR and 24 hours after ECR
- Site of occlusion
- Final eTICI (expanded thrombolysis in central infarction) score
- Adverse event related to ECR

Hospital outcomes/discharge data

- In-hospital death
- Date of discharge/death
- Discharge destination
- ICD-10 diagnosis codes and procedures
- *Functional status on discharge*

Follow-up variables 90 to 180 days after admission

- Survivor status
- Place of residence
- Living alone status
- Subsequent stroke since discharge
- Readmission to hospital
- Quality of life
- Modified Rankin Scale
- Would like an information pack from the Stroke Foundation
- Would be willing to participate in future research

Note:

Different programs within the AuSCR collect different bundles of variables, depending on hospital resources and priorities. Items in italics are variables which are collected only as part of the NSW Foundation Program.

APPENDIX H (CONTINUED): AuSCR VARIABLES

In 2019 the following optional datasets were available for participating hospitals to contribute data to, in addition to one of the five admitted datasets (core AuSCR programs):

EMERGENCY DEPARTMENT DATASET

Identifying information
- Name
- Date of Birth
- Sex
- Hospital Medical Record number
- Country of Birth
- Aboriginal or Torres Strait Islander status
- Postcode
- State

Admission and transfer information
- Hospital Name
- Onset date and time
- Date and time of discovery
- Date and time of arrival to emergency department
- Arrival by ambulance
- Pre-hospital notification
- Date and time of transfer

Care provided at transferring hospital
- Reason for transfer

Pre stroke history
- Functional status prior to stroke
- Dependency prior to admission

Acute clinical data
- Triage category
- Direct admission
- NIHSS at baseline
- Date and time of first brain scan
- Advanced imaging types
- Type of stroke

Telemedicine and reperfusion
- Date and time stroke telemedicine consultation conducted
- Date and time when patient received thrombolysis?
- Drug used (e.g. for thrombolysis)
- Adverse event related to thrombolysis

Other clinical information
- Formal swallow screen performed?
- Swallow screen or swallow assessment before given oral medications, or food or fluids?
- Was the patient able to walk independently?

Discharge information
- Discharge destination

FESS (FEVER, SUGAR, SWALLOW) DATASET

Identifying information
- Name
- Date of Birth
- Sex
- Hospital Medical Record number
- Country of Birth
- Aboriginal or Torres Strait Islander status
- Postcode
- State

Admission and transfer information
- Hospital Name
- Onset date and time
- In-hospital stroke
- Date and time of arrival to emergency department
- Transferred from another hospital
- Date and time of transfer

Acute clinical data
- NIHSS at baseline
- Type of stroke

Other clinical information

Swallowing
- Date and time formal swallow screen performed?
- Date and time swallowing assessment by a speech pathologist
- Swallow screen or swallow assessment before given oral medications, or food or fluids?

Assessment and management of fever
- Temperature recorded regularly
- Did the patient develop a fever ≥ 37.5 ^{0}C within 72 hours after admission?
- Paracetamol administered within 1 hour for the first elevated temperature

Assessment and management of hyperglycaemia
- Finger-prick blood glucose level recorded regularly
- Did the patient develop a finger-prick glucose level of greater or equal to 10 mmols/L in 48 hours after admission?
- Was insulin administered within 1 hour of the first elevated finger-prick glucose (≥ 10 mmol/L)

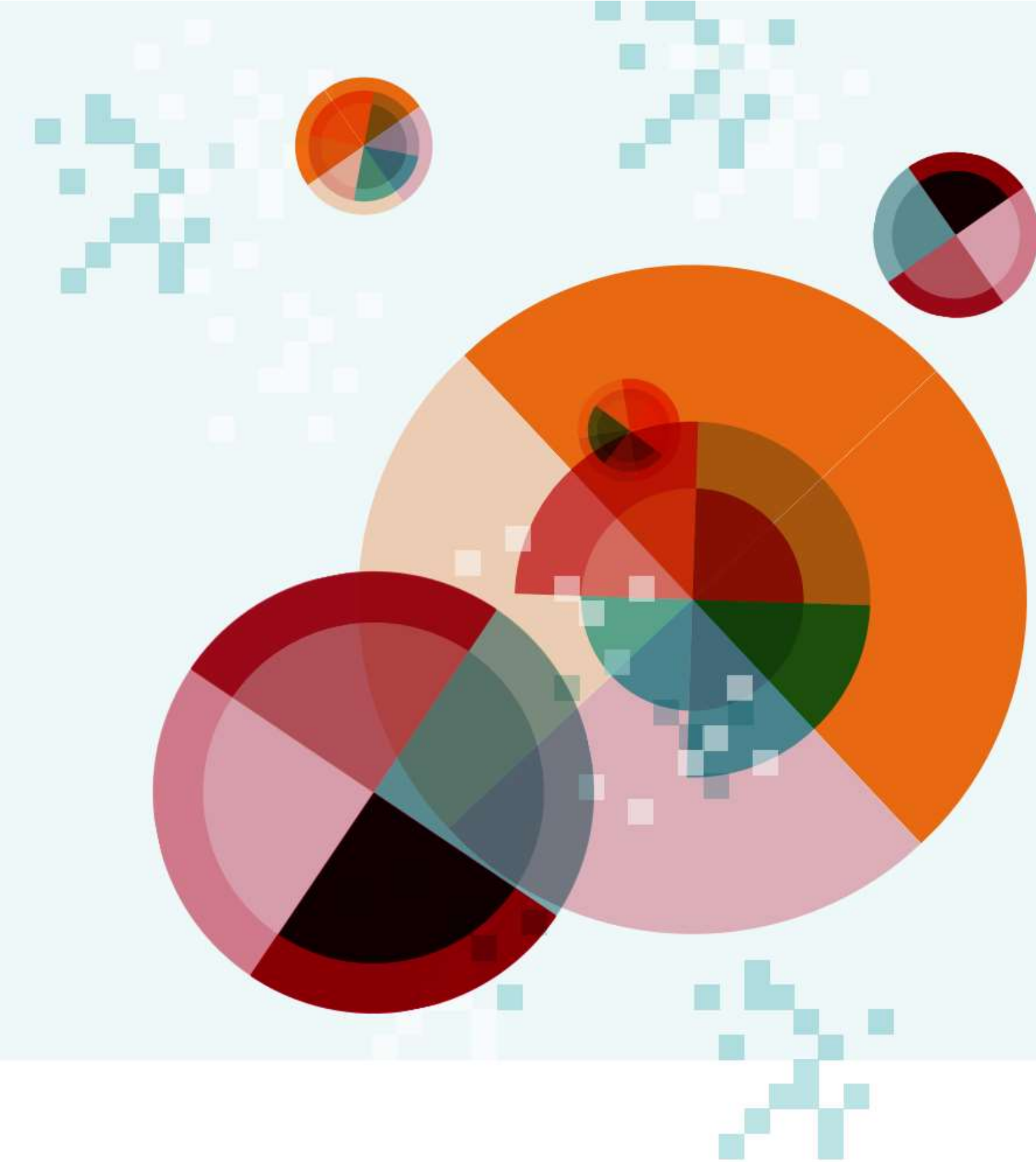
APPENDIX I: APPLICATIONS TO THE AUSCR RESEARCH TASK GROUP

In 2019, there were two external applications reviewed by the Research Task Group:

- Pre-hospital stroke care: economic evaluation of the Melbourne Mobile Stroke Unit (PI: Prof Dominique Cadilhac; AIs: Prof Karen Smith, Dr Joosup Kim, Dr Henry Zhao Florey; The Florey Institute of Neuroscience and Mental Health, Monash University).
- How effective is using Registry Data for recruitment to a Falls/Rehabilitation in Stroke Randomised Controlled Trial? (PI: Prof Natasha Lannin; AIs: Prof Lindy Clemson, Prof Catherine Dean, Prof Louise Ada, Prof Dominique Cadilhac; Monash University).

APPENDIX J: ABBREVIATIONS

ABC™	Achievable benchmarks of care
ACI	Agency for Clinical Innovation
ACT	Australian Capital Territory
AF	Atrial fibrillation
APF	Adjusted performance fraction
ASGS	Australian Statistical Geography Standard
ASC	Australian Stroke Coalition
AuSCR	Australian Stroke Clinical Registry
AuSDaT	Australian Stroke Data Tool
DVT	Deep vein thrombosis
ECR	Endovascular clot retrieval
ED	Emergency Department
EQ-5D-3L™	European Quality of Life - five dimension three level instrument
eTICI	expanded Thrombolysis In Central Infarction
FeSS	Fever Sugar Swallow
HRQoL	Health-related quality of life
ICD-10	International Classification of Diseases (10th Revision)
ICH	Intracerebral haemorrhage
mRS	Modified Rankin Scale
NDI	National Death Index
NHMRC	National Health and Medical Research Council
NIHSS	National Institutes of Health Stroke Scale
NSW	New South Wales
Q1/Q3	25th percentile/75th percentile
QLD	Queensland
QSQIP	Queensland Stroke Quality Improvement Program
PE	Pulmonary embolism
PROMs	Patient reported outcome measures
RAMR	Risk adjusted mortality rate
SA	South Australia
SCV	Safer Care Victoria
SD	Standard deviation
SSA	Stroke Society of Australasia
TAS	Tasmania
TIA	Transient ischaemic attack
tPA	Tissue plasminogen activator
UTI	Urinary tract infection
VAHI	Victorian Agency for Health Information
VAS	Visual Analogue Scale
VIC	Victoria
VSCN	Victorian Stroke Clinical Network
VST	Victorian Stroke Telemedicine
WA	Western Australia



AUSCR

Australian Stroke Clinical Registry