ANNUAL REPORT 2021

AuSCR

Australian Stroke Clinical Registry

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

SUGGESTED CITATION:

Cadilhac DA, Dalli LL, Morrison J, Lester M, Paice K, Moss K, Carter H, Campbell BCV, Cloud GC, Kilkenny MF, Faux S, Dewey H, Hill K, Donnan GA, Grimley R, Middleton S, Lannin NA; on behalf of the AuSCR Consortium. The Australian Stroke Clinical Registry Annual Report 2021. The Florey Institute of Neuroscience and Mental Health; December 2022, Report No. 14, 66 pages. doi.org/10.26188/21753812

December 2022 | Report No. 14

Any enquires about, or comments on, this publication should be directed to:

Australian Stroke Clinical Registry Office

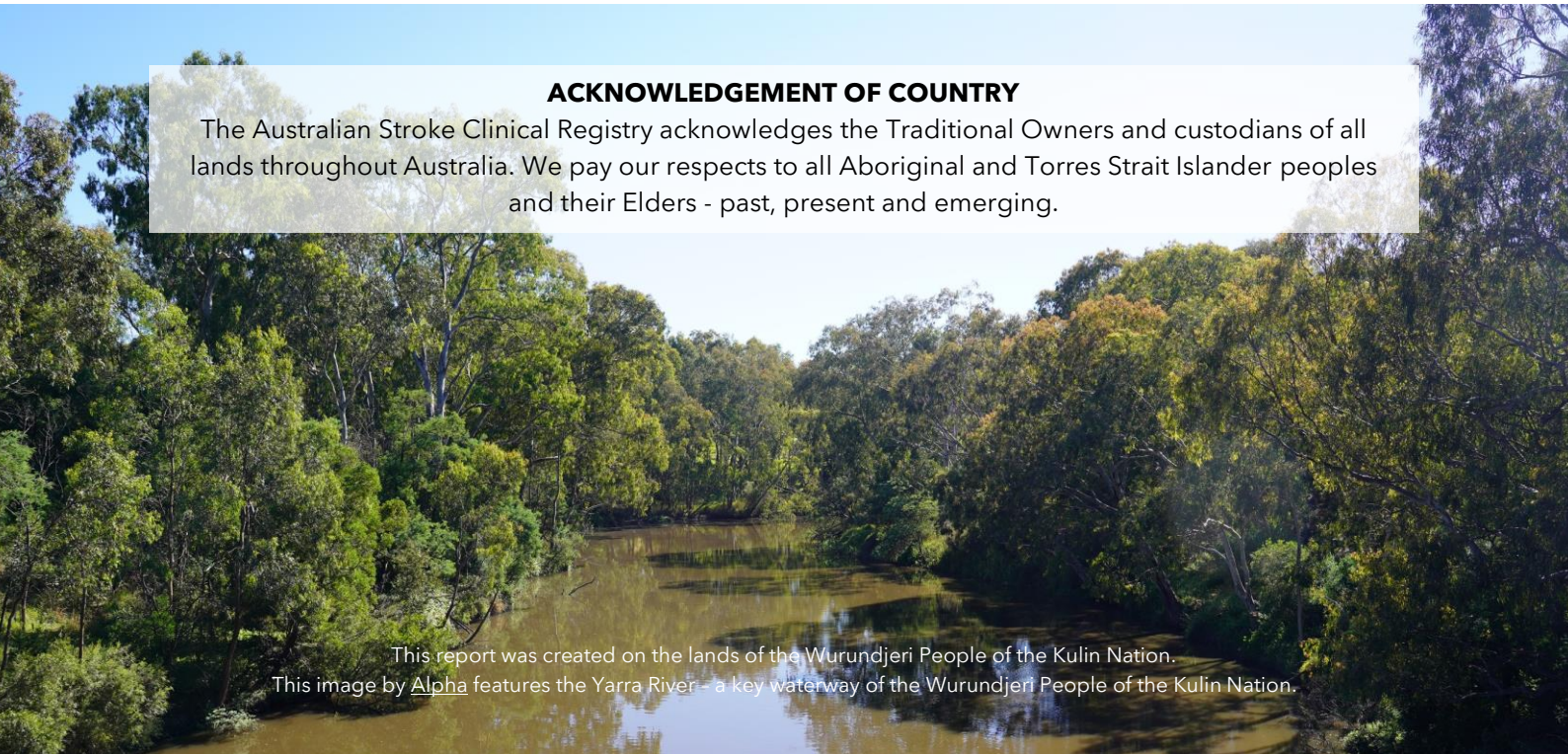
The Florey Institute of Neuroscience and Mental Health
245 Burgundy Street
Heidelberg
Victoria 3084
Australia

Phone: 1800 673 053
Email: admin@auscr.com.au
Website: www.auscr.com.au
@AustStrokeReg

CONSORTIUM PARTNERS

ACKNOWLEDGEMENT OF COUNTRY

The Australian Stroke Clinical Registry acknowledges the Traditional Owners and custodians of all lands throughout Australia. We pay our respects to all Aboriginal and Torres Strait Islander peoples and their Elders - past, present and emerging.



This report was created on the lands of the Wurundjeri People of the Kulin Nation.
This image by Alpha features the Yarra River - a key waterway of the Wurundjeri People of the Kulin Nation.

CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

HIGHLIGHTS OF 2021

- In 2021, 62 hospitals contributed data to the AuSCR (47% from Victoria; 35% from Queensland; 5% each from South Australia and Tasmania; 3% each from the Australian Capital Territory and New South Wales; and 2% from Western Australia).
- Information is presented from 18,251 patients on 19,753 presentations for acute stroke or transient ischaemic attack (TIA). This represents fewer episodes than 2020. Fewer hospitals contributed data (68 in 2020 vs 62 in 2021), particularly those from New South Wales (8 in 2020 vs 2 in 2021). Three hospitals also paused data collection during 2021 because of competing demands due to the COVID-19 pandemic.
- Overall, 16% of patients were transferred from another hospital. Where the data were available to link between hospitals, we have reported data from the Emergency Department (ED) dataset of the hospital that transferred the patient, as well as from the receiving hospital providing the admission for stroke care.
- Between 90 and 180 days after admission, collection of patient-reported outcomes was completed for 65% of all eligible patients. This is a testament to the AuSCR Office staff who were faced with additional challenges in 2021 in response to the COVID-19 pandemic, whereby staff had reduced ability to conduct patient follow-up on-site.
- To support hospitals, we conducted three educational webinars and co-convened the 9th National Stroke Quality Improvement Workshop, which was held virtually.
- To better understand the unintended impacts of the COVID-19 pandemic on stroke care in hospitals, we undertook analyses for the Victorian Department of Health on their request on two occasions (April and June). These examined the impact of reduced access to stroke unit care during the pandemic on access to guideline-recommended stroke care and patient outcomes.
- For the first time, we have reported on hospital characteristics from the 2021 Stroke Foundation Organisational Survey. For the most part, AuSCR hospitals were similar to non-AuSCR hospitals in the Organisational Survey, apart from having a greater number of beds, greater annual volume of stroke admissions, and being more likely to offer thrombolysis.

HOSPITAL PERFORMANCE AGAINST STROKE CLINICAL CARE STANDARDS

- Overall provision of stroke unit care was 77% for episodes of stroke, with the achievable benchmark of 95% derived from the top performing hospitals. This is despite stroke unit care being associated with 50-63% improved survival within six months. Between 2017 and 2021, stroke unit care has remained consistently lower in regional (vs metropolitan) hospitals.
- Reperfusion therapies can be provided to patients with confirmed ischaemic stroke if they meet the eligibility criteria. In 2021, 11% of patients were provided intravenous thrombolysis compared to the achievable benchmark of 18%, highlighting variation in practice that exists among the participating hospitals. When limited to patients arriving within 4.5 hours of ischaemic stroke onset, less than one in four were provided thrombolysis.
- A total of 1,268 patients at 13 hospitals received endovascular clot retrieval. The median time from hospital arrival to groin puncture was 91 minutes.
- Of those provided with thrombolysis, less than one in three received treatment within 60 minutes of hospital arrival. Patients who were treated in an inner or outer regional hospital were less likely to have a door-to-needle time under 60 minutes for thrombolysis compared than those treated at a metropolitan hospital (17% vs 33%; $p<0.001$).
- Several hospitals were found to be outside the limits set for normal variation in relation to the clinical care performance measures. Processes of care with the most variation were management in a stroke unit, swallow screen or

assessment within four hours of arrival, and provision of a discharge care plan. Only five hospitals had a median door-to-needle time below 60 minutes.

- Although the achievable benchmark for the provision of a discharge care plan was 98% in 2021, a high level of variation was observed between hospitals, and 31% of patients missed out on receiving a plan at hospital discharge.
- In this report, changes in adherence to selected quality indicators between 2017 and 2021 were evaluated, among 46 hospitals that participated throughout this period. We chose 2017 as the reference period since this was the first full year of data collection using the Australian Stroke Data Tool (AuSDaT).
- Notably, the proportion of patients provided a care plan (if discharged directly home or to aged care) significantly increased from 58% in 2017 to 67% in 2021. However, the disparity between metropolitan and regional hospitals in provision of discharge care plans has increased from 10% in 2017 to 19% in 2021.
- A steady improvement in access to early mobilisation was observed from 2017 until 2020, after which a sharp decline was observed in both metropolitan and regional hospitals in 2021, possibly due to the COVID-19 pandemic.
- Concerningly, access to intravenous thrombolysis has declined since 2017 and approximately nine out of ten patients with ischaemic stroke missed out on this clot-busting drug in 2021. Average door-to-needle times have also remained stable, with regional hospitals experiencing 19 minutes slower door-to-needle times than their metropolitan counterparts.
- We also identified several sex differences in stroke care which persisted after adjusting for age and stroke severity. Compared with men, women were less likely to receive: hyperacute antithrombotic therapy, care in stroke units, early mobilisation (same or day following admission), timely swallow screens or assessments, and secondary prevention medications at hospital discharge. Access to guideline-recommended stroke care is a universal healthcare right which should be available to all, regardless of sex.

HOSPITAL AND POST-DISCHARGE OUTCOMES

- Overall, 1,557 (9%) of the patients registered in the AuSCR died in hospital, consistent with prior years, and 18% had died within 180 days of admission.
- After discharge from acute care, 21% of patients went to rehabilitation (23% in 2020) and 53% returned to their usual residence, with or without some form of support (54% in 2020).
- At the 90-180 day follow-up, 26% of 8,686 registrants who responded were free of disability symptoms on the modified Rankin Scale (mRS).
- With respect to health-related quality of life as measured with the EQ-5D-3L: some or extreme problems in the following domains were reported: mobility 50%, self-care 30%, completion of usual activities 58%, pain/discomfort 49%, and anxiety or depression 49%. The mean Visual Analogue Scale score, representing a measure of overall wellbeing, was 68.
- Unmet information needs about stroke were reported by 48% of respondents whereby they requested an information pack about stroke and support services from the Stroke Foundation.

FUTURE CONTRIBUTIONS TO RESEARCH

- The AuSCR has a secondary role in maintaining a registry of potential research participants who are living with stroke. In 2021, 5,272 registrants said they would be willing to receive an invitation to participate in a research project. Overall, there are >35,000 people registered with the AuSCR who are willing to be contacted for research studies. Survival status is updated each year via national death registrations data.
- Since 2009, there have been 25 research studies where the AuSCR office sent an invitation to eligible registrants (n=14,330) to participate in a project on behalf of investigators with approved projects.

GOVERNANCE REPORT

We acknowledge the challenges of managing competing demands within hospitals throughout 2021 from the COVID-19 pandemic. Despite these challenges, the AuSCR supported 62 hospitals that contributed almost 20,000 episodes of hospital care for stroke or TIA. The AuSCR continued to be flexible and was able to continue, in most respects, business as usual with an excellent proportion of patient reported outcomes collected. We were pleased that most hospitals were able to complete AuSCR data collection for the year and provide a representative picture of their stroke care.

The AuSCR is governed by a Steering Committee chaired by Professor Sandy Middleton, and a Management Committee, chaired by Professor Natasha Lannin (Appendix A). The day-to-day registry operations are managed centrally by staff at The Florey Institute of Neuroscience and Mental Health (The Florey). The Data Custodian is Professor Dominique Cadilhac (The Florey and Monash University). Subcommittees include the Research Task Group, Reperfusion and Telemedicine Subcommittee, Quality Improvement Committee and the newly formed Paediatric Subcommittee. These committees provide input to registry policies and processes, education and training webinars or the secondary use of data. Members of the governance committees and subcommittees volunteer their time to ensure the rigorous operation and ongoing development of the Registry (Appendix B). The success of the AuSCR is due to the efforts of many organisations, individuals, and funding agencies (Appendix C). We acknowledge the efforts of staff in hospitals contributing to the AuSCR (Appendix D), in collecting data and using this to improve stroke care. We thank the patients, their caregivers and family members, for their input and time. We are also grateful to the experienced statistical team from Monash University, for their expert analysis of the de-identified AuSCR data.

In 2021, under our governance policy, the five-year term of the data custodianship with The Florey was reviewed. The multistage process resulted in The Florey being re-engaged as the Data Custodian. Areas for improvement were also identified through this process and we initiated an external review to be conducted in 2022.

The AuSCR continued its partnership with the Australian Stroke Coalition and World Stroke Organisation in providing data for national and international awards and formed new collaborations with the Paediatric Acute Stroke Care Study team to increase the number of contributing paediatric hospitals. In November 2021, the AuSCR also co-convened the 9th National Stroke Quality Improvement workshop as a virtual event with over 370 attendees.

We hope you enjoy the 13th Annual Report providing a compilation of data essential to national benchmarking and spotlighting areas for quality improvement.

Prof Sandy Middleton
Chair, Steering Committee

Prof Natasha Lannin
Chair, Management Committee

Prof Dominique Cadilhac
Florey 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 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.[1]

The AuSCR adheres to the national guidelines for best-practice in clinical quality registries,[2] and both public and private hospitals can participate. Adult and paediatric episodes are included. All participating hospitals are required to have ethics and site-specific governance approvals. As recommended for national registries, an 'opt-out' model for patient inclusion is used,[3] 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 AuSDaT, which is a harmonised online database platform enabling standardised and systematic data collection for multiple stroke data collection programs. 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 across the acute treatment pathway. In 2021, a total of seven AuSCR programs were available for participating hospitals to contribute data (Appendix G). Five programs enabled data collection on eligible stroke/TIA patients who were admitted for care, with each program featuring a shared set of core variables from the national minimum dataset for stroke.[1] The optional ED dataset enables acute data to also be collected for patients provided care in the ED prior to transfer. The optional Fever Sugar Swallow (FeSS) dataset enables the collection of fever and blood glucose monitoring and management data to supplement data collected in other programs (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 90180 days after admission. The AuSCR office staff are responsible for following up patients who have not: been reported as deceased; previously refused follow-up; or opted out of the registry. For patients 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 participants living with stroke for studies (Appendix I).

The data presented in this 2021 report provide insights into the care received, and the health outcomes, for 19,753 episodes of care for 18,251 patients from 62 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 control processes include:

Support for hospital data collectors and teams

- A comprehensive data dictionary with help notes to guide data entry (consistent with the National Stroke Data Dictionary).[4]
- AuSCR training for staff at participating hospitals, completed in person or via videoconference. A detailed manual, and training by AuSCR staff, to ensure standardised data collection and interpretation.
- Fact sheets, webinars, regular electronic newsletters for dissemination of new information, reminders and updates.

Database functions

- Database with built-in logic checks and variable limits to reduce the likelihood of data inaccuracies.
- Mandatory fields to reduce missing data.
- Integrated functions to identify duplicate entries and multiple patient records for a single episode.

Data management activities by the AuSCR office

- Monthly database maintenance undertaken by Senior Data Managers, including checks for duplicate entries using patient identifiers (name, date of birth, hospital medical record number) and date of stroke onset, arrival, admission or discharge.
- Training and reference resources available on the AuSCR website, including videos and written information.
- Reports back to hospital staff on missing and discrepant data, produced bi-annually.
- AuSCR Office staff conduct audits of randomly selected medical records. These were limited (n=3) in 2021 because of the COVID-19 pandemic.
- Bi-annual case ascertainment assessments, completed by cross-checking hospital reports of all eligible admissions (based on the ICD-10 principal diagnosis codes related to stroke/TIA) with the episode data entered in the AuSCR.

The ***AuSCR Annual Data Quality Report*** is a summary of data quality for the final 2021 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

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 2021. Data entry for these acute stroke/TIA episodes, and the associated follow-up questionnaires was closed off, and data extracted, on 28 October 2022. Data cleaning and analyses were undertaken by authorised Monash University statisticians.

Hospital postcodes were mapped to the Australian Statistical Geography Standard (ASGS) Remoteness Standard (2016) available from the Australian Bureau of Statistics.[5] 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 episodes (aged <18 years) were not included in the overall patient characteristics, clinical and outcome data analyses.

As patients often receive care in more than one hospital for the same stroke/TIA event, multiple AuSCR records for the same patient event were linked using a person-level identifier (a Statistical Linkage Key) and the date of stroke onset +/- 1 day. This enabled us to more accurately examine the delivery of certain processes of care across the care continuum. For example, provision of thrombolysis was calculated only for eligible episodes of ischaemic stroke where thrombolysis had not already been provided during an earlier episode of care for the same patient event. Episodes were also excluded from the calculation of thrombolysis provision 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***. If the data were not provided, it was assumed that care related to that indicator was not offered.

For analyses of secondary prevention medications provided at discharge, patients who were recorded as being contraindicated were excluded from the denominator. For other time-based performance measures (e.g. door-to-needle or door-to-puncture), erroneous times (e.g. negative or beyond 12 hours) were excluded. See Appendix J for an overview of the methods used to derive quality indicators in the AuSCR.

For each quality indicator, data from individual hospitals were excluded if more than 30% of data for that variable were missing. Hospitals contributing fewer than 50 episodes of care were excluded from the funnel plots of process of care indicators to ensure fair and reliable comparisons between hospitals.

Benchmarks for AuSCR national indicators were calculated based on a modified version of the Achievable Benchmark of Care (ABC™) methodology[6] which has been used and validated for stroke.[7] Only hospitals that had submitted at least 50 episodes 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 that had registered at least 50 episodes of care.

Changes in adherence to selected quality indicators over time were also reported, from 2017 (the first full year data were collected in the AuSDaT) to 2021. These analyses were restricted to the 46 hospitals that consistently participated in the registry and provided data on at least 30 episodes each year.

Follow-up survey data collection attempts were made between 90 and 180 days after each admission except:

- where acute data were not entered by the hospital within 180 days post-admission; or
- for patients reported as deceased prior to the 90-180 day follow-up.

In the case where there was a second admission (including transfer) within 180 days of the first admission, follow-up was only completed for the first admission.

Functional disability is measured using the modified Rankin Scale (mRS), which is a standardised instrument used to categorise deficits after stroke.[8] During follow-up between 90 and 180 days post-admission, patients are asked to rate their level of functional disability across six levels: 0 (no symptoms at all; 1 (no significant disability despite symptoms); 2 (slight disability); 3 (moderate disability); 4 (moderately severe disability) and 5 (severe disability). The mRS analyses in this report exclude responses from individuals who were deceased at the time of follow-up (mRS=6).

Health-related quality of life (HRQoL) is measured in the AuSCR using the European Quality of Life measure of health status (EQ5D™),[9] three-level version of the instrument (EQ-5D-3L). The EQ-5D-3L provides a simple descriptive profile across five dimensions: mobility, self-care, usual activities, pain and discomfort, and anxiety and depression. Each profile is divided into three levels: no problems (1), some or moderate problems (2) and extreme problems (3). Responses to the EQ-5D-3L were dichotomised and reported based on whether patients had 'any' (i.e. moderate or extreme) versus 'no' problems with each domain.

Additionally, the EQ-5D-3L includes a self-rated summary score of overall health using a Visual Analogue Scale (VAS) with a range of responses from zero (i.e. worst imaginable health state) to 100 (i.e. best imaginable health state). Responses to the VAS were described using the mean (and standard deviation) to facilitate comparisons with published estimates for the normative population.[10] For comparisons between hospitals, mean VAS scores were adjusted to account for differences in case mix. Where possible, reference to the median (and interquartile range) was also made to assist in the interpretation of results.

Post-discharge survival is ascertained for registrants using linkage death registration data from the National Death Index. A risk adjusted mortality rate (RAMR) at 30 days post-admission was calculated for each hospital for episodes of ischaemic stroke and intracerebral haemorrhage (ICH). To ensure RAMRs were reliable, analyses were conducted for hospitals that provided a minimum number of episodes (at least 200 for ischaemic stroke and at least 50 episodes for ICH). For hospitals with fewer episodes, data from 2020 and 2021 were pooled and used to derive RAMRs. Episodes of in-hospital stroke or TIA were excluded from all RAMR analyses. Similar to earlier years, RAMRs were presented including and excluding hospital transfers.

Each RAMR was calculated by dividing the risk adjusted hospital specific mortality by the risk adjusted average hospital mortality, and then multiplying by the unadjusted proportion of deaths in the whole sample.[11] Hospitals with risk-adjusted mortality outside the three standard deviation threshold limits were considered to have unwarranted variation.

All RAMR models were adjusted for age, sex, socioeconomic position, stroke type, previous history of stroke, and a measure of stroke severity. For ischaemic stroke, we adjusted for stroke severity using the National Institutes of Health Stroke Scale (NIHSS) score. Because NIHSS scores were missing for approximately one in three episodes, multiple imputation techniques were used to assign an NIHSS score from another episode that had a similar set of patient characteristics (e.g. matched on age, sex, hospital ID, ability to walk on admission, transfer from another hospital, in-hospital stroke, and previous history of stroke). For ICH, it was not possible to adjust RAMR models using NIHSS scores as they were missing for the majority (>50%) of episodes and could not be reliably imputed. Therefore, similar to earlier years, RAMR models for ICH were adjusted for stroke severity using the ability to walk on admission (a validated measure of post-stroke outcome).[12] All analyses were performed using Stata/SE 17.0 (College Station, USA, 2021).

PARTICIPATING HOSPITALS

In 2021, 62 hospitals provided data for 19,756 episodes care (Figure 1). Most hospitals participated in the Red data collection program (see Appendix H for the variables collected in each program). Data on ECR provision were collected by 12 hospitals as part of the Black program, and one hospital as part of the Violet program used in NSW.

In 2021, there were 29 hospitals located in Victoria (VIC), 22 in Queensland (QLD), two in New South Wales (NSW), three each in Tasmania (TAS) and South Australia (SA), two in the Australian Capital Territory (ACT), and one in Western Australia (WA; Table 1). There were 22 hospitals that contributed to the ED dataset. A total of 260 episodes were recorded in the optional ED dataset to capture processes of care provided prior to transfer to another hospital for ongoing management (e.g. ECR).

Overall, 58 participating hospitals had a stroke unit and 58 provided thrombolytic therapy using intravenous tissue plasminogen activator (tPA). There were also two children's hospitals collecting AuSCR data in the Paediatric Program in 2021.

FIGURE 1: TOTAL EPISODES IN 2021, BY DATA PROGRAM

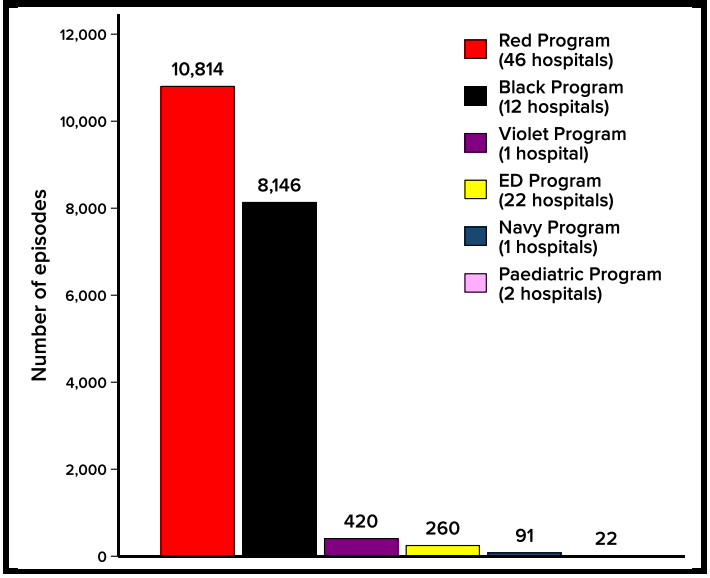


Table 1: Characteristics of participating AuSCR hospitals

		HOSPITAL STATE						
	Total	**ACT**	**NSW**	**QLD**	**SA**	**TAS**	**VIC**	**WA**
Number of hospitals	62	2	2	22	3	3	29	1
Number of episodes*								
<75 episodes	10	0	0	2	0	0	7	1
75-349 episodes	31	1	1	13	0	2	14	0
350-499 episodes	11	0	1	4	2	1	3	0
≥500 episodes	10	1	0	3	1	0	5	0
Location#								
Major city	35	2	2	14	3	0	13	1
Inner Regional	19	0	0	6	0	2	11	0
Outer Regional	8	0	0	2	0	1	5	0
Stroke unit	58	2	2	22	3	2	26	1
Used telemedicine	41	1	1	18	1	2	18	0
Thrombolysis provided	58	2	2	21	3	3	26	1
ECR provided	13	1	1	3	1	1	5	1
Contributed to the ED dataset	22	0	1	5	0	0	16	0
Contributed to the FeSS dataset	15	0	0	3	0	2	10	0

ECR: endovascular clot retrieval, ED: emergency department; FeSS: Fever, sugar, swallow optional variables.
* Categories as per definitions used by the Stroke Foundation National Stroke Audit reports.
# Location categorised using Australian Statistical Geography Standard Remoteness Standard 2016.[5]

STROKE FOUNDATION ORGANISATIONAL SURVEY RESULTS

For the first time, we report information from the 2021 Stroke Foundation Organisational Survey according to whether hospitals participated in the AuSCR in 2021. The Stroke Foundation Organisational Survey is self-reported by nominated stroke service clinicians and conducted biennially in the majority of acute public hospitals that admit at least 40 or more people with stroke each year within Australia. Consequently, review of this information provides an opportunity to better understand the representativeness of the AuSCR data for monitoring stroke care. As part of this survey, staff from participating hospitals respond to a standardised set of questions related to the availability of resources at their hospital to support best-practice stroke care (see www.informme.org.au/stroke-data/acute-audits for more information).

For the Stroke Foundation National Audit in 2021, there were 111 public services, and four private services, that completed the Organisational Survey. These hospitals collectively had 35,652 acute stroke admissions in 2021.[13] As shown below in Table 2, when compared with the characteristics of non-AuSCR hospitals, the hospitals that participated in the AuSCR in 2021 tended to have a larger number of admissions, were more likely to offer thrombolysis, and were more likely to have a clinical pathway for managing TIA. All other characteristics reported in the 2021 Stroke Foundation Organisational Survey were generally similar between AuSCR and non-AuSCR hospitals.

Table 2: Selected hospital characteristics reported in the 2021 Stroke Foundation organisational survey, by participation in the AuSCR

Organisational Survey complete 2021 (N= 115 hospitals)	Participated in the AuSCR in 2021		*p*
	Yes N=56 hospitals*	No N= 59 hospitals	
Number of beds, median (Q1 to Q3)	297 (177-541)	220 (111-446)	0.08
Number of patients admitted with stroke in the last year, median (Q1 to Q3)	267 (148-479)	212 (68-310)	0.008
Receive pre-notification of potential stroke patient, n (%)	48 (86)	45 (76)	0.20
Presence of a stroke unit, n (%)	49 (88)	44 (75)	0.08
Number of stroke unit beds, median (Q1-Q3)	8 (4-12)	6 (4-8)	0.10
Rapid access to onsite CT brain (24/7), n (%)	46 (82)	42 (71)	0.17
Offers thrombolysis to eligible patients, n (%)	55 (98)	46 (78)	0.001
Dedicated stroke coordinator position, n (%)	40 (71)	40 (68)	0.67
Clinical pathway for managing stroke, n (%)	48 (86)	54 (92)	0.33
Clinical pathway for managing TIA, n (%)	52 (93)	47 (80)	0.041
Rapid assessment clinics/services for TIA, n (%)	27 (48)	31 (53)	0.64
Routine use of discharge care plans, n (%)	44 (79)	40 (68)	0.19

CT: computed tomography: Q1: 25th percentile; Q3: 75th percentile; TIA: transient ischaemic attack.
*Excludes six AuSCR hospitals that did not participate in the 2021 Stroke Foundation Organisational Survey.

PATIENT CHARACTERISTICS

In 2021, there were 18,251 patients registered in the AuSCR (Table 3). During a calendar year, patients may have multiple admissions for stroke or TIA that are eligible for inclusion in the AuSCR. In 2021, there were 19,753 episodes of acute hospital care entered in the AuSCR for the 18,251 individuals registered. A total of 19,717 adult episodes of care were captured in the AuSCR in 2021.

The median number of episodes per hospital was 270 (Q1 to Q3: 164 to 487). Excluding paediatric hospitals, the minimum number of episodes registered was at a regional hospital in VIC (n=18) that began participating in the registry in November and the maximum number registered was at a metropolitan hospital in VIC (n=1,587).

Table 3: Number of patients and episodes in 2021

	All episodes	Adult episodes
Number of episodes (N= 62 hospitals)	19,753	19,717
Emergency Department dataset (n= 28 hospitals)	260	258
Hospital admissions	19,493	19,459
Number of individual patients	18,251	18,217
Number of unique acute stroke/TIA events	18,920	18,886

PATIENT DEMOGRAPHICS

Table 4 provides the baseline characteristics of patients, and information related to their episodes of care. Adult and paediatric episodes are presented separately. Ten hospitals admitted paediatric episodes (patients aged <18 years) in 2021.

In total, 44% of all adult patients were female. The mean age of adult patients was 73 years (median: 75 years). There were 4,928 (28%) patients who were of working age (18 to 65 years), and 1,362 (8%) patients who were between 18 and 50 years of age.

Information on country of birth was available for 16,790 adult patients, with the majority (73%) born in Australia. The second most common place of birth was Europe (11%), followed by the UK (7%) and then Asia (6%). The majority of the registered adult patients spoke English (92%). There were 358 adult patients (2%) who identified as having an Aboriginal or Torres Strait Islander background.

Table 4: Patient characteristics (adults and paediatric episodes)

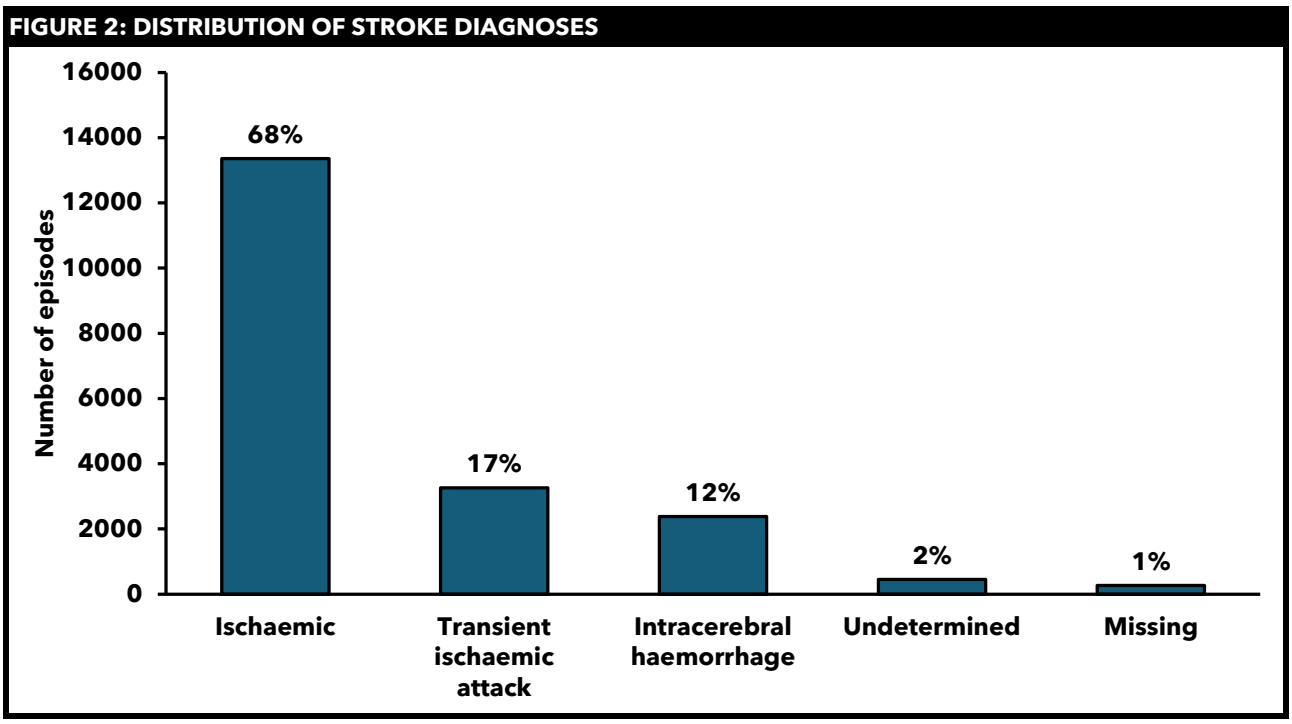
Patients	Adults (n=18,217)	Paediatrics (n=34)
Episodes (N = 19,753)	**19,717**	**36**
Age in years, median (Q1 to Q3)	75 (65 to 84)	5 (1 to 15)
Female, n (%)	7,806 (44)	17 (50)
Place of birth, n (%)		
Australia	12,245 (73)	32 (100)
United Kingdom	1,189 (7)	0 (0)
Other European counties	1,881 (11)	0 (0)
North Africa/Middle East	163 (1)	0 (0)
Asia	1,068 (6)	0 (0)
Rest of Africa	206 (1)	0 (0)
Others	6 (<1)	0 (0)
Aboriginal and/or Torres Strait Islander, n (%)	358 (2)	<5 (<14)
English spoken, n (%)	14,329 (92)	29 (97)

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

CLINICAL DIAGNOSES

Of the 19,717 adult episodes, clinicians indicated that there were 13,358 ischaemic strokes, 2,377 intracerebral haemorrhages (ICH), 3,259 TIAs and 454 episodes of undetermined stroke type (Figure 2). There were 269 episodes (1.4%) where the stroke type was missing. An increase in the assignment of undetermined stroke type was observed since 2020 (i.e. 1.2% of episodes in 2020 vs 2.3% of episodes in 2021; $p<0.001$). Of the 723 episodes with missing or undetermined stroke type for clinical diagnosis, ICD-10 codes were provided for 656, which comprised ischaemic stroke (n=259), ICH (n=37), TIA (n=146), and undetermined (n=214). Including these additional ICD-10 codes did not significantly alter the overall proportion of each stroke type.

FIGURE 2: DISTRIBUTION OF STROKE DIAGNOSES



STROKE SEVERITY

In the AuSCR, we collect two different variables to provide an indication of stroke severity at time of arrival to hospital. The patients' ability to walk on admission was recorded in 18,232 episodes (92% of the 2021 cohort), of whom 43% were documented as being able to walk at the time of admission.

A National Institutes of Health Stroke Scale (NIHSS) score at the time of presentation to hospital was recorded for 12,815 episodes (65% of the 2021 cohort vs 60% in 2020, $p<0.001$). Patients with a diagnosis of ischaemic stroke had the lowest proportion of missing NIHSS scores (29%). Of the episodes receiving thrombolysis (N=1,413), a NIHSS score was missing for 7%. Patients treated in a stroke unit had a greater proportion of NIHSS scores recorded in contrast to those treated in alternate ward settings (71% vs 48%, $p<0.001$).

Of those episodes with a NIHSS score recorded, 6% had a NIHSS ≥21, indicative of a severe stroke. Excluding those with TIA, there were 10,284 episodes with data for both of the stroke severity variables recorded (Table 5). The greatest proportion of patients who were unable to walk on admission had a NIHSS score between five and 15, indicating a moderate stroke (45%). Of those who were able to walk on admission, the majority (57%) had a NIHSS score of one to four, indicating a minor stroke.

Table 5: NIHSS and ability to walk on admission

National Institutes of Health Stroke Scale (NIHSS) categories	Ability to walk on admission	
	No n (%)	Yes n (%)
No stroke symptoms (score 0)	265 (4)	684 (18)
Minor stroke (score 1-4)	1,883 (29)	2,168 (57)
Moderate stroke (score 5-15)	2,890 (45)	800 (21)
Moderate to severe stroke (score 16-20)	756 (12)	83 (2)
Severe stroke (score 21-42)	697 (11)	58 (2)
Total, N	**6,491**	**3,793**

Excludes episodes of transient ischaemic attack.

INPATIENT STROKES

There were 764 episodes (4%) that occurred while patients were already in hospital for another condition. The proportion of inpatient strokes varied from 0% to 11% between hospitals. The majority of inpatient episodes were ischaemic (n=592, 79%) and the largest proportion of inpatient strokes (n=231, 32%) occurred among patients aged between 75 and 84 years.

ARRIVAL WITHIN 4.5 HOURS OF SYMPTOM ONSET

Among patients presenting from the community (i.e. excluding inpatient strokes and episodes transferred from another hospital; N=15,970), valid dates and times of stroke onset and hospital arrival were available for 14,755 (92%). Of these, 7,265 (49%) arrived at hospital within 4.5 hours of symptom onset. A smaller proportion of patients with ischaemic stroke (45%) arrived at hospital within 4.5 hours of symptom onset compared to episodes of ICH (50%) or TIA (63%; $p<0.001$).

ARRIVAL BY AMBULANCE

Method of arrival to the ED was collected for 18,464 episodes. Of these, 14,394 (78%) were transported by ambulance. Of the 7,263 episodes who arrived to hospital from the community within 4.5 hours of symptom onset, 88% were transported by ambulance. The proportion of patients who arrived by ambulance was greatest for those experiencing ICH (84%).

ACUTE CARE DATA

PATIENT TRANSFERS

There were 3,139 episodes (16%) where patients were transferred from another hospital. Of these, 686 were transferred from another hospital participating in the AuSCR and both episodes were recorded in the AuSCR. The majority (75%) of patients who were transferred from another hospital arrived by ambulance. The reason for transfer was collected for hospitals participating in the AuSCR Black and Violet data collection programs (54% of transferred episodes in 2021). Transfer for thrombolysis was indicated for 24 episodes (12 VIC; 6 QLD; 3 ACT; and 3 SA) and transfer for ECR was indicated for 851 patients (412 VIC; 242 QLD; 108 SA; 43 ACT; 30 TAS; 11 NSW; and 5 WA).

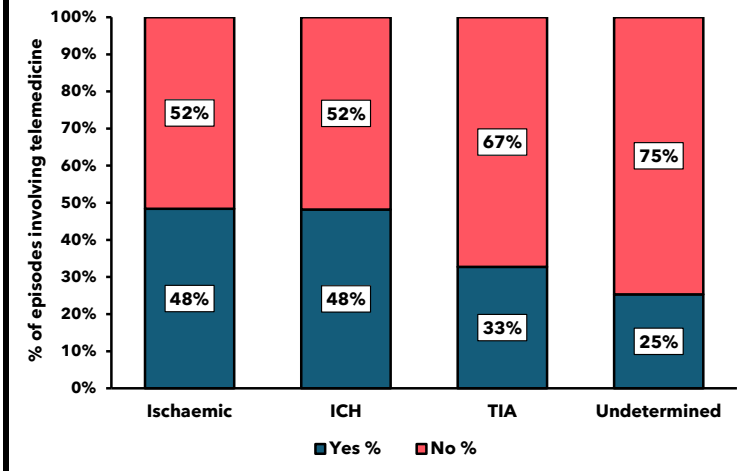
TELEMEDICINE IN ACUTE STROKE CARE

Telemedicine consultations were recorded as being provided for 26 regional hospitals (16 VIC; 8 QLD; 2 TAS) for a total of 2,079 episodes (60% of regional episodes in VIC, 38% in TAS, and 24% in QLD).

There were 1,381 episodes of ischaemic stroke involving a telemedicine consultation at regional hospitals (Figure 3). Provision of thrombolysis was more common in episodes with (*vs* without) telemedicine (17% vs 4%; $p<0.001$).

The median door-to-needle time for these episodes was 94 minutes (Q1 to Q3: 69 to 121).

FIGURE 3: CLINICAL DIAGNOSIS OF PATIENTS PROVIDED WITH A TELEMEDICINE CONSULTATION AT REGIONAL HOSPITALS



ICH: intracerebral haemorrhage; TIA: transient ischaemic attack

BRAIN SCANS

Excluding data from hospitals with >30% missing information on the provision of brain scans (n=4 hospitals; 2,127 episodes), there was evidence that 98% of adult episodes were provided a brain scan in 2021. Fewer episodes of undetermined stroke received a brain scan (93%) compared to other stroke types (>98%; $p<0.001$). Of those who received a brain scan, there were 17,008 episodes where a date and time of the brain scan was recorded. Of these, 1,382 episodes received a brain scan prior to transfer to the hospital at which they were admitted. For episodes provided a brain scan after arrival to hospital, the median time to scan was 43 minutes, with seven hospitals achieving a median time ≤25 minutes (Figure 4). The median time to brain scan after arrival to hospital was 30 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

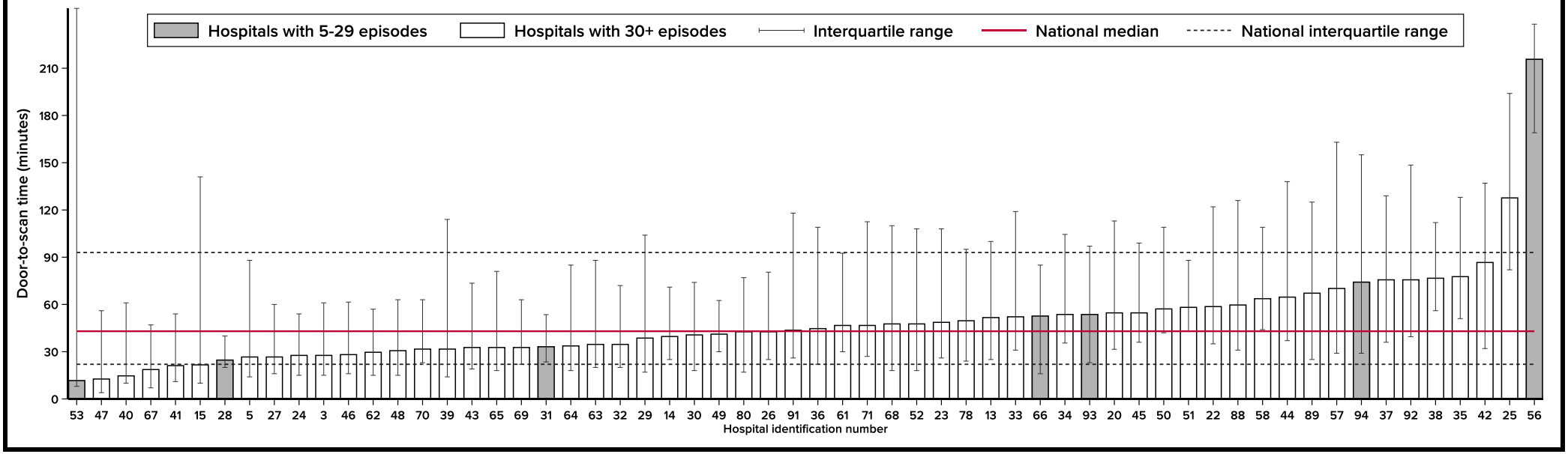
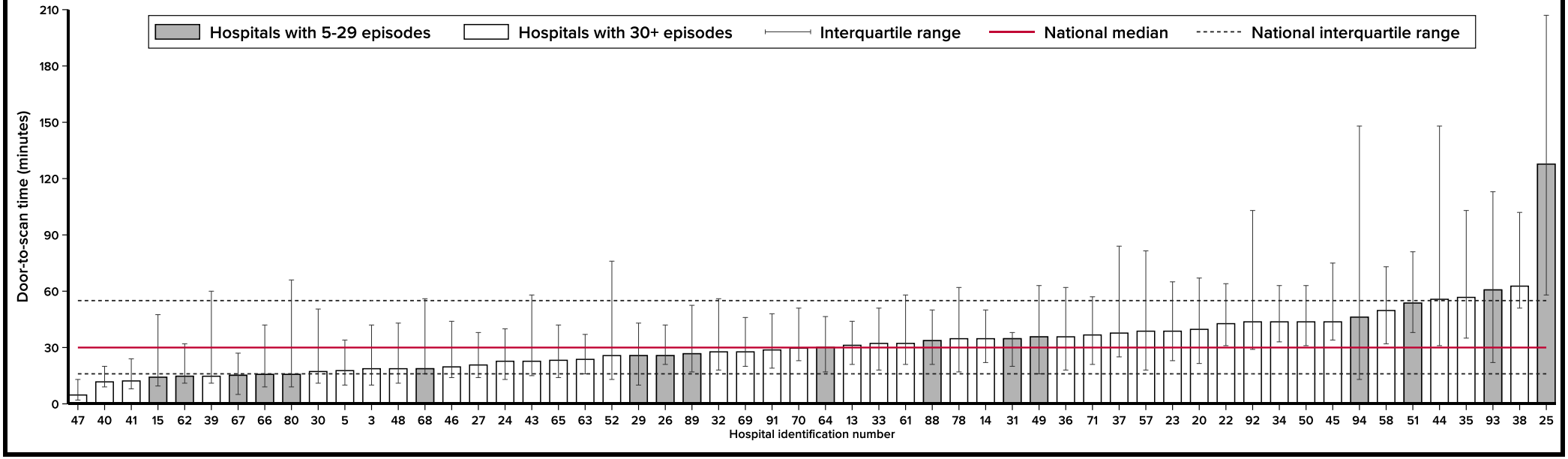


FIGURE 5: MEDIAN DOOR-TO-SCAN TIME FOR ISCHAEMIC STROKES PRESENTING WITHIN 4.5 HOURS, BY HOSPITAL



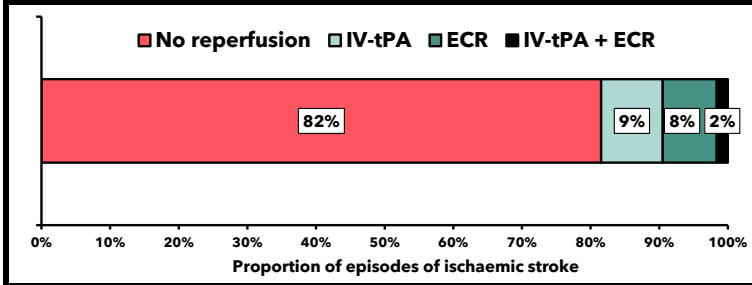
Figures 4 and 5 exclude data from hospitals with >30% missing data, <5 episodes, or erroneous dates/times of brain scan (e.g. negative or after 4.5 hours of arrival). Number of episodes with door-to-scan times by hospital range from 6 to 987 in Figure 4, and 5 to 465 in Figure 5.

OVERALL ADHERENCE TO QUALITY INDICATORS

REPERFUSION THERAPY

Overall, 2,466 (18.5%) patients with ischaemic stroke received a type of reperfusion therapy (intravenous thrombolysis or ECR; Figure 6). In the following sections, we detail information for patients that received either type of reperfusion therapy, acknowledging that patients may be eligible to receive both of these therapies.

FIGURE 6: REPERFUSION THERAPY IN ISCHAEMIC STROKE



ECR: endovascular clot retrieval; IV-tPA: intravenous thrombolysis

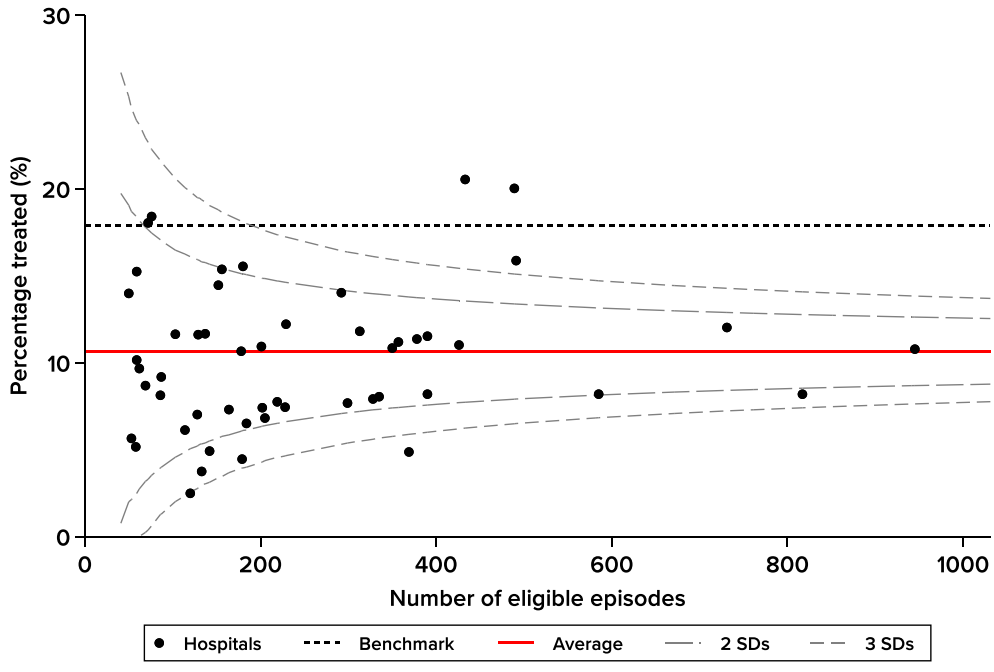
THROMBOLYSIS TREATMENT DELIVERY

Of the episodes of ischaemic stroke not previously provided intravenous thrombolysis (N=13,210), 1,413 (11%) received thrombolysis treatment (Figure 7). Of these, 109 episodes received thrombolysis for the first time after transfer from another hospital. Overall provision of thrombolysis varied by state: VIC (12%), TAS (12%), NSW (11%), QLD (10%), SA (9%), ACT (8%); p=0.001).

Provision of thrombolysis was similar between hospitals located in major cities (11%), inner regional areas (11%) or outer regional areas (9%; p=0.24). However, hospitals providing ECR had a greater provision of thrombolysis (12%) compared to hospitals that did not offer this intervention (10%; p<0.001). Of the 4,817 eligible patients with ischaemic stroke who arrived within 4.5 hours of symptom onset, 24% were provided with intravenous thrombolysis.

FIGURE 7: RECEIVED INTRAVENOUS THROMBOLYSIS, BY HOSPITAL

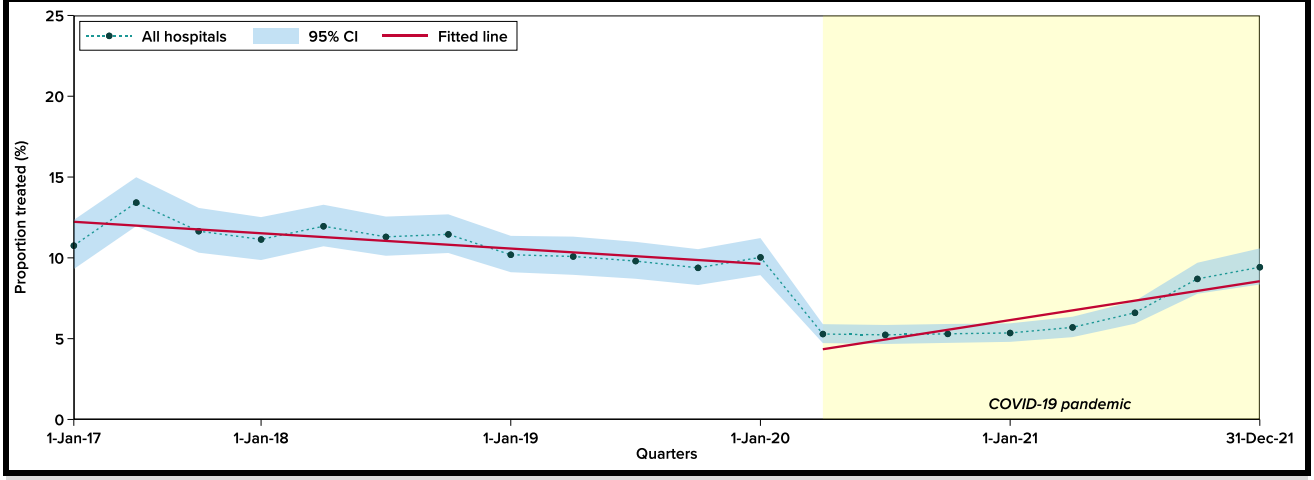
ACHIEVABLE BENCHMARK*†: 18% **AVERAGE ADHERENCE†: 11%**



Each dot represents the percentage adherence for an individual hospital.
** Benchmark based on a modified ABC™ method using data from sites with at least 50 eligible episodes.*
† Excludes 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 ambulance.

The provision of thrombolysis has steadily decreased since 2017 (Figure 8), with a pronounced decline evident in the first quarter of 2020 – coinciding with the COVID-19 pandemic. From the start of the COVID-19 pandemic period until the end of 2021, the provision of thrombolysis has slowly increased but remains slightly below pre-pandemic levels.

FIGURE 8: QUARTERLY CHANGES IN PROVISION OF THROMBOLYSIS

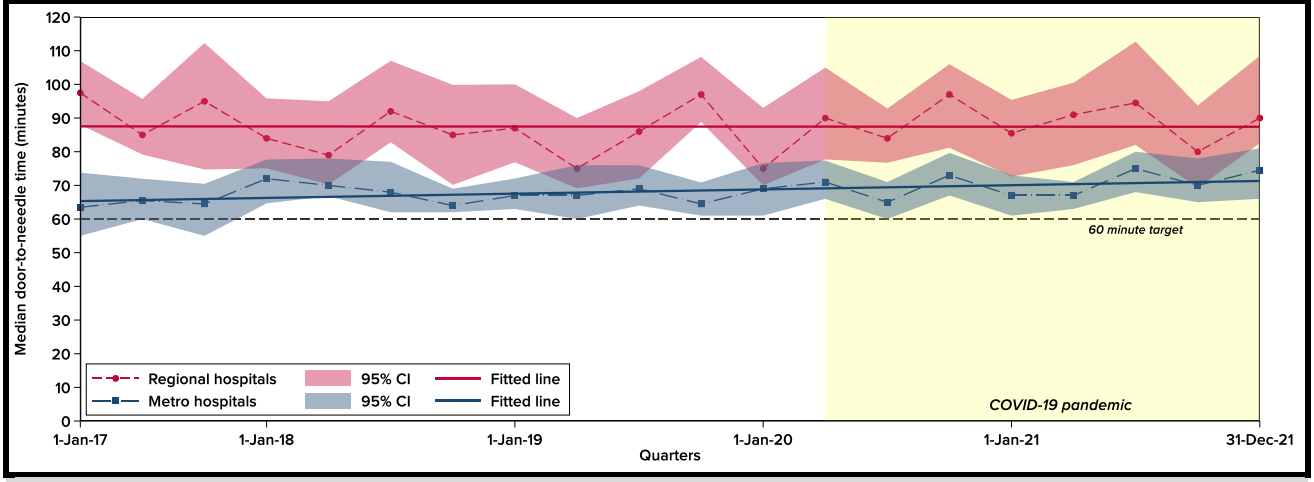


Data derived from a sub-set of 46 hospitals that have consistently participated in the AuSCR between 2017 and 2021 and contributed ≥30 episodes each calendar year.
* Includes episodes of ischaemic stroke only.

Of the 1,320 episodes with a date and time recorded for the provision of thrombolysis that was not administered prior to hospital arrival, 29% had a door-to-needle time under 60 minutes. The median door-to-needle time was 77 minutes and median onset-to-needle time was 159 minutes. There was no significant difference in the median onset-to-needle time between patients who were directly admitted and those transferred from another hospital (159 vs 169 minutes; p=0.86).

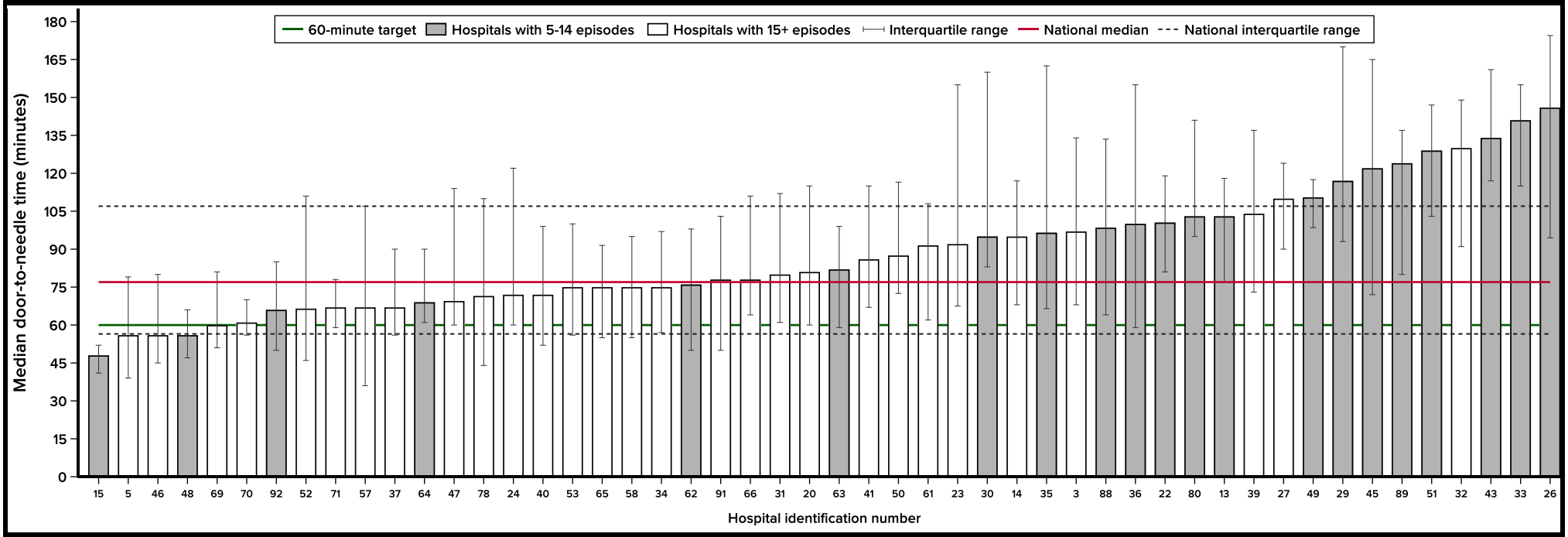
We noted that median door-to-needle times have remained stagnant between 2017 and 2021, with no clear upward or downward trend observed (Figure 9). Of greater concern is the disparity observed in median door-to-needle times between metropolitan and regional hospitals, with those treated in a regional (*vs* metropolitan) hospital less likely to have a door-to-needle time under 60 minutes (18% *vs* 33%; p<0.001). Based on overall average treatment times, the international door-to-needle target of treatment within 60 minutes of arrival was not met at any time point between 2017 and 2021. At the individual hospital level, only five hospitals had a median door-to-needle time of 60 minutes or less in 2021 (Figure 10).

FIGURE 9: QUARTERLY CHANGES IN DOOR-TO-NEEDLE TIMES, BY HOSPITAL LOCATION



Data derived from a sub-set of 46 hospitals that have consistently participated in the AuSCR between 2017 and 2021 and contributed ≥30 episodes each calendar year.
* Includes episodes of ischaemic stroke provided thrombolysis only.

FIGURE 10: DOOR-TO-NEEDLE TIMES, BY HOSPITAL



Excludes episodes where thrombolysis was provided prior to arrival or after 270 minutes of arrival.
Number of episodes with door-to-needle times by hospital range from 5 to 101.
Excludes data from 7 hospitals with <5 episodes.

CASE STUDY 1

Using AuSCR data to monitor outcomes following a change in practice

The problem

Hospital A in inner regional Victoria admits approximately 200 stroke and TIA patients per year and cares for a population of more than 250,000 people. They have a stroke coordinator two days per week and began participating in the AuSCR in 2014.

The solution

Following promising results from other regional hospitals in Victoria using a telehealth communication system for pre-notification from ambulance services of patients with stroke, Hospital A began its implementation. Noting the importance of measuring the impact of such changes, they used AuSCR data to look at their door-to-scan and door-to-needle times both before and three months after implementation of the pre-notification system.

The outcomes

Results showed that post-implementation of the pre-notification system, door-to-scan times for those provided thrombolysis improved 83%, and door-to-needle times for thrombolysis improved 12%.

Image by Liamdavies

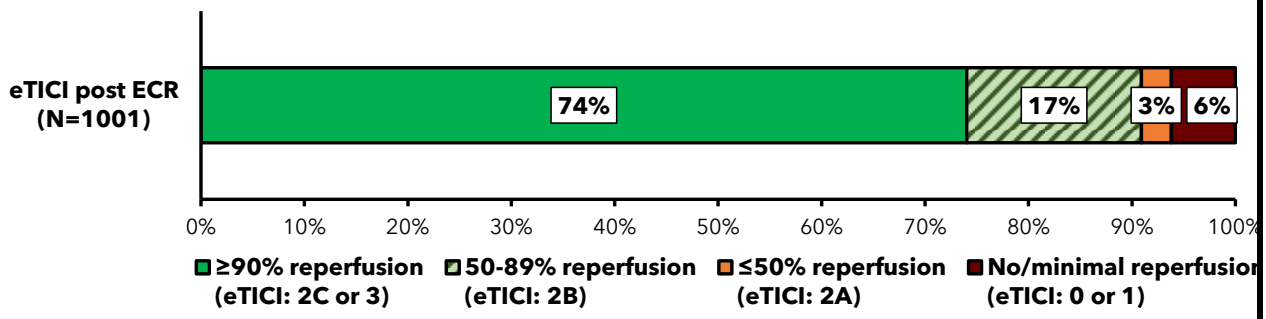
ENDOVASCULAR CLOT RETRIEVAL (ECR)

Overall, ECR was provided in 1,268 episodes in 2021 (10% of all episodes of ischaemic stroke included in the AuSCR). ECR was performed in thirteen hospitals *(5 in VIC, 3 in QLD, and 1 each in ACT, NSW, SA, TAS, WA),* which represented 20% of all ischaemic strokes treated in these hospitals. The achievable benchmark for these ECR-capable hospitals, based on two top performing hospitals, was 30%.

For episodes where times of both arrival and treatment were collected, the median time from arrival to groin puncture was 91 minutes (Q1 to Q3: 39 to 133 minutes) and the median time from arrival to recanalisation was 135 minutes (Q1 to Q3: 87 to 187 minutes).

The expanded treatment in cerebral infarction (eTICI) score is an indication of blood flow restored after thrombectomy and an indication of success. Figure 11 shows eTICI outcomes following ECR, where 2C or 3 is considered successful (i.e. >90% reperfusion).

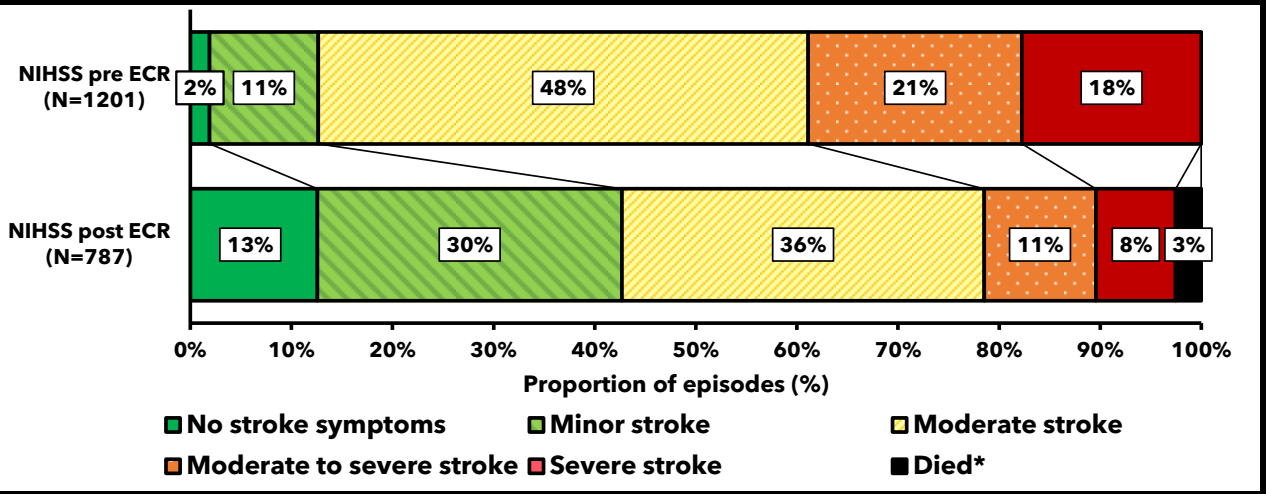
FIGURE 11: REPERFUSION SCORES AFTER ECR



eTICI: expanded treatment in cerebral infarction score.

In addition to the NIHSS score obtained at hospital arrival, hospitals participating in the AuSCR Black or Violet Programs also collect a NIHSS score before ECR and 24 hours after ECR. Of the 1,268 patients provided with ECR, 1,201 had a NIHSS score recorded at hospital presentation or before ECR (95% complete) and 787 had a NIHSS score post-ECR recorded or were recorded as having died on the same day or day after ECR (62% complete). Of those with a missing NIHSS score post-ECR, 60% were discharged to another hospital for further acute care, 21% were discharged directly home, and 19% were discharged to rehabilitation. A summary of NIHSS scores before and after ECR is shown in Figure 12.

FIGURE 12: NIHSS SCORES BEFORE AND AFTER ECR



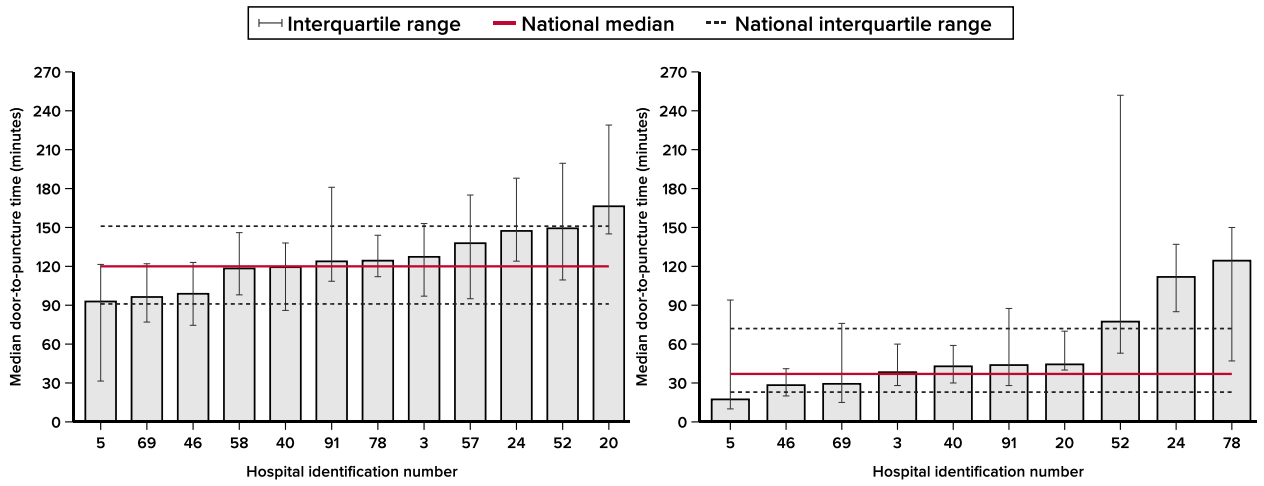
NIHSS 0: No stroke symptoms; NIHSS 1-4: Minor stroke; NIHSS 5-15: Moderate stroke; NIHSS 16-20: Moderate to severe stroke; NIHSS 21-42: Severe stroke
**Died on the same day or day after endovascular clot retrieval and a post-procedure NIHSS score was missing.*

TIMELINESS OF ECR

For episodes transferred from another hospital, the median time from arrival to groin puncture was 83 minutes faster when compared to direct admissions (p<0.001; Figure 13). The median time from arrival to recanalisation time was also significantly faster for transferred patients than for those admitted directly (Figure 14; p<0.001). Conversely, the median onset to groin puncture time was significantly longer for transferred patients at 345 minutes (Q1 to Q3: 229 to 460 minutes) compared to 218 minutes (Q1 to Q3: 170 to 320 minutes) for direct admissions (p<0.001).

FIGURE 13: DOOR-TO-PUNCTURE TIME FOR DIRECT VS TRANSFERRED EPISODES, BY HOSPITAL

A. ADMITTED DIRECTLY TO HOSPITAL **B. TRANSFERRED FROM ANOTHER HOSPITAL**

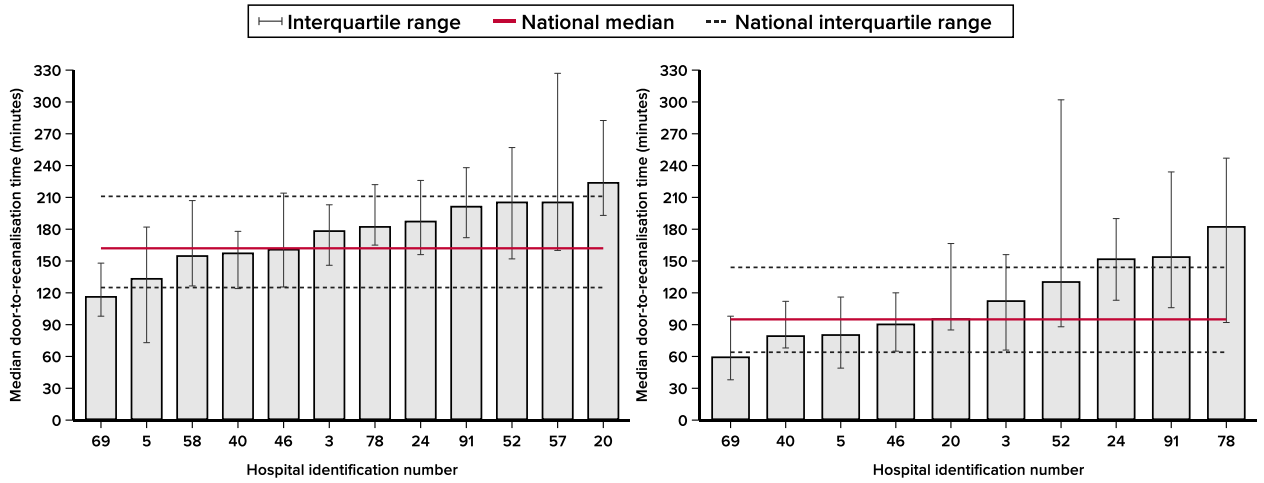


National median: 120 mins (Q1 to Q3: 91 to 151 mins) ***National median: 37 mins (Q1 to Q3: 23 to 72 mins)***

Includes data only from hospitals participating in the AuSCR Black or Violet data collection programs.
Excludes data from hospitals with <5 episodes and episodes with invalid door-to-puncture times (i.e. negative or greater than 720 minutes). Data from Hospital 58 are excluded in Panel B due to data quality.
Sample sizes at each hospital range from 9 to 122 in panel A; and from 5 to 166 in panel B.

FIGURE 14: DOOR-TO-RECANALISATION TIME FOR DIRECT VS TRANSFERRED EPISODES, BY HOSPITAL

A. ADMITTED DIRECTLY TO HOSPITAL **B. TRANSFERRED FROM ANOTHER HOSPITAL**



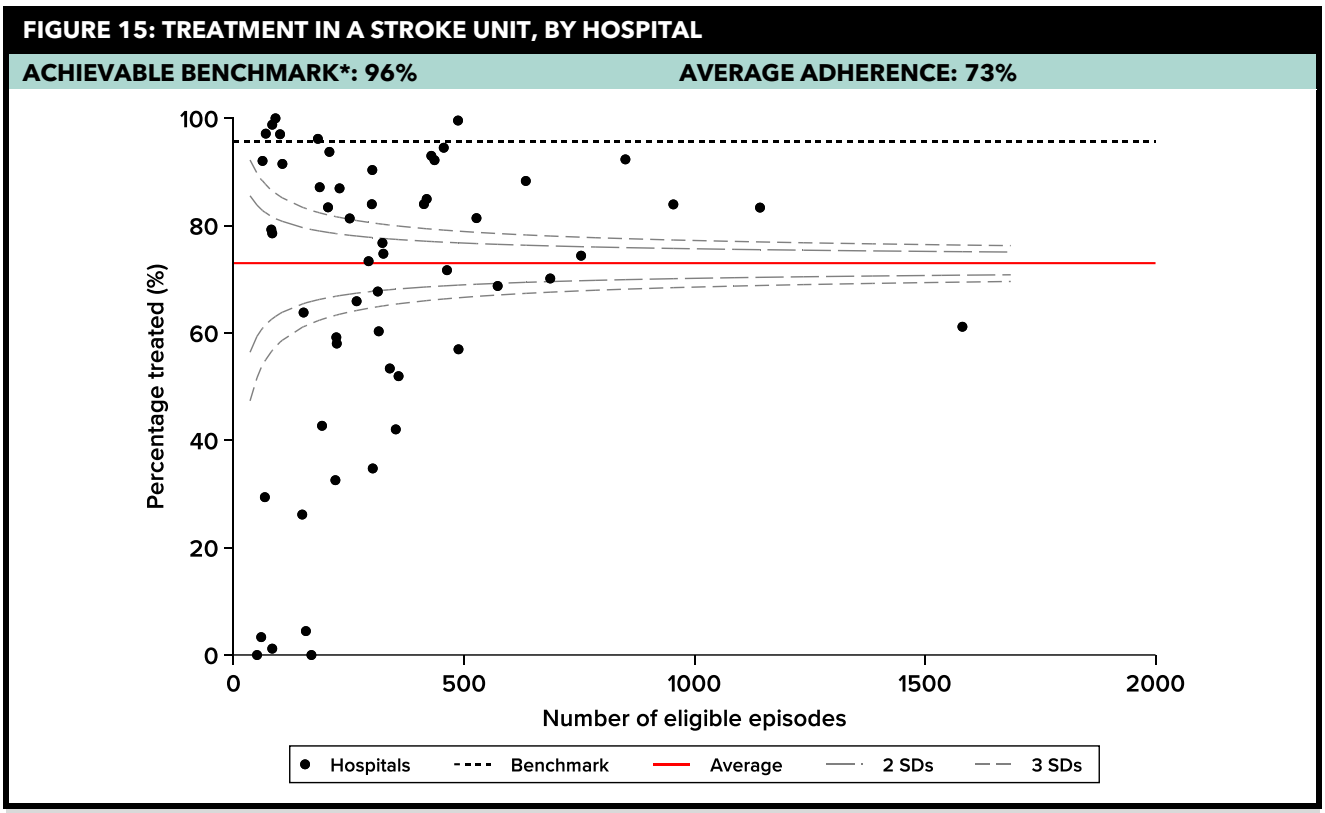
National median: 162 mins (Q1 to Q3: 124 to 211 mins) ***National median: 95 mins (Q1 to Q3: 64 to 144 mins)***

Includes data only from hospitals participating in the AuSCR Black or Violet data collection programs.
Excludes data from hospitals with <5 episodes and episodes with invalid door-to-puncture times (i.e. negative or greater than 720 minutes). Data from Hospital 58 are excluded in Panel B due to data quality.
Sample sizes at each hospital range from 9 to 122 in panel A; and from 5 to 166 in panel B.

STROKE UNIT CARE

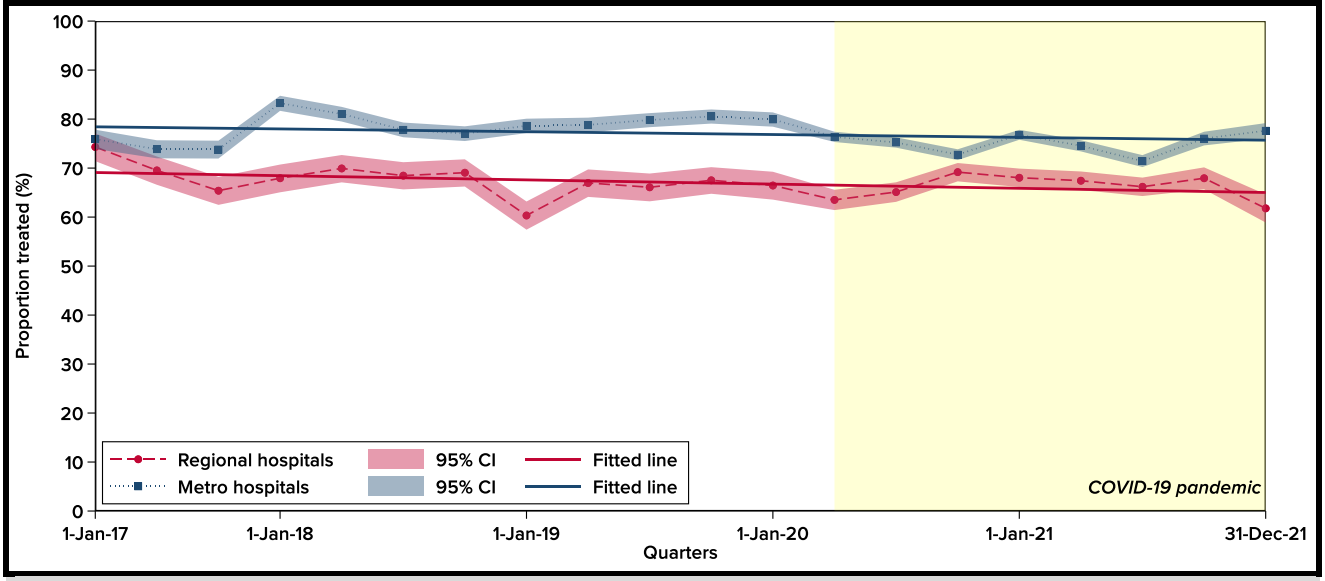
Overall, 73% of episodes in 2021 were treated in a stroke unit. Patients who experienced a stroke or TIA while already in hospital for a different condition (i.e. an inpatient episode) were less likely to receive stroke unit care than those who presented from the community (54% vs 74%, $p<0.001$). There were fourteen hospitals that provided stroke unit care to patients in ≥90% of their episodes in 2021 (Figure 15). Stroke unit care has remained stable over time and is less common in regional (*vs* metropolitan) hospitals (Figure 16).

FIGURE 15: TREATMENT IN A STROKE UNIT, BY HOSPITAL



Each dot represents the percentage adherence for an individual hospital. Excludes ED episodes.
** Benchmark based on a modified ABC™ method using data from sites with at least 50 eligible episodes.*

FIGURE 16: QUARTERLY CHANGES IN STROKE UNIT CARE, BY HOSPITAL LOCATION



Data derived from a subset of 46 hospitals that have consistently participated in the AuSCR between 2017 and 2021 and contributed ≥30 episodes each calendar year. Excludes ED episodes.

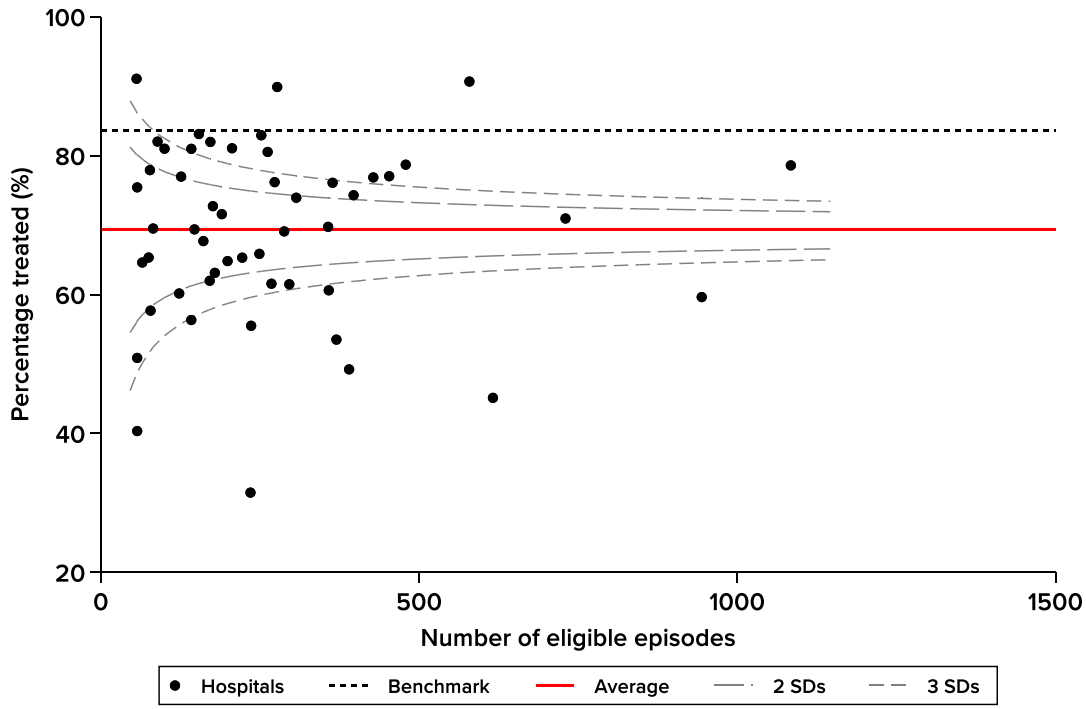
OTHER ACUTE ASSESSMENT AND MANAGEMENT PRACTICES

HYPERACUTE ANTIPLATELET THERAPY

In 2021, we report the hyperacute provision of any antiplatelet agent, instead of aspirin only, for the first full year since the AuSCR Data Dictionary was updated to accommodate the changes in national clinical guidelines.[14] Patients who received an anticoagulant agent instead of antiplatelet therapy (11%) were also included in the numerator for this indicator. After excluding episodes of intracerebral haemorrhage and those with documented contraindications, hyperacute antiplatelet therapy was provided within 48 hours of stroke onset in 69% of episodes (Figure 17).

FIGURE 17: HYPERACUTE ANTIPLATELET THERAPY, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 84% **AVERAGE ADHERENCE†: 69%**



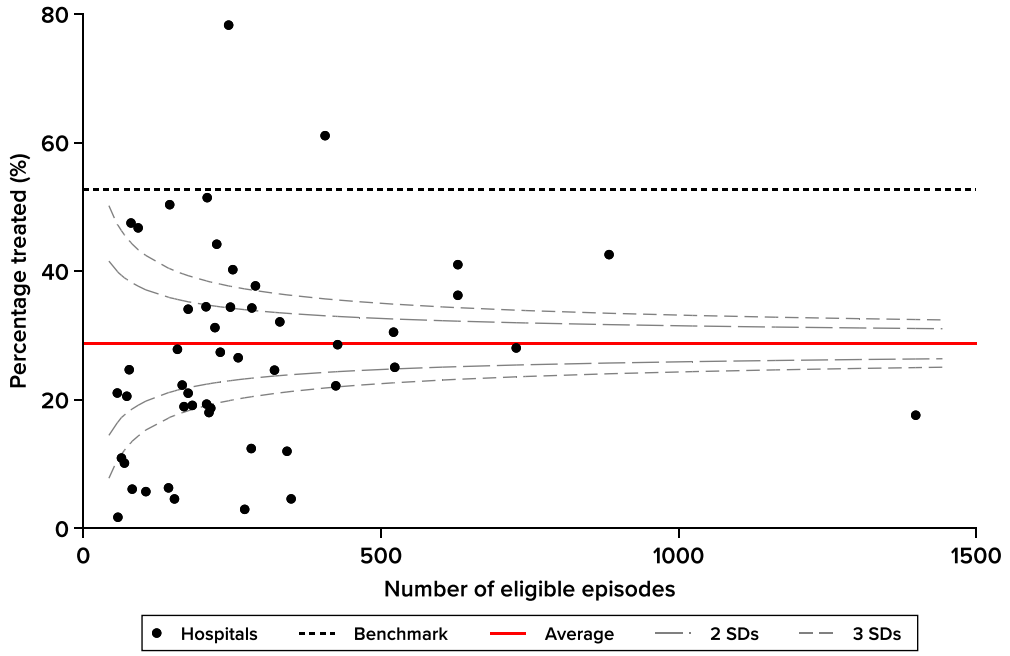
Each dot represents the percentage adherence for an individual hospital.
** Benchmark based on a modified ABC™ method using data from sites with at least 50 eligible episodes.*
† Excludes episodes of intracerebral haemorrhage, episodes with contraindications, and ED episodes.

SWALLOW SCREEN AND ASSESSMENT

A swallow screen was undertaken in two-thirds (56%) of all episodes, and a formal swallow assessment was conducted by a speech pathologist in 66% of episodes in 2021. Overall, a swallow screen or assessment was conducted within four hours of arrival to hospital for 29% of episodes (Figure 18), and within 24 hours for 68% of all episodes. A swallow screen or assessment occurred prior to oral intake in 58% of episodes (Figure 19).

FIGURE 18: SWALLOW SCREEN OR ASSESSMENT WITHIN 4 HOURS OF ARRIVAL, BY HOSPITAL

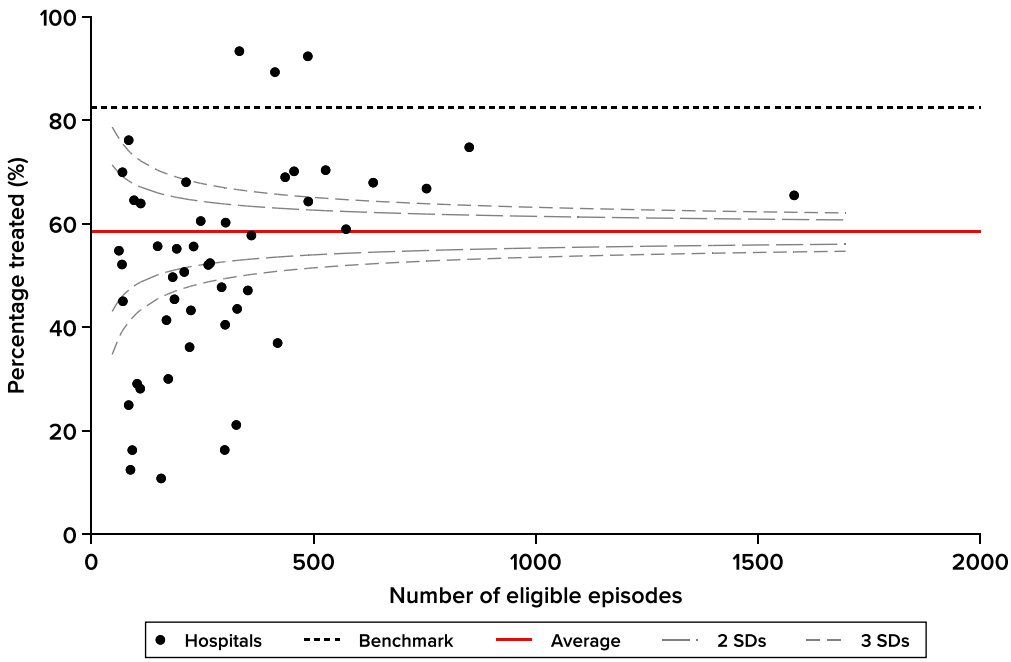
ACHIEVABLE BENCHMARK*: 53% **AVERAGE ADHERENCE*: 29%**



Each dot represents the percentage adherence for an individual hospital.
** Benchmark based on a modified ABC™ method using data from sites with at least 50 eligible episodes*

FIGURE 19: SCREEN OR ASSESSMENT PRIOR TO ORAL INTAKE, BY HOSPITAL

ACHIEVABLE BENCHMARK*: 83% **AVERAGE ADHERENCE*: 58%**



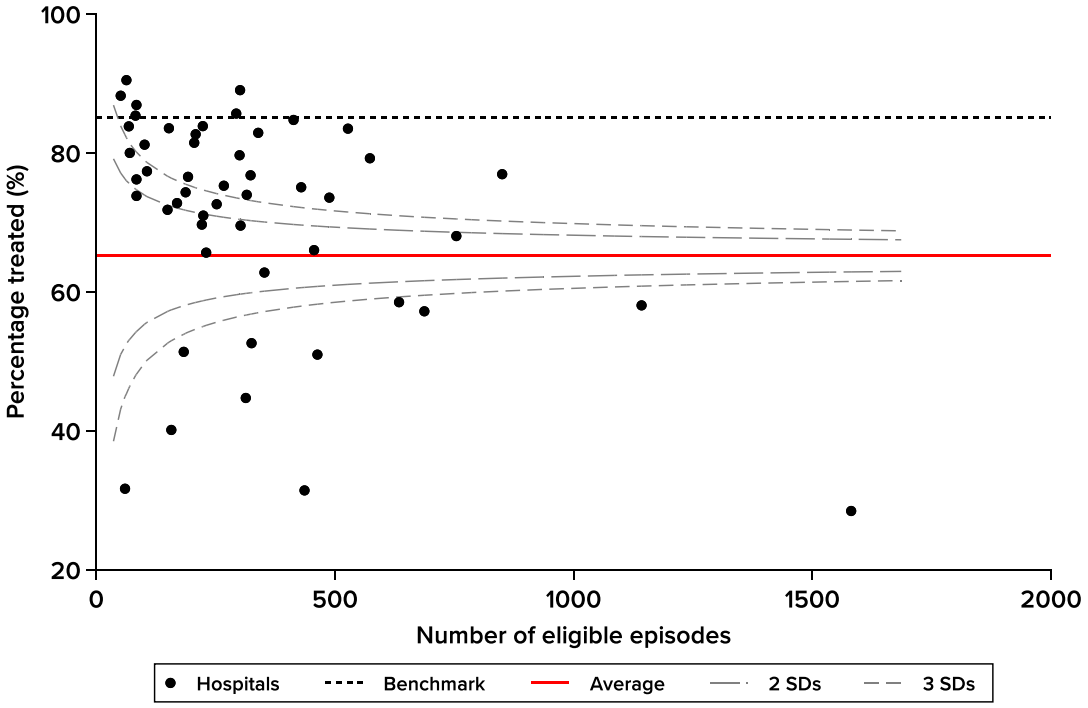
Each dot represents the percentage adherence for an individual hospital.
** Benchmark based on a modified ABC™ method using data from sites with at least 50 eligible episodes.*

MOBILISATION

Of the episodes submitted from hospitals participating in either the AuSCR Red or Black programs (N=16,570), 84% were mobilised during their admission, with most patients (65%) mobilised on the same day, or the day after, arrival to hospital (Figure 20). Patients with ICH were less likely to be mobilised on the same day, or day after arrival, than other clinical diagnoses (Table 6). Interestingly, patients treated in regional hospitals were more likely to receive early mobilisation between 2017 and 2021 (Figure 21).

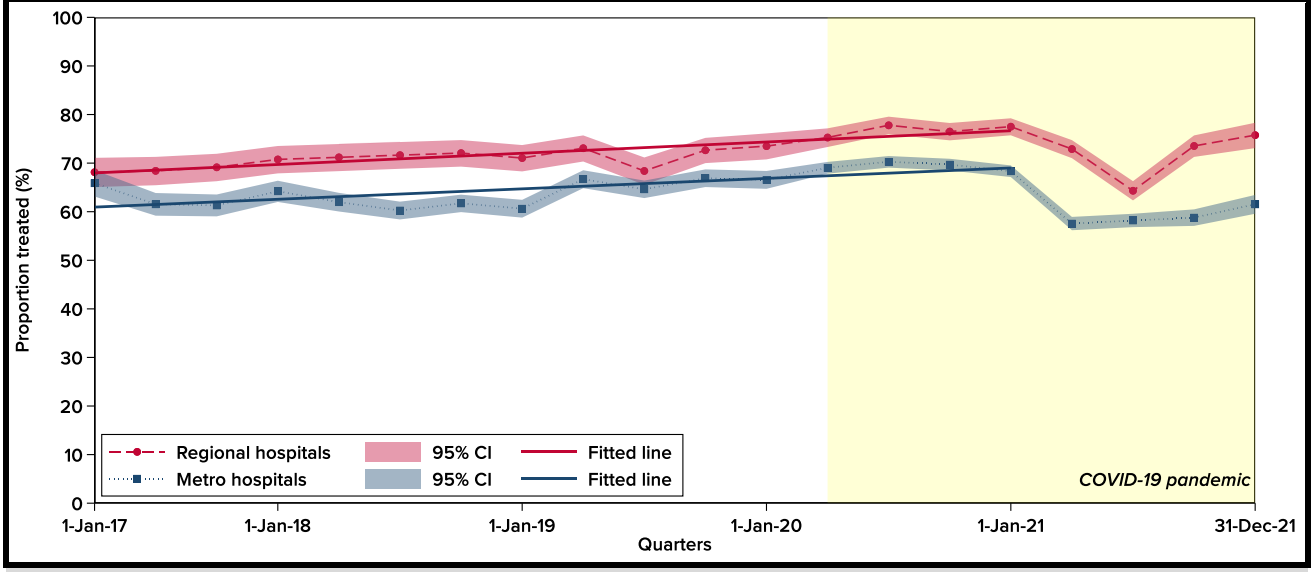
FIGURE 20: MOBILISATION SAME DAY OR DAY AFTER, BY HOSPITAL

ACHIEVABLE BENCHMARK*: 85% **AVERAGE ADHERENCE: 65%**



Each dot represents the percentage adherence for an individual hospital.
** Benchmark based on a modified ABC™ method using data from sites with at least 50 eligible episodes.*

FIGURE 21: QUARTERLY CHANGES IN EARLY MOBILISATION, BY HOSPITAL LOCATION



Data derived from a sub-set of 46 hospitals that have consistently participated in the AuSCR Red or Black programs between 2017 and 2021 and contributed ≥30 episodes each calendar year.

Table 6: Stroke evaluation and therapy

Hospital stroke care	All episodes	Ischaemic	ICH	TIA	UND
Stroke unit care	73%	81%	69%	51%	49%
Antithrombotic therapy within 48 hours of stroke onset*	69%	67%	-	80%	64%
Mobilised during episode	84%	88%	65%	88%	78%
Mobilised same day or day after arrival	65%	67%	39%	83%	63%
If unable to walk on admission, patient mobilised during episode	79%	83%	58%	89%	64%
If unable to walk on admission, mobilised same day or day after arrival	57%	61%	30%	82%	51%
Swallow screen conducted	56%	60%	45%	52%	51%
Screened within 4 hours	25%	26%	18%	26%	22%
Screened within 24 hours	50%	54%	40%	49%	47%
Swallow assessment conducted	66%	74%	62%	45%	51%
Assessed within 4 hours	6%	7%	4%	6%	5%
Assessed within 24 hours	39%	44%	36%	30%	30%
Swallow screen or assessment within 4 hours	29%	30%	22%	29%	27%
Swallow screen or assessment within 24 hours	68%	72%	58%	61%	59%
Swallow screen or assessment prior to oral intake	58%	64%	59%	44%	42%

ICH: intracerebral haemorrhage; TIA: transient ischaemic attack; UND: undetermined stroke type.
* Excludes intracerebral haemorrhage and episodes with documented contraindications.

MANAGEMENT OF FEVER AND BLOOD GLUCOSE

In 2021, 15 hospitals contributed a total of 2,353 episodes to the FeSS dataset (median of 105 episodes per hospital; min-max: 1-488). The FeSS dataset includes the documentation of fever and hyperglycaemia in addition to swallow screen/assessment (Appendix H). Temperatures were recorded ≥4 times on the day of admission for 96% of episodes (Table 7). Of the 242 eligible episodes with a fever (temperature ≥37.5°C) recorded within 72 hours of admission, 28% were administered paracetamol.

The majority (68%) of the 2,353 episodes with FeSS data available had blood glucose levels recorded at least four times on the first day of the ward admission. A total of 481 episodes (20%) recorded blood glucose levels above 10mmol/L within 48 hours of admission. Of these, 24% were administered insulin within the first hour of the measured elevation.

Table 7: Monitoring and management of fever and blood glucose

Fever and blood glucose	All episodes
	N=2,353
Temperature recorded ≥4 times on day one of ward admission	96%
Patient developed a fever of ≥37.5C in the first 72 hours following admission	12%
Where fever was present, paracetamol was administered within 1 hour of the first elevated temperature measurement*	28%
Finger prick blood glucose documented ≥4 times on day 1 of ward admission	68%
Patient developed blood glucose level above 10mmols/L within 48 hours of admission	20%
Where patient developed blood glucose level above 10mmols/L, insulin was administered within the first hour of elevated blood glucose measurement	24%

* Excludes episodes with contraindications (or if paracetamol was previously administered).

DISCHARGE MEDICATIONS

Among those patients alive at discharge, 74% were discharged on an antihypertensive medication (Figure 22). Of those with ICH, 79% were discharged on an antihypertensive medication (Table 8). Excluding episodes of ICH, antithrombotic medications were prescribed at discharge for 92% of all episodes (Figure 23), and lipid-lowering medications were prescribed for 79% (Figure 24).

Of the patients with ischaemic stroke, 62% were discharged on a combination of antihypertensive, antithrombotic and lipid-lowering medications. Men were more likely to receive all three medications than women (62% *vs* 58%; $p<0.001$). Interestingly, patients who were treated in a regional (*vs* metropolitan) hospital were more likely to receive all three medications (71% *vs* 56%; $p<0.001$).

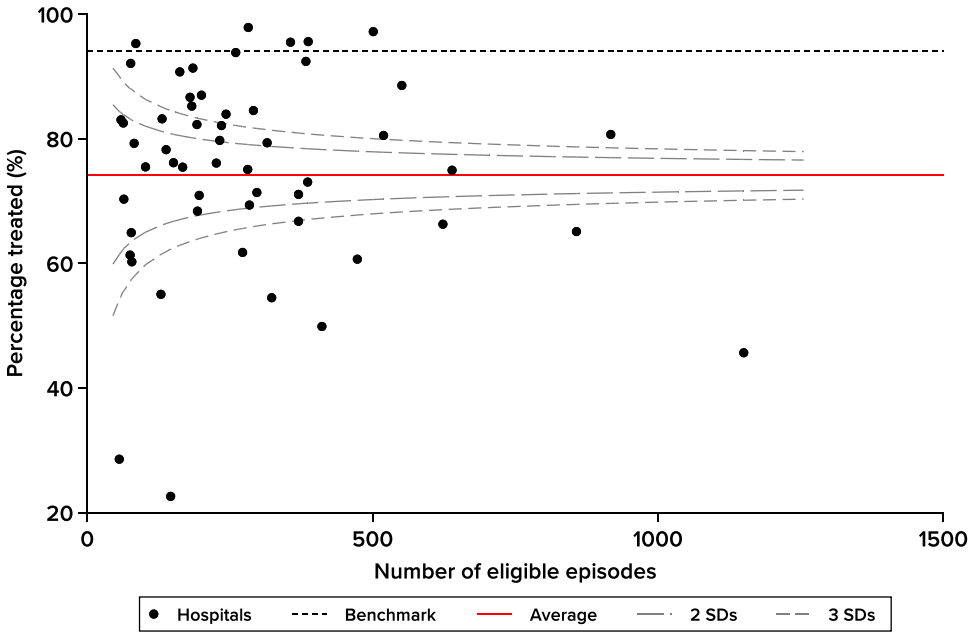
Table 8: Discharge medications, by clinical diagnosis

Medication on discharge	All episodes	Ischaemic	ICH	TIA	UND
Discharged on an antihypertensive medication*	74%	77%	79%	68%	56%
Discharged on an antithrombotic medication*	92%	94%	N/A	91%	70%
Discharged on a lipid-lowering medication*	79%	80%	N/A	80%	66%
Discharged on a combination of secondary prevention medications*†	60%	62%	N/A	59%	44%

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

FIGURE 22: DISCHARGED ON ANTIHYPERTENSIVE MEDICATIONS, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 94% **AVERAGE ADHERENCE†: 74%**



Each dot represents the percentage adherence for an individual hospital.
** Benchmarks based on a modified ABC™ method using data from sites with at least 50 eligible episodes.*
† Excludes episodes with documented contraindications, in-hospital deaths and episodes recorded in the ED dataset.

FIGURE 23: DISCHARGED ON ANTITHROMBOTIC MEDICATIONS, BY HOSPITAL

ACHIEVABLE BENCHMARK*†‡: 99% **AVERAGE ADHERENCE†‡: 92%**

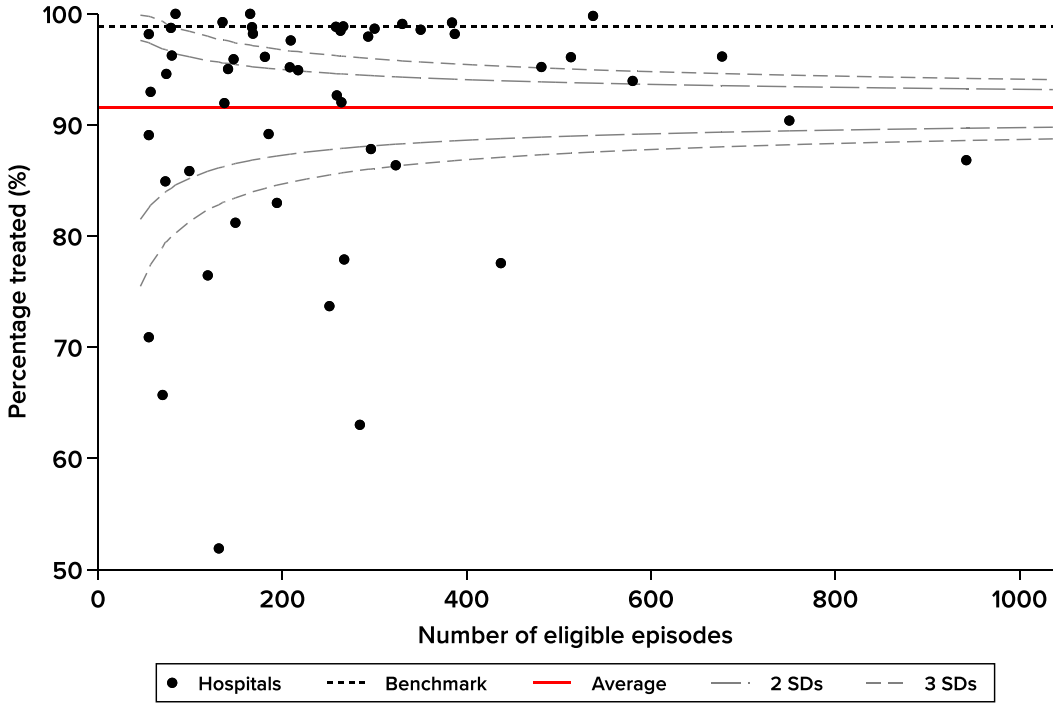
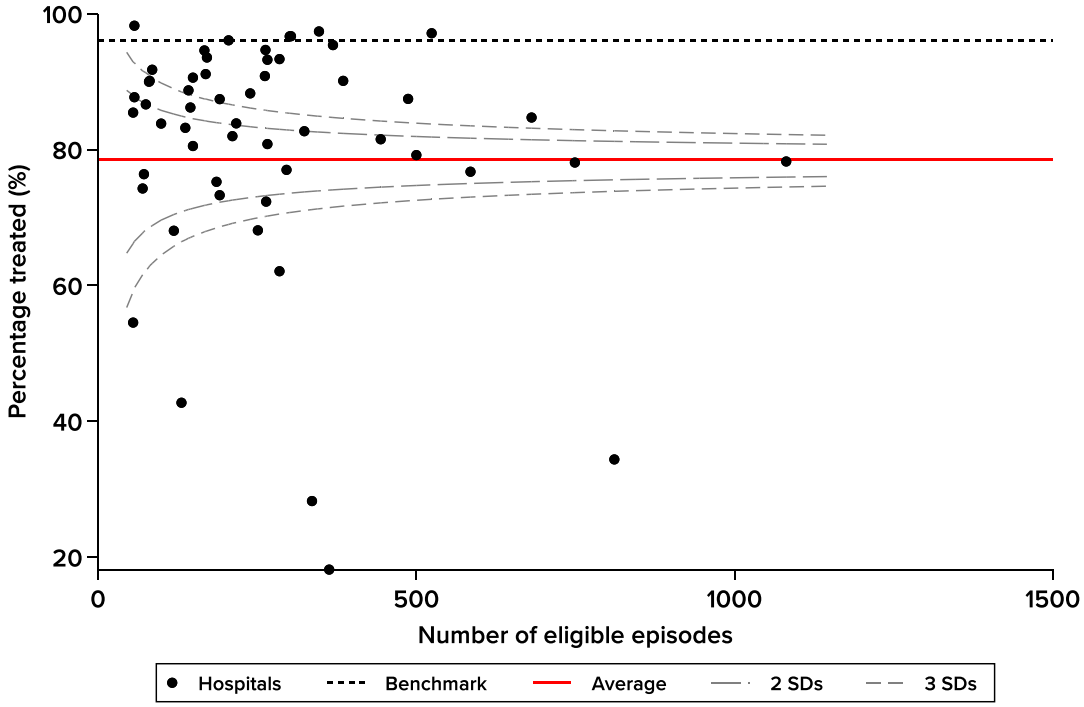


FIGURE 24: DISCHARGED ON LIPID-LOWERING MEDICATIONS, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 96% **AVERAGE ADHERENCE†: 79%**



Each dot represents the percentage adherence for an individual hospital.
** Benchmarks based on a modified ABC™ method using data from sites with at least 50 eligible episodes.*
† Excludes episodes of intracerebral haemorrhage, episodes with documented contraindications, in-hospital deaths and episodes recorded in the ED dataset.

CASE STUDY 2

Using AuSCR data to drive quality improvement

The problem

Hospital B in outer regional Queensland admits approximately 400 patients with stroke each year. In 2018, the AuSCR Hospital Performance Report indicated this hospital was performing poorly for prescription of prevention medications at discharge (i.e. antihypertensive medications 58%, antithrombotic 72% and lipid-lowering medications 68%). A workshop with hospital staff, facilitated by the Stroke Foundation and AuSCR, was held in 2019. Following review of the data and discussion of barriers to evidence-based care provision, a quality improvement action plan was developed and implemented.

The solution

The following strategies were included in the quality improvement action plan:

1. Ensuring data collectors understood the variable definitions, and where to find this information in the medical record.
2. New junior medical staff were advised of the importance of prevention medications being prescribed prior to discharge, the need to ensure consistent documentation, and that these national indicators of evidence-based care were being audited.
3. A pharmacist was allocated to the stroke unit to attend the multidisciplinary team meetings to verify medications at discharge.
4. A discharge medication template was created for the electronic medical record.

The outcome

In 2020, this hospital was found to be a 'top performing' hospital for discharge medications (i.e. top 15% of hospitals). Using the strategies outlined above, the hospital has sustained its excellent performance in 2021 (antihypertensive medications 95%, lipid-lowering medications 98%, and antithrombotic medications on discharge 98%).

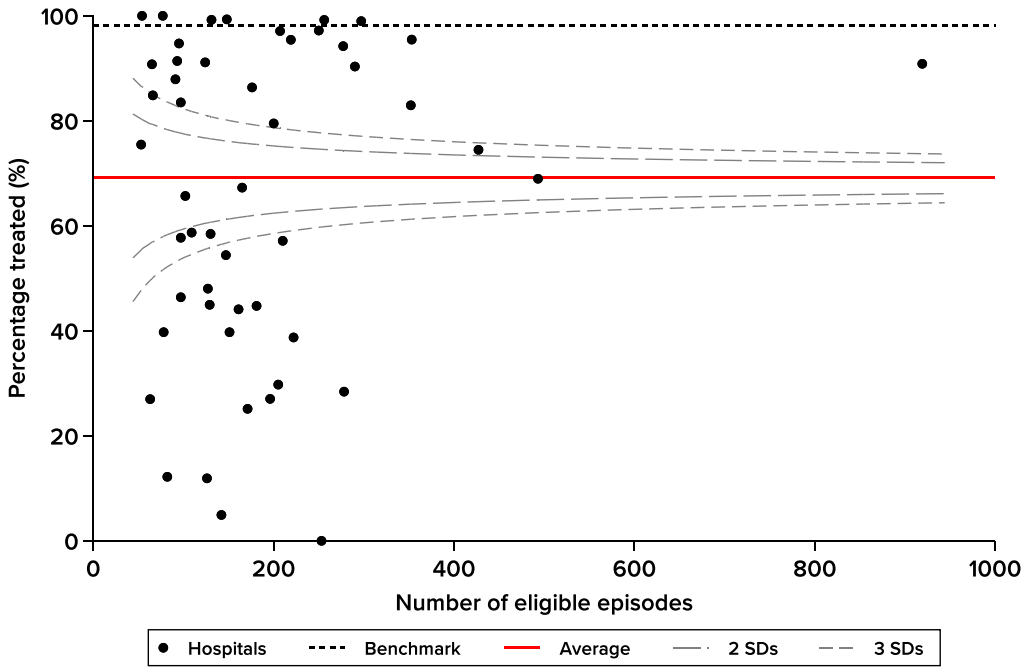
AuSCR
Australian Stroke Clinical Registry

TRANSITION FROM HOSPITAL CARE

Of the 9,724 episodes resulting in discharge home or to a residential aged care facility, 69% received a care plan outlining post-discharge care in the community that was developed with the patient or their family (Figure 25). Of the patients with ischaemic stroke, 76% were provided a care plan at discharge, compared with 74% of those with ICH, 57% of those with TIA, and 60% of those with an undetermined stroke. Since 2017, metropolitan-regional disparities in the provision of discharge care plans have worsened from a 10% difference in the entirety of 2017 to a 19% difference in entirety of 2021 (Figure 26).

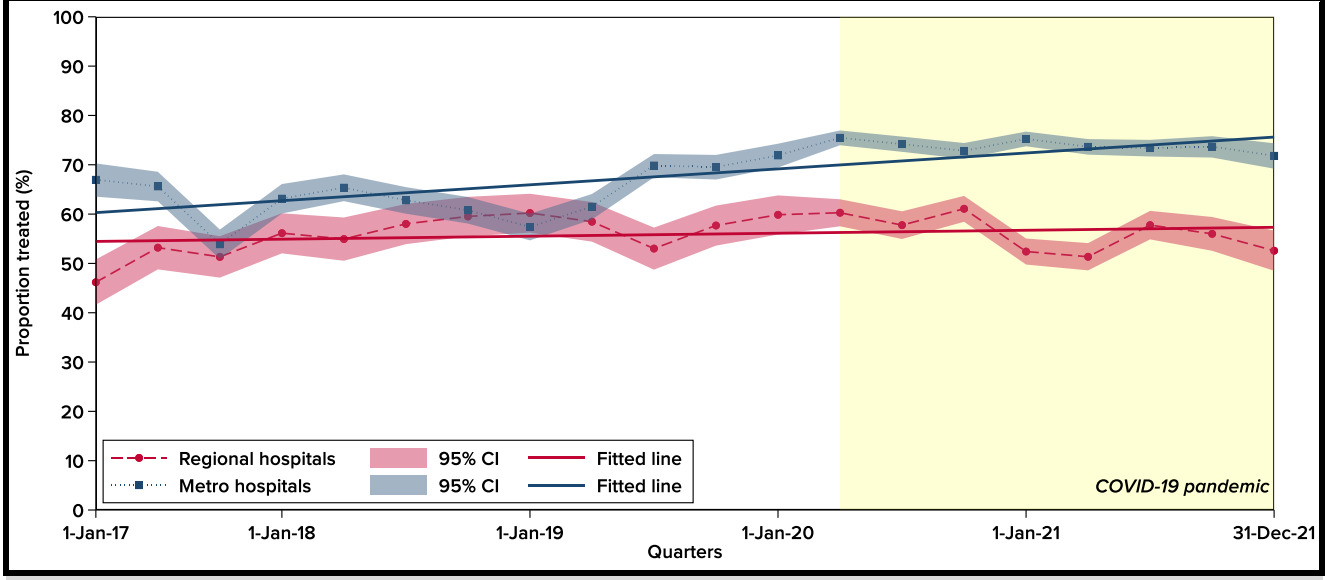
FIGURE 25: CARE PLAN PROVIDED IF DISCHARGED HOME OR TO RESIDENTIAL AGED CARE, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 98% **AVERAGE ADHERENCE†: 69%**



Each dot represents the percentage adherence for an individual hospital.
** Benchmarks based on a modified ABC™ method using data from sites with at least 50 eligible episodes.*
† Adherence and benchmarks relate only to admitted episodes discharged directly home or to residential aged care.

FIGURE 26: QUARTERLY CHANGES THE PROVISION OF CARE PLANS AT DISCHARGE, BY HOSPITAL LOCATION



Data derived from a subset of 46 hospitals that have consistently participated in the AuSCR between 2017 and 2021 and contributed ≥30 episodes each year. Includes episodes discharged directly home or to residential aged care.

SEX DIFFERENCES IN STROKE CARE

In 2021, a number of sex differences were observed in the provision of guideline-recommended stroke care, after accounting for differences in age and stroke severity (Table 9). Compared to men, women were less likely to receive hyperacute antithrombotic therapy, stroke unit care, mobilisation, timely swallow screens or assessments, and all discharge medications. Access to guideline-recommended stroke care is a universal healthcare right which should be available to all, regardless of sex. Further work is needed to minimise these sex differences in stroke care.

Table 9: Sex differences in stroke care

Hospital stroke care	Women N=8,431 Adjusted %*	Men N=10,830 Adjusted %*	*P*
Antithrombotic therapy within 48 hours of stroke onset†	68%	71%	0.002
Intravenous thrombolysis (ischaemic stroke only)	10%	11%	0.049
Door-to-needle time within 60 minutes, if thrombolysis provided	29%	30%	0.92
Endovascular clot retrieval (ischaemic stroke only)	10%	10%	0.85
Stroke unit care	72%	74%	0.004
Mobilised during episode	83%	85%	<0.001
Mobilised same day or day after arrival	64%	66%	0.001
Swallow screen or assessment within 4 hours	28%	30%	0.007
Swallow screen or assessment within 24 hours	66%	69%	0.008
Swallow screen or assessment prior to oral intake	58%	59%	0.21
Discharged on an antihypertensive medication†	73%	76%	<0.001
Discharged on an antithrombotic medication†	92%	93%	<0.001
Discharged on a lipid-lowering medication†	77%	82%	<0.001
Discharged on a combination of secondary prevention medications†‡	58%	62%	<0.001
Care plan provided, if discharged home or to residential aged care	72%	71%	0.50

** Adjusted for age and stroke severity using the NIHSS (missing NIHSS scores modelled as a separate category).*
† Excludes intracerebral haemorrhage and episodes with documented contraindications.
‡ A combination of antihypertensive, antithrombotic and lipid-lowering medications.

ADHERENCE TO THE ACUTE STROKE CLINICAL STANDARD

In 2015, the Australian Commission on Quality and Safety in Health Care facilitated the co-design (with clinicians, academics and consumers) of the national Acute Stroke Clinical Care Standard. After publication, the standard was reviewed in 2019.[15] Where we have been able to align quality indicators collected in the AuSCR with the indicators for the Acute Stroke Clinical Care Standard,[15] these are shown in Table 10. Benchmarks and adherence values presented in this table reflect episodes of stroke only (i.e. excludes patients admitted with TIA) and may differ slightly from estimates provided elsewhere in this report. Under the National Safety and Quality Health Service Standards (2nd ed.), health service organisations are expected to support clinicians to use the best available evidence, including clinical care standards such as the Acute Stroke Clinical Care Standard.[15]

Table 10: Adherence to the Acute Stroke Clinical Care Standard

Indicator	Description	Achievable Benchmark*	Adherence in the AuSCR in 2021		
			All hospitals	Metropolitan hospitals	Regional hospitals†
2a	Proportion provided thrombolysis (if an ischaemic stroke)	18%	11%	11%	11%
2b	Proportion provided endovascular clot retrieval (if an ischaemic stroke admitted in a hospital capable of performing this intervention)	30%	21%	21%	18%
2c	Proportion with a door-to-needle time under 60 minutes (if an ischaemic stroke provided thrombolysis)	57%	29%	33%	18%
2d	Median door-to-groin puncture time for patients provided endovascular clot retrieval	90 minutes	91 minutes	89 minutes	144 minutes
3a	Proportion managed in a stroke unit	95%	77%	80%	68%
4a	Proportion mobilised same day or day after arrival^	82%	61%	59%	69%
5a	Proportion provided antihypertensive medication at discharge‡	95%	76%	74%	80%
5b	Proportion provided lipid-lowering medication at discharge‡§	97%	78%	75%	85%
5c	Proportion provided antithrombotic medication at discharge‡§	99%	92%	92%	91%
7a	Proportion provided a care plan (if discharged home or to residential aged care)	98%	75%	82%	56%

** Benchmarks based on a modified ABC™ method using data from sites with at least 50 eligible episodes. Benchmark for median door-to-groin puncture based on international targets.*

† Includes hospitals located in 'Inner Regional' or 'Outer Regional' areas according to the Australian Statistical Geography Standard Remoteness Standard 2016.[5]

^ Surrogate measure for the proportion seen by a physiotherapist within 48 hours of presentation to hospital.

‡ Excludes episodes with documented contraindications, in-hospital deaths and episodes recorded in the ED dataset.

§ Excludes episodes of intracerebral haemorrhage.

DISCHARGE INFORMATION

Hospital outcome measures include length of stay, discharge destination and discharge status. Where data for an individual person are segregated across more than one hospital for the same stroke episode, the discharge information is reported from the first hospital providing care. Unless otherwise stated, the data presented in this section relate to the hospital that provided the initial care.

IN-HOSPITAL DEATHS

Among the 18,217 adult patients with stroke/TIA, 1,557 patients (9%) died while in hospital. Patient mortality was similar between men and women after adjustment for age, stroke type and severity (p=0.83). Case fatality was greater for episodes of ICH (28%) when compared to ischaemic (7%), undetermined (4%) and TIA (<1%; p<0.001). There were no paediatric in-hospital deaths reported.

LENGTH OF STAY

Of the 17,801 admissions where the patient was known to be alive at the time of hospital discharge, 17,566 had valid information provided on length of stay. The median length of stay was four days (Q1 to Q3: 2 to 7 days; Table 11) and 797 (5%) stayed 21 days or more. Patients with TIA more often had a short length of stay (less than five days) compared to patients with stroke (90% TIA, 51% stroke, p<0.001).

Patients treated in a stroke unit experienced significantly longer length of stay than those in alternative wards (median 4 days, Q1 to Q3: 2 to 8 days *vs* median 2 days, Q1 to Q3: 1 to 6 days, p<0.001).

Table 11: Median length of stay

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

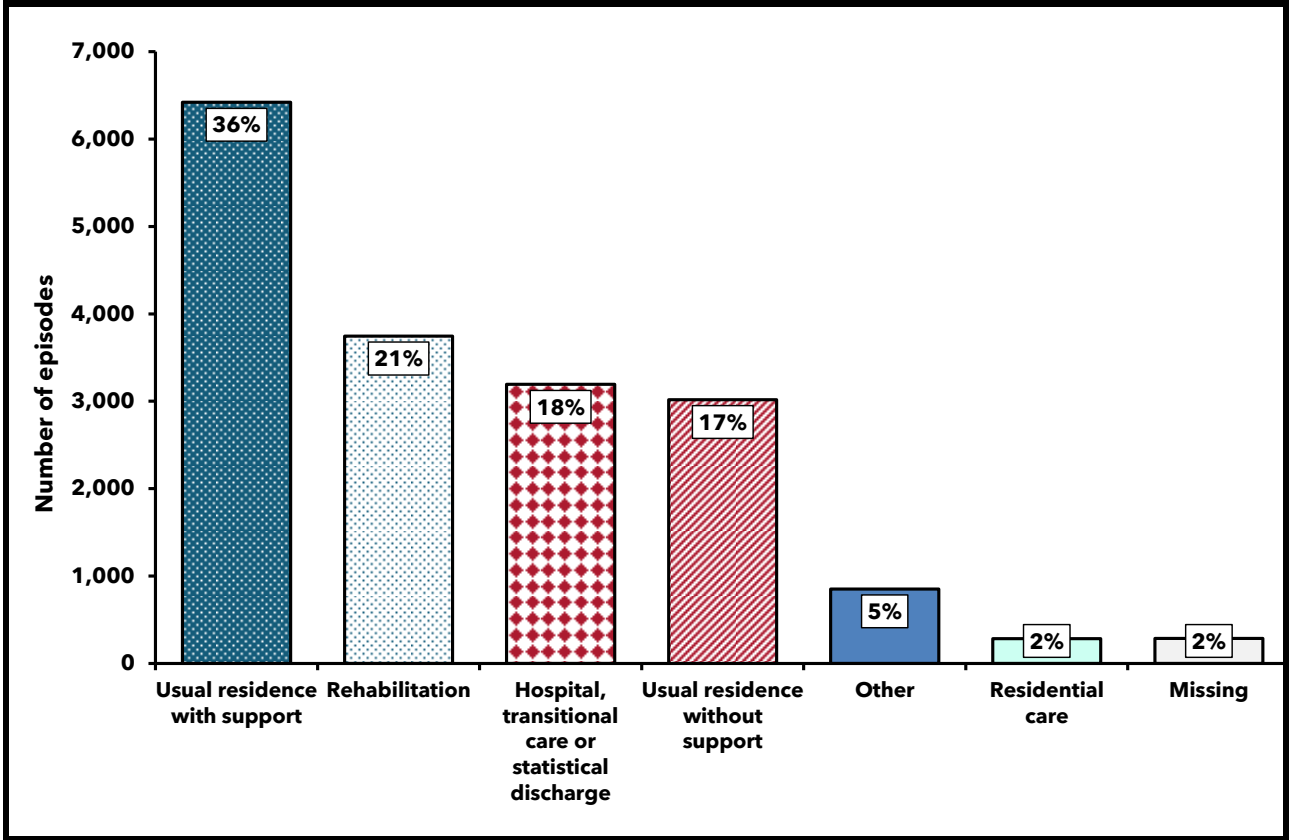
DISCHARGE DESTINATION

In 2021, excluding in-hospital deaths, approximately half of the admitted episodes of care resulted in patients being discharged to their usual residence (n=9,441; 53%), with the majority of these patients requiring support (Figure 27). The definition of support provided within a usual residence may include regular care and assistance by health professionals, council services or volunteers including spouse or family members who may or may not be living in the same residence.

Patients managed in a stroke unit were 66% more likely to be discharged to a rehabilitation facility compared to those managed in an alternate ward (odds ratio 1.66, 95% confidence interval 1.49–1.86, $p<0.001$) when adjusted for age, sex, type of stroke, ability to walk on admission, inpatient or community-onset stroke, and whether the patient was transferred from another hospital. Patients treated in a stroke unit were more often discharged to inpatient rehabilitation regardless of their ability to walk on admission (31% *vs* 20% unable to walk on admission, $p<0.001$; 16% *vs* 7% able to walk on admission, $p<0.001$).

Most patients with TIA (88%, n=2,868) were discharged to their usual residence, 2% (n=60) went to rehabilitation and the remainder went to aged care, transitional care services or other hospitals. It is unclear whether patients were in aged care prior to their event or had other co-morbidities, or complications while in hospital, which may have influenced their discharge destination. Of the 32 patients with TIA who were discharged to residential aged care, 50% had a documented history of a previous stroke.

FIGURE 27: DISCHARGE DESTINATION



N=17,801 episodes.
Excludes ED episodes and episodes of care resulting in death while in hospital.

POST-DISCHARGE HEALTH INFORMATION

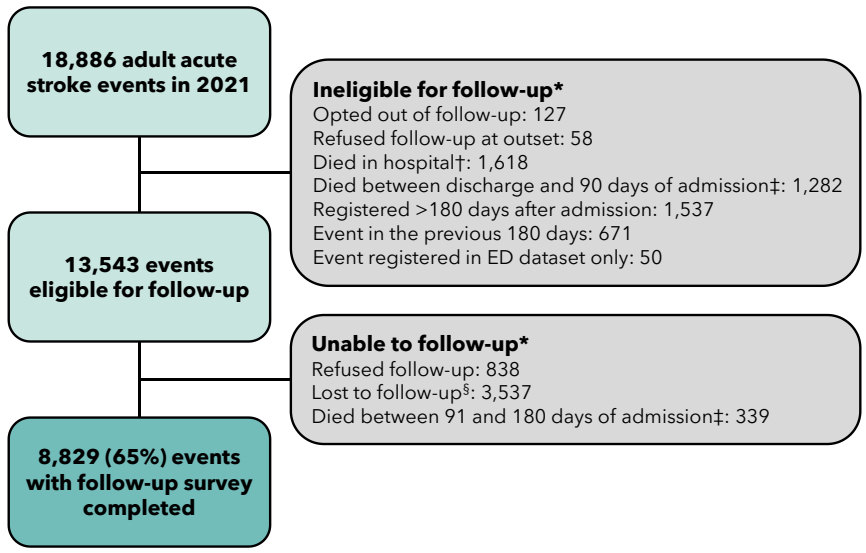
RESPONSE RATES

In 2021, there were 13,543 unique stroke or TIA events eligible to complete a follow-up survey among 13,472 adult patients (i.e. there were 71 recurrent events for the same person which were both eligible for follow-up in the same calendar year). In 2021, 8,829 (65%) of these eligible events for registrants living with stroke or TIA, or their proxies (i.e. next of kin or nominated contact person), provided information about their health status (Figure 28). Responders tended to be slightly older in age, admitted for a less severe stroke, and were more often managed in a stroke unit (Table 12).

There were also 34 events occurring in patients under the age of 18, of which 27 were eligible for follow-up. In total, follow-up surveys were completed by 21 (78%) of the eligible patients, or their proxies.

The median time to completion of follow-up- for adult responders was 144 days following admission (Q1 to Q3: 108 to 181 days).

FIGURE 28: FOLLOW-UP OF PATIENT EVENTS IN 2021 (EXCLUDING PAEDIATRIC EPISODES)



** Reasons for ineligibility are not mutually exclusive (i.e. a patient may be ineligible for follow-up for more than one reason).*
† In-hospital deaths were reported by AuSCR hospitals and validated using linked data from the National Death Index.
‡ Post-discharge death information was determined through linkage of data with the National Death Index.
§ Contact unable to be made using our follow-up protocol (2 postal attempts and 1 telephone attempt).

PARTICIPATION IN RESEARCH

Among the 8,328 adult patients who answered the question about whether they would be willing to be contacted to participate in future research, 5,272 (63%) replied affirmatively. Compared to those who did not reply in the affirmative, these patients were younger (median age 73 *vs* 78 years, $p<0.001$) and more often male (61% *vs* 53%, $p<0.001$).

UNMET INFORMATION NEEDS

Stroke can be a devastating and life changing event for people, and there is a possibility that stroke survivors and their care providers have unmet care and information needs. In 2021, 48% (n=3,953) of the 8,296 adult patients who answered this question indicated that they would like to receive such information from the Stroke Foundation.

Table 12: Characteristics of adult patients with and without post discharge information

	Completed (n=8,779)	Not completed (n=4,693)	*p*
Age (years), mean (SD)	73 (13)	70 (15)	<0.001
Age (years), median (Q1 to Q3)	75 (65 to 83)	72 (60 to 82)	<0.001
Female, n (%)	3,654 (42)	1,974 (43)	0.33
Aboriginal and/or Torres Strait Islander, n (%)	135 (2)	139 (3)	<0.001
Clinical diagnosis, n (%) *Ischaemic* *Intracerebral haemorrhage* *Transient ischaemic attack* *Undetermined*	 6,048 (70) 709 (8) 1,726 (20) 205 (2)	 3,165 (69) 428 (9) 909 (20) 112 (2)	0.18
Able to walk on admission, n (%)	4,258 (53)	2,024 (47)	<0.001
Length of hospital admission (days), median (Q1 to Q3)	4 (2 to 7)	4 (2 to 8)	<0.001
Treated in a stroke unit, n (%)	6,535 (77)	3,388 (74)	<0.001

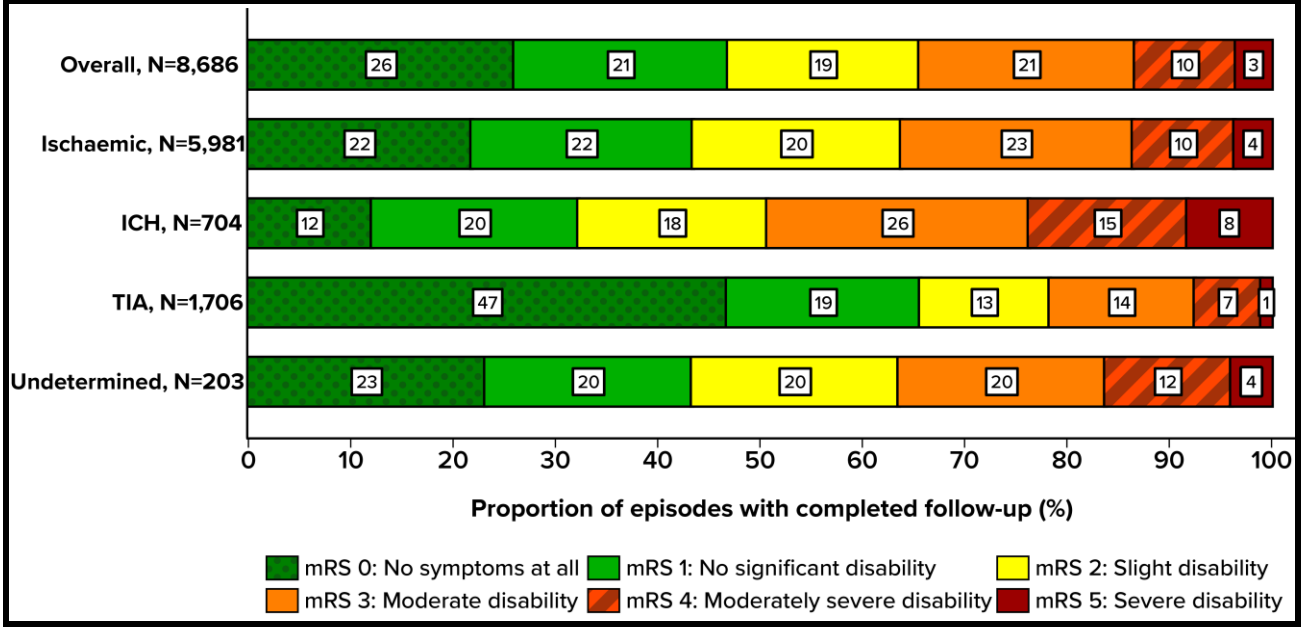
SD: standard deviation; Q1: 25th percentile; Q3: 75th percentile.

DISABILITY – MODIFIED RANKIN SCALE

The modified Rankin Scale (mRS) is used widely in stroke studies to describe person-centred global disability outcomes in terms of the degree of disability, or dependence, in daily activities. Of those providing responses to the mRS at follow-up, 26% were free from disability (mRS= 0) and 21% had no significant disability despite symptoms (mRS=1; Figure 29).

The unadjusted median mRS score reported by patients with stroke was two (i.e. moderate disability), compared to a median mRS score of one (i.e. no significant disability despite symptoms) for patients with TIA. Patients who were residing at home at the time of follow-up had lower levels of disability compared to those not residing at home (median mRS 1 *vs* 4; p<0.001).

FIGURE 29: UNADJUSTED MODIFIED RANKIN SCALE SCORE BY CLINICAL DIAGNOSIS AT FOLLOW-UP



mRS: modified Rankin Scale; ICH: intracerebral haemorrhage; TIA: transient ischaemic attack.

READMISSIONS AND LIVING ARRANGEMENTS

At follow-up, approximately one in five adult patients reported hospital readmissions (Table 13), with stroke or TIA the most common reason given.

Most patients who provided follow-up information were living at home (87%), 25% of whom were living alone. There were 804 (9%) patients who reported living in low- or high-level care.

HEALTH-RELATED QUALITY OF LIFE

With respect to health-related quality of life, problems were most frequently reported with completion of usual activities (Figure 30). Three out of four (75%) responders reported problems with ≥1 dimension of the EQ-5D-3L.

FIGURE 30: UNADJUSTED PROPORTION OF PATIENTS REPORTING PROBLEMS WITH EQ-5D-3L DIMENSIONS

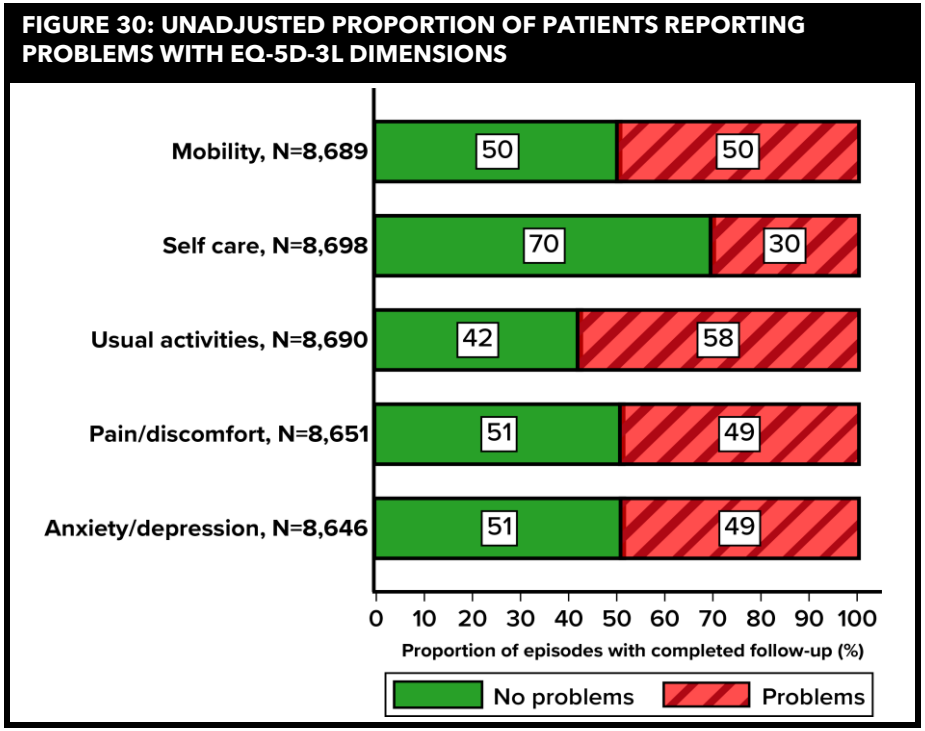


Table 13: Recurrent strokes, readmissions and living arrangements

	N=8,779
	n (%)
Had a recurrent stroke	468 (5)
Readmitted to hospital	1,936 (22)
Time to readmission (days), median (Q1 to Q3)	80 (34 to 114)
Reason for readmission	**N=1,932**
Stroke or transient ischaemic attack	355 (18)
Cardiovascular disease	333 (17)
Injury	182 (9)
Other neurological condition	138 (7)
Elective surgery	139 (7)
Gastrointestinal disease	106 (5)
Infection	81 (4)
Respiratory disease	70 (4)
Other	528 (27)
Location at time of follow-up interview	**N=8,738**
Home	7,615 (87)
Living alone *Living with others*	1,912 (25) 5,657 (75)
With care support *Without care support*	3,472 (46) 4,143 (54)
Institutional care or other setting	1,123 (13)
In hospital *Transitional care services* *Low level care (hostel care)* *High level care (nursing home)* *Inpatient rehabilitation* *Other*	76 (<1) 59 (<1) 28 (<1) 776 (9) 57 (<1) 63 (6)

Missing responses excluded from denominators.

HEALTH-RELATED QUALITY OF LIFE (continued)

Patients with ICH reported problems in all dimensions of the EQ-5D-3L more commonly than those with other stroke types (Table 14). The mean Visual Analogue Scale (VAS) score, which represents patients' self-reported overall health, was 68 (median: 70; min-max: 0-100). Compared to the mean VAS of the normative population (83 in the United Kingdom),[10] the VAS scores of AuSCR patients were >8 points worse, representing a clinically meaningful difference.[16]

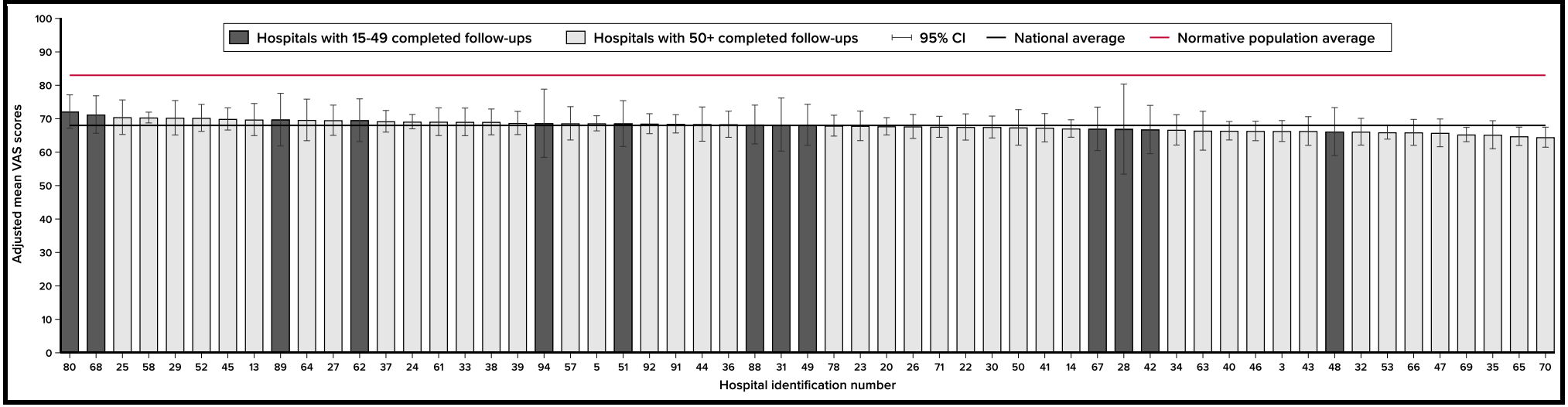
The overall minimum and maximum mean VAS scores differed between AuSCR hospitals by eight points after adjustment for patient demographics and stroke clinical characteristics (Figure 31). Compared to patients who were discharged directly home or to aged care, those who were discharged to inpatient rehabilitation were 22% more likely to report a VAS score above the national median, after adjusting for patient demographics and stroke clinical characteristics.

Table 14: Unadjusted health-related quality of life, by diagnosis

EQ-5D-3L dimension	Ischaemic N=6,077	ICH N=714	TIA N=1,740	Undetermined N=205
Mobility	51%	59%	41%	55%
Self-care	31%	42%	21%	35%
Usual activities	60%	71%	43%	61%
Pain/Discomfort	49%	59%	44%	50%
Anxiety/Depression	49%	58%	43%	53%
VAS mean (SD)	68 (22)	63 (24)	71 (21)	66 (21)
VAS median (Q1-Q3)	70 (50-85)	69 (49-80)	75 (60-86)	70 (50-80)

ICH: intracerebral haemorrhage; TIA: transient ischaemic attack; VAS: visual analogue scale. Missing responses (<2%) excluded from denominators.

FIGURE 31: HEALTH-RELATED QUALITY OF LIFE SCORES ACCORDING TO THE ADJUSTED VAS AT FOLLOW-UP, BY HOSPITAL

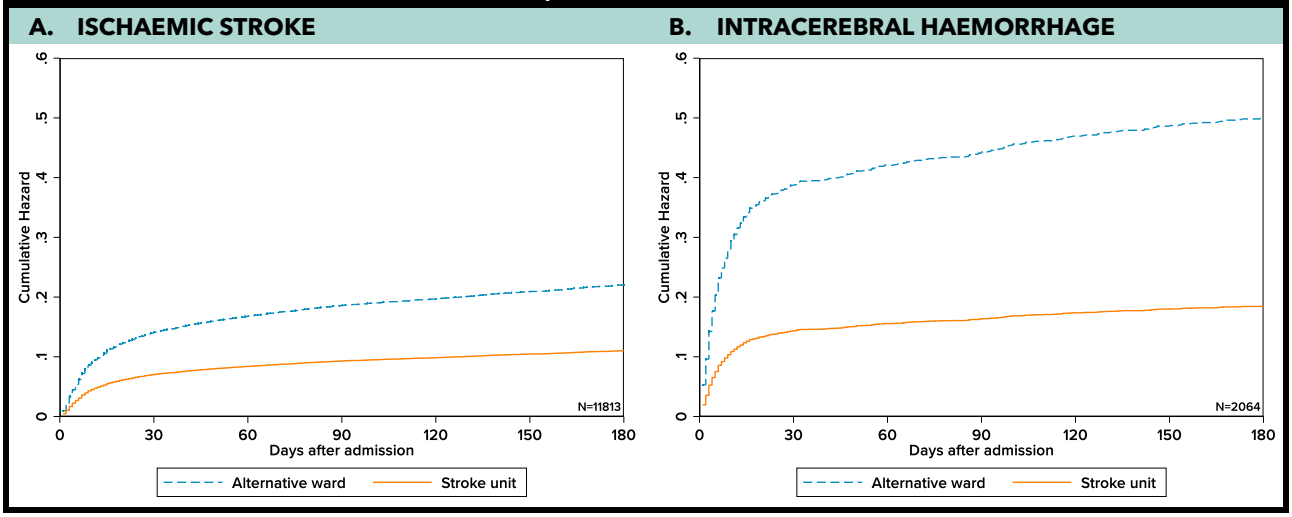


Hospitals with fewer than 15 episodes with completed follow-ups were excluded. Normative population average of 83 is for the United Kingdom, as Australia-specific estimates are unavailable.[10]

SURVIVAL

Survival status was ascertained for the entire AuSCR cohort using data linkage with the National Death Index. Of the total registrants in 2021, 9% died prior to hospital discharge, 7% between discharge and 90 days of admission, and 2% between 91 and 180 days of admission. Among patients with ischaemic stroke, treatment in a stroke unit was associated with a 50% lower hazard of death at 180 days after admission than treatment on an alternate ward (hazard ratio 0.50, 95% confidence interval 0.45-0.55, $p<0.001$; Figure 32). A larger reduction in the risk of death of 63% was found for patients with ICH (hazard ratio 0.37, 95% confidence interval 0.32-0.43, $p<0.001$). These analyses were adjusted for age, sex, ability to walk on admission, in-hospital stroke and transfer from another hospital.

FIGURE 32: CUMULATIVE HAZARD OF DEATH, BY TREATMENT IN A STROKE UNIT



RISK ADJUSTED MORTALITY

Risk adjusted mortality rate (RAMR) comparisons at 30 days following admission for ischaemic stroke and ICH have been plotted for tertiary referral hospitals that offer ECR services (grey open circles) and for other hospitals that do not offer ECR services (black closed circles; Figure 33 and Figure 34).

To ensure reliable estimates, analyses were conducted for individual hospitals that provided at least 200 episodes of ischaemic stroke and at least 50 episodes of ICH in 2021. For hospitals with fewer episodes, data from 2020 and 2021 were pooled and used to derive mortality estimates if the minimum number of episodes was achieved across both years (i.e. 200+ for ischaemic and 50+ for ICH). RAMRs for tertiary referral hospitals have been colour coded separately as these hospitals are more likely to treat a different cohort of stroke patients, including more complex and severe cases, than other hospitals participating in the AuSCR.

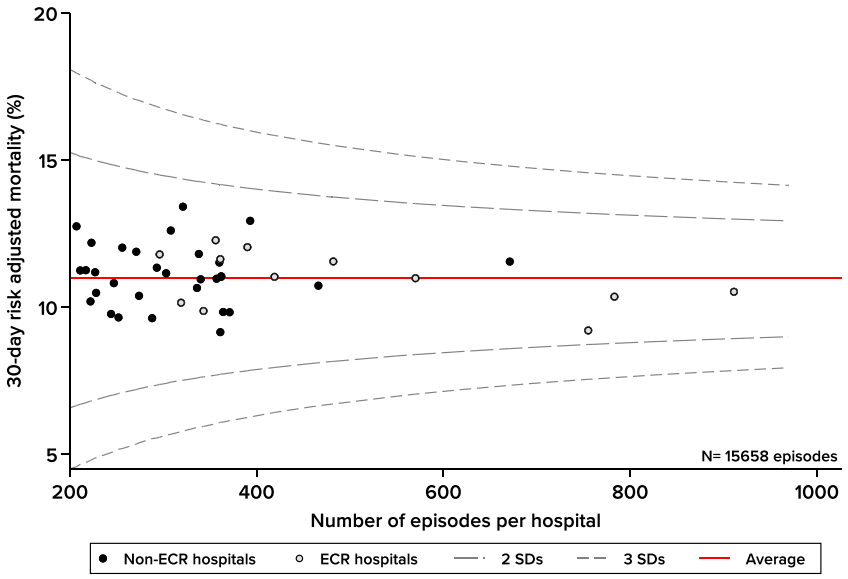
All RAMR models were adjusted for age, sex, socioeconomic position, stroke type, previous history of stroke, and a measure of stroke severity:

For ischaemic stroke, we adjusted for stroke severity using the National Institutes of Health Stroke Scale (NIHSS). Because NIHSS scores were missing for approximately one in three episodes, multiple imputation techniques were used to assign an NIHSS score from another episode that had a similar set of patient characteristics (e.g. matched on age, sex, hospital ID, ability to walk on admission, transfer from another hospital, in-hospital stroke, and previous history of stroke).

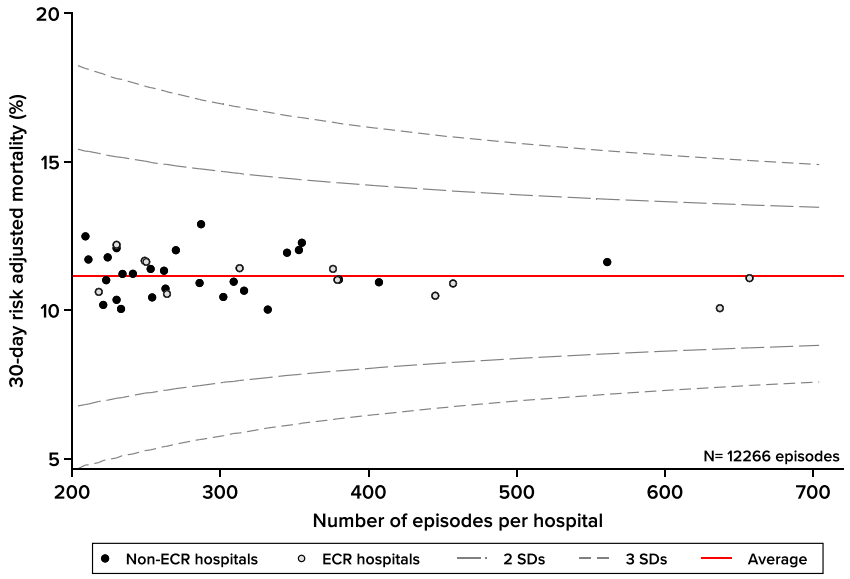
For intracerebral haemorrhage, it was not possible to adjust RAMR models using NIHSS scores as they were missing for the majority (>50%) of episodes and could not be reliably imputed. Therefore, similar to earlier years, RAMR models for ICH were adjusted for stroke severity using the ability to walk on admission (a validated measure of post-stroke outcome).[12]

FIGURE 33: 30-DAY RISK ADJUSTED MORTALITY FOR ISCHAEMIC STROKE

A. INCLUDING TRANSFERS



B. EXCLUDING TRANSFERS



NOTES:

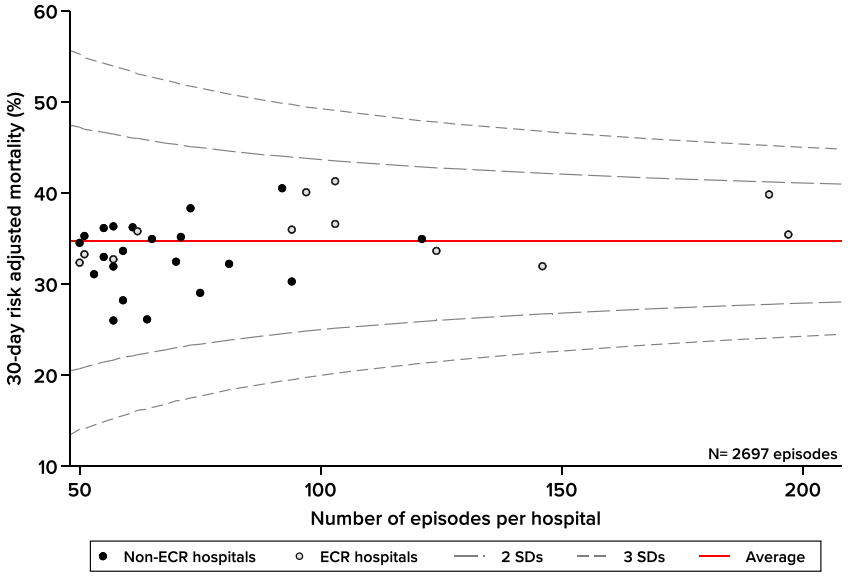
Each dot represents the risk-adjusted percentage of patients who were deceased within 30 days of admission at each hospital

Excludes in-hospital strokes and hospitals with less than 200 episodes for ischaemic stroke.

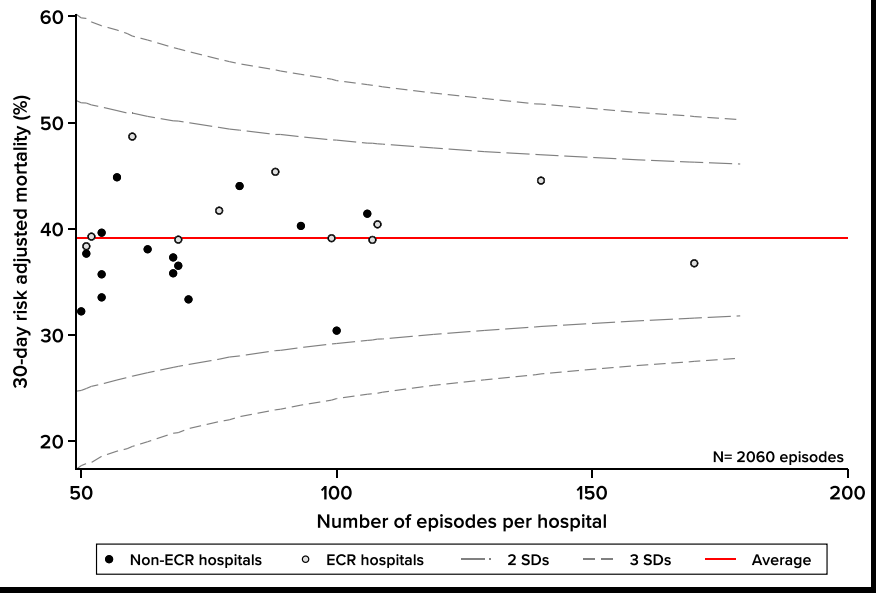
ECR: endovascular clot retrieval

FIGURE 34: 30-DAY RISK ADJUSTED MORTALITY FOR INTRACEREBRAL HAEMORRHAGE

A. INCLUDING TRANSFERS



B. EXCLUDING TRANSFERS



NOTES:

Each dot represents the risk-adjusted percentage of patients who were deceased within 30 days of admission at each hospital

Excludes in-hospital strokes and hospitals with less 50 episodes for intracerebral haemorrhage.

ECR: endovascular clot retrieval

DISCUSSION

In the 2021 AuSCR Annual Report, we present information on 19,753 episodes of stroke and TIA collected at 62 hospitals across seven states and territories.

Overall, 2021 was a successful year for the AuSCR despite impacts created by the COVID-19 pandemic. For the majority of 2021, staff from the AuSCR Office, based in Melbourne, adapted operations to effectively work remotely, with a minimum of staff in the office. Some changes in processes were necessary, including:

- Postponement of hospital visits and onsite medical record audits; and
- Use of videoconferencing to train and support hospital staff.

We had fewer hospitals participating in 2021, with only two hospitals from NSW continuing (one for four months and one for the full year) following state government funding for hospitals in NSW ceasing in June 2020. One Victorian hospital did not participate in 2021 due to resource limitations, and a further three had data pauses, where data was not collected for between two to nine months. One Queensland hospital restarted AuSCR participation in mid-2021 after not participating for two-and-a-half years. Based on data submitted to the Stroke Foundation National Stroke Audit in 2021,[13] the AuSCR data on episodes of care represents 55% of the reported collective admissions for stroke nationally.

Fewer hospitals contributed to the ED dataset in 2021 than 2020 (22 *vs* 28) and this resulted in fewer ED episodes recorded (260 in 2021 *vs* 313 in 2020), which may reflect the impact of the COVID-19 pandemic on hospitals.

Similarly, fewer hospitals contributed to the optional FeSS dataset in 2021 (15 in 2021 *vs* 22 in 2020), however a similar number of episodes were recorded (2,353 in 2021 *vs* 2,470 in 2020).

Following the Paediatric dataset launch in mid-2020, an AuSCR paediatric sub-committee was established in 2021 with co-chairs Mark Mackay (RCH, VIC) and Louise Sparkes (QCH, QLD), which met once during 2021.

Data quality

The AuSCR state coordinators and data managers continue to work with participating hospital staff to ensure data are as complete and accurate as possible, based on correct interpretations of the variables.

We are pleased that completion of the NIHSS score improved again in 2021 to 65% of all episodes, a 5% improvement on 2020 and 9% improvement on 2019. Better capture of NIHSS scores in the AuSCR has provided an opportunity to improve our statistical methods for adjusting outcome models.

Case ascertainment participation and median rate improved in 2021. Ninety-two percent of hospitals participated in case ascertainment (improvement of 4% from 2020). The median rate of case ascertainment by hospitals improved by 4% from last year (84% in 2020 to 88% in 2021), although rates may not be directly comparable as the process was simplified in 2021 to exclude TIA and only use principal diagnosis code. The AuSCR office will continue to work with hospitals to highlight the importance of case ascertainment and reducing the potential for selection bias.

In 2021, the AuSCR was also able to receive ICD-10 discharge diagnosis data for participating Victorian hospital sites as a single data file from the Victorian Agency for Health Information (VAHI). This streamlined process reduced the burden on clinicians and health information departments to provide case ascertainment data at each hospital. We will continue to work with VAHI and other state government agencies to reduce the workload of all hospitals for this aspect of data quality.

The proportion of patients recorded clinically as an undetermined stroke type increased in 2021, with the majority of these actually representing ischaemic stroke based on ICD-10 discharge diagnoses. Whereas, 848 episodes were coded

with undetermined ICD-10 diagnoses (I64: Stroke not specified as haemorrhage or infarction), despite 674 of these episodes receiving a more specific clinician assigned diagnosis (e.g. ischaemic stroke, ICH or TIA). There may be various reasons for the assignment of an ICD-10 I64 code, including the lack of access to brain imaging records, poor documentation in medical notes or lack of coder knowledge of stroke terminology. The AuSCR team will continue to work with hospitals to minimise the use of the undetermined stroke type. In addition, a pilot study is being undertaken by A/Prof Kilkenny (Monash University, VIC) to improve the coding of stroke. The study includes a clinical coding education program and a community of practice to improve knowledge of stroke and its treatments to improve the quality of coded data for stroke. The pilot study was conducted across Australia and New Zealand, and the results will be available next year.

Acute care for stroke

Access to stroke units, the cornerstone of ensuring access to best-practice stroke care, was provided to 73% of patients and has remained unchanged since 2017. This statistic also mirrors what was previously reported in the 2021 Stroke Foundation Acute Audit.[13] It is concerning that more than one in four patients continue to miss out on specialist care for stroke – adversely impacting not only their acute care, but also their long-term outcomes. It is also troublesome to observe continued disparities in stroke unit care for patients in regional hospitals of Australia.

Of concern is that the rate of thrombolysis remains unchanged from previous years at 11%, with variations seen between states (highest in Tasmania and Victoria at 12% and the lowest in the ACT at 8%). A reduction in the proportion provided thrombolysis was seen at the start of the pandemic, and this has not yet returned to pre-pandemic levels. We also noted that ECR-capable hospitals were more likely to provide thrombolysis than non-ECR hospitals (12% vs 10%).

The median time from arrival to thrombolysis provision was 76 minutes (similar to 2020, at 75 minutes). A similar proportion were provided thrombolysis within 60 minutes (29% 2021 compared to 31% in 2020). Although there have been some improvements in the number of hospitals treating within 60 minutes, it is concerning that the vast majority of Australian hospitals do not reach this international benchmark.

The proportion of patients who received thrombolysis in regional centres was also significantly greater when telemedicine was used, compared to when it was not used (17% *vs* 4%). Generally, door-to-needle times were similar with or without telemedicine, with the exception of Queensland where median door-to-needle times increased an average of 21 minutes with use of telemedicine. This may reflect the lack of a formal state-wide telemedicine service in Queensland.

Swallow screening is an important care process for patient safety following stroke,[17] and remains an area for improvement. Only 29% of patients received a swallow screen or assessment within four hours of arrival, and 58% before oral intake.

AuSCR State Coordinators will continue to work with hospitals to improve understanding of the variable definitions and the summary data provided in their Hospital Performance Reports. For 2021, these tailored reports have been enhanced following clinician feedback to include a single page scorecard that aligns with the Acute Stroke Clinical Care Standards and utilises a traffic-light system to compare hospital performance to their peers and over time. To support the wider use of this data for quality improvement, we expanded this service to provide these reports to CEOs from all participating hospitals, rather than only where contractually required in Victoria and Queensland.

In 2021 we also provided stroke performance results for Victorian Hospital Board reports on the request of Victorian Agency for Health Information. In this annual report we present an overview of the changes in selected indicators of quality stroke care since 2017 across the national acute care standard indicators. In particular, there was a decline in the proportion of patients receiving thrombolysis, and median door-to-needle times have not changed. The ability to reliably track changes in care quality over time is a strength of the registry. Audit and feedback programs are the cornerstone of a Clinical Quality

Registry such as the AuSCR, and can expect to change clinical practice by around 5%.[18] Where use of the data can be more actively fed back to hospitals, in programs like StrokeLink, greater shifts in adherence to process of care can be achieved.[19] We encourage increased resourcing of these quality improvement activities to empower staff from hospitals to act on their AuSCR data.

In this report we have highlighted some of the impacts of the COVID-19 pandemic, which may explain many of the reductions in access to quality acute care. Hospital workflows and processes, while needing to be flexible during a pandemic, should not mean that patients with stroke are disadvantaged. Access to specialised stroke units should not be compromised during a pandemic. Access to time critical treatments should not diminish. Maintaining access to stroke units is paramount to ensuring best-practice care, even during a pandemic.

Discharge information

Nine percent of patients died while in hospital following their stroke, equal to the rate in 2020. Length of stay remained similar to previous years, with no impact seen on the acute length of stay from the COVID pandemic. Overall, only 21% of patients were discharged to rehabilitation, which was more likely if they had been treated in a stroke unit. This was a slight reduction from 24% in 2020 and 25% in 2019. This is of concern, as inpatient rehabilitation is essential to supporting recovery for a range of impacts caused by stroke. Based on linked AuSCR data with hospital administrative data from the Stroke123 study,[20] compared to patients discharged home, people who received inpatient rehabilitation were less often readmitted to hospital within 90, 180 or 365 days; and reported fewer problems with mobility between 90-180 days after stroke. These results are aligned with the national clinical guidelines whereby the ongoing rehabilitation needs of all patients with stroke should be assessed, and rehabilitation offered regardless of their discharge destination.

Follow-up data

The overall rate of follow-up completion for eligible patients was 65%, the same as in 2020. This is a testament to the AuSCR Office team, given the ongoing workflow disruptions of COVID-19 such as restrictions on office attendance and delays with mail delivery. The response rate is an excellent outcome by international standards for stroke registries. For example, in recent data from the Sentinel Stroke National Audit Programme, less than 40% of eligible patients were followed up.[21] Maintenance of the overall proportion of follow-up response rate is a result of the hard work and refined protocols of the AuSCR office. Nonetheless, as the AuSCR continues to grow, the need to identify and implement more cost-effective mechanisms of patient follow-up increases. In 2022 we will commence testing an electronic version of the follow-up survey which will be distributed via short message service (SMS) for those who have provided a mobile phone number and are randomly selected to complete the survey using this new method.

Over 5,000 people (58% of respondents) reported difficulties performing their usual activities. Around half also reported difficulties with mobility, pain or discomfort and anxiety or depression. This represents a large proportion of people in the community living with the impacts of stroke with unmet needs. Although this information is available to AuSCR contributors both at a patient-level and aggregate data, feedback from clinicians is that this information is not regularly reviewed or acted upon. To address this issue, a Medical Research Future Fund (MRFF) grant was awarded to enable the co-design and feasibility testing of a hospital-initiated follow-up service for people reporting extreme health problems in their AuSCR follow-up survey. The two-year project will commence in 2022.

The number of people registered in the AuSCR living with stroke willing to be contacted for invitations for research studies grew by over 5,000 in 2021. Every year survival status is updated in the registry, and the AuSCR currently has records of over 35,000 people living with stroke who are willing to be contacted for research studies. This provides an important national source of research infrastructure for stroke.

Up to the end of 2021, there had been 25 research studies where AuSCR office had sent an invitation to eligible AuSCR registrants to participate in a study on behalf of investigators for approved projects.

Quality improvement initiatives

Throughout 2021 various quality improvement initiatives were undertaken with individual sites or via educational webinars, and in providing data to State governments for CEO or Hospital Board reports, as requested. In creating greater clinician-led support in use of AuSCR data for quality improvement, the AuSCR Clinical Quality Improvement Committee continued in 2021chaired by Professor Geoff Cloud (Alfred Health, VIC). This initiative aims to provide support for state-based clinical networks in their review and use of the AuSCR data for quality improvement and in lobbying governments to support better hospital care. In 2021, we also contributed to the 9th National Stroke Quality Improvement workshop, in partnership with the Stroke Foundation and Monash University. This was conducted as a virtual event, permitting over 300 people to attend. Four sessions were held over three days:

- *Health Care Improvement Initiatives*, 4 Nov
- *Post Stroke Care Including Use of e-Health,* 5 Nov
- *National Stroke Data Linkage Interest Group,* 5 Nov
- *Prehospital, Emergency and Hospital Care*, 11 Nov

National and international awards

For the third time, participating hospitals had their data analysed for the Australian Stroke Coalition (ASC) awards of Excellence in Quality of Stroke Care, which assess adherence to the National Acute Care Stroke Standards, and for the World Stroke Organization (WSO) Angels Awards. Each hospital was provided with a tailored report with their results to inform them of areas they could focus on to make them eligible for an award in the next year. Congratulations to all recipients (see Appendix E), and we hope that these awards will inspire further quality improvement activities.

Conclusion

The findings presented in this report provide important insights into aspects of care to be improved to optimise patient outcomes after stroke in Australia. We report more granular information about the characteristics of hospitals contributing data from accessing the Stroke Foundation Organisational Survey data and provide insights into disparities in care based on sex. Collectively, these findings underpin the continued importance of actively addressing practice gaps and ensuring access to evidence-based care. It is essential that quality improvement programs are supported and that we maintain the quality of care for people experiencing stroke during a pandemic.

REFERENCES

1. Cadilhac DA, Lannin NA, Anderson CS, et al. Protocol and pilot data for establishing the Australian Stroke Clinical Registry. *Int J Stroke*. 2010;5:217-226. doi: 10.1111/j.1747-4949.2010.00430.x
2. Australian Commission on Safety and Quality in Health Care. Framework for Australian clinical quality registries. 2014. www.safetyandquality.gov.au/our-work/health-and-medical-research/national-arrangements-clinical-quality-registries. Accessed Oct 7, 2021.
3. Evans SM, Loff B, Cameron PA. Clinical registries: the urgent need to address ethical hurdles. *Med J Aust*. 2013;198:134-135. doi: 10.5694/mja12.10648
4. Australian Stroke Coalition. National Stroke Data Dictionary; Mar 2021. www.strokefoundation.org.au/Australian-Stroke-Coalition/AusDAT. Accessed Nov 3, 2021.
5. Australian Bureau of Statistucs. Australian Statistical Geography Standard (ASGS): Volume 5 - Remoteness Structure. 2016. www.abs.gov.au/websitedbs/d3310114.nsf/home/remoteness+structure. Accessed Oct 27, 2021.
6. Kiefe CI, Weissman NW, Allison JJ, Farmer R, Weaver M, Williams OD. Identifying achievable benchmarks of care: concepts and methodology. *Int J Qual Health Care*. 1998;10:443-447. doi: 10.1093/intqhc/10.5.443
7. Hall RE, Khan F, Bayley MT, et al. Benchmarks for acute stroke care delivery. *Int J Qual Health Care*. 2013;25:710-718. doi: 10.1093/intqhc/mzt069
8. van Swieten JC, Koudstaal PJ, Visser MC, Schouten HJ, van Gijn J. Interobserver agreement for the assessment of handicap in stroke patients. *Stroke*. 1988;19:604-607. doi: 10.1161/01.str.19.5.604
9. EuroQol--a new facility for the measurement of health-related quality of life. *Health Policy*. 1990;16:199-208. doi: 10.1016/0168-8510(90)90421-9
10. Kind P, Dolan P, Gudex C, Williams A. Variations in population health status: results from a United Kingdom national questionnaire survey. *Bmj*. 1998;316:736-741. doi: 10.1136/bmj.316.7133.736
11. Cadilhac DA, Kilkenny MF, Levi CR, et al. Risk-adjusted hospital mortality rates for stroke: evidence from the Australian Stroke Clinical Registry (AuSCR). *Med J Aust*. 2017;206:345-350. doi: 10.5694/mja16.00525
12. Counsell C, Dennis M, McDowall M, Warlow C. Predicting outcome after acute and subacute stroke: development and validation of new prognostic models. *Stroke*. 2002;33:1041-1047. doi: 10.1161/hs0402.105909
13. Stroke Foundation. National Stroke Audit – Acute Services Report 2021. 2022. www.informme.org.au/stroke-data/acute-audits. Accessed Dec 7, 2022.
14. Stroke Foundation. Clinical guidelines for stroke management. 2021. www.informme.org.au/Guidelines/. Accessed Oct 10, 2021.
15. Australian Commission on Safety and Quality in Health Care. Acute Stroke Clinical Care Standard. 2019. https://www.safetyandquality.gov.au/publications-and-resources/resource-library/acute-stroke-clinical-care-standard-2019. Accessed Dec 7, 2022.
16. Kim SK, Kim SH, Jo MW, Lee SI. Estimation of minimally important differences in the EQ-5D and SF-6D indices and their utility in stroke. *Health Qual Life Outcomes*. 2015;13:32. doi: 10.1186/s12955-015-0227-3
17. Middleton S, McElduff P, Ward J, et al. Implementation of evidence-based treatment protocols to manage fever, hyperglycaemia, and swallowing dysfunction in acute stroke (QASC): a cluster randomised controlled trial. *Lancet*. 2011;378:1699-1706. doi: 10.1016/s0140-6736(11)61485-2
18. Ivers N, Jamtvedt G, Flottorp S, et al. Audit and feedback: effects on professional practice and healthcare outcomes. *Cochrane Database Syst Rev*. 2012:Cd000259. doi: 10.1002/14651858.CD000259.pub3
19. Cadilhac DA, Grimley R, Kilkenny MF, et al. Multicenter, Prospective, Controlled, Before-and-After, Quality Improvement Study (Stroke123) of Acute Stroke Care. *Stroke*. 2019;50:1525-1530. doi: 10.1161/strokeaha.118.023075
20. Lynch EA, Labberton AS, Kim J, et al. Out of sight, out of mind: long-term outcomes for people discharged home, to inpatient rehabilitation and to residential aged care after stroke. *Disabil Rehabil*. 2020:1-7. doi: 10.1080/09638288.2020.1852616
21. Intercollegiate Stroke Working Party Publication. Sentinel Stroke National Audit Programme 7th Annual Report. In: London, United Kingdom: School of Population Health and Environmental Sciences, King's College London; 2021: www.hqip.org.uk/resource/sentinel-stroke-national-audit-programme-annual-report-2019-20. Accessed Oct 19, 2021.

APPENDIX A: GOVERNANCE & COLLABORATIONS

In 2021, the AuSCR program was 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 support 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.

The Steering Committee provides governance and strategic direction for the AuSCR and has inclusion from relevant stakeholders, including people with lived experience. Professor Sandy Middleton continued to be the Chairperson in 2021. 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 Chair for the Management Committee in 2021 (see Appendix B for committee membership lists).

There has been highly valued support from the Victorian Agency for Health Information (VAHI), Queensland Health and the ACT government through joint projects with the Stroke Foundation. The Western Australian Department of Health, South Australian Government and Tasmanian Department of Health have also assisted in increasing hospital participation in their states.

Collaborations are continuing with staff from the Australian Institute of Health and Welfare to enable the linking of AuSCR data with government data from the National Death Index, so that survival status can routinely be updated for registrants each year.

In partnership with the Victorian Stroke Telemedicine (VST) program, Melbourne Health, Royal Adelaide Hospital and other Australian collaborators, we agreed to contribute to an international data pooling study to compare the effectiveness of Tenecteplase versus Alteplase in acute ischaemic stroke (CERTAIN Collaboration). This project will continue in 2022.

With the funding of the MRFF Frontiers "Stroke Golden Hour" grant, led by Profs Geoff Donnan and Stephen Davis, there is an opportunity to use real-world data from the AuSCR as part of their evaluation platform, including linkage with ambulance records. A successful pilot project to link AuSCR data and data from Ambulance Victoria has been conducted, providing important insights into pre-hospital care.

We co-convened the 9th national stroke quality workshop with the Stroke Foundation and Monash University. We appreciated the sponsorship support from the Angels Initiative and a donation from Medtronic for this event. In-kind support was also received from various state government representatives and collaborators in planning the event. Such events provide additional opportunities for clinicians and academics to be involved in translational activities to further enhance stroke care and outcomes.

A continuing significant 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 stroke data collection in Australia, and to also establish the first National Stroke Quality Awards program.

APPENDIX B: COMMITTEE MEMBERSHIP

AuSCR Steering Committee membership 2021

Prof Sandy Middleton (Chair)	**Director, Nursing Research Institute, St Vincent's Health Australia (Sydney) and Australian Catholic University [NSW]**
Prof Craig Anderson	Executive Director, The George Institute, China; Professor of Neurology and Epidemiology, Faculty of Medicine, UNSW Sydney [NSW]
Prof Julie Bernhardt	Head, Stroke Division, The 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]
Prof Dominique Cadilhac	Head, Public Health, Stroke Division, The 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 and Stroke) [TAS]
Prof Geoffrey Donnan	Professor of Neurology, The University of Melbourne [VIC]
Dr Andrew Evans	Geriatrician and Stroke Physician, Westmead Hospital [NSW]
A/Prof 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]
Prof Susan Hillier	Dean, Research (and Research Education), Division of Health Sciences, University of South Australia [SA]
A/Prof Martin Krause	Director Neuroscience Network, Northern Sydney Local Health District, University of Sydney [NSW]
Prof Natasha Lannin	Group Leader, Brain Recovery and Rehabilitation Group, Monash University [VIC]
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]
Dr Andrew Wesseldine	Geriatrician and Stroke Physician, St John of God Subiaco; State Stroke Director [WA]
Prof Bernard Yan	Neurointerventionist and Neurologist, Royal Melbourne Hospital [VIC]
Ms Katherine Jaques	A/Network Coordinator – Statewide Stroke Clinical Network [QLD]
Dr Lisa Murphy	Executive Director Stroke Services and Research, Stroke Foundation [VIC]
Dr Ross Clifton	Director of Australasian Rehabilitation Outcomes Centre, University of Wollongong [NSW]

AuSCR Management Committee membership 2021

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, The Florey Institute of Neuroscience and Mental Health; Head, Translational Public Health Division, Stroke and Ageing Research, Monash University [VIC]
Prof Geoff Cloud	Director of Stroke Services, Alfred Health [VIC]
Prof Helen Dewey	Director of Neurosciences, Eastern Health; Professor, Eastern Health Clinical School, Monash University [VIC]
Prof Geoffrey Donnan	Professor of Neurology, The University of Melbourne [VIC]
Prof Steven Faux	Director, Rehabilitation Unit, St Vincent's Hospital, Sydney [NSW]
A/Prof Rohan Grimley	Conjoint Senior Lecturer, Sunshine Coast Clinical School; Clinical Chair, Queensland Statewide Stroke Clinical Network [QLD]
Mr Kelvin Hill	National Manager, Clinical Services, Stroke Foundation [VIC]
Prof Bruce Campbell	Head, Hyperacute Stroke, Royal Melbourne Hospital [VIC]
Ms Shahla Cowans	Stroke Nurse Navigator, Canberra Hospital [ACT]
A/Prof Monique Kilkenny	Head, National Stroke Data Linkage Program, Monash University [VIC]
Ms Belinda Stojanovski	Stroke Nurse Consultant, Royal Children's Hospital [VIC]

AuSCR Reperfusion and Telemedicine Subcommittee membership 2021

Prof Bruce Campbell (Co-Chair)	**Head, Hyperacute Stroke, Royal Melbourne Hospital [VIC]**
Dr Kate Mahady (Co-Chair)	**Interventional Neuroradiologist, Royal Brisbane and Women's Hospital [QLD]**
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, The 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]
Prof Tim Kleinig	Head, Neurology, Royal Adelaide Hospital [SA]
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]
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]
A/Prof Andrew Wong	Neurologist, Royal Brisbane and Women's Hospital [QLD]
Prof Bernard Yan	Neurointerventionist and Neurologist, Royal Melbourne Hospital [VIC]
Dr Darshan Shah	Stroke Physician, Co-Chair of Queensland Stroke Clinical Network [QLD]
Dr Mark Brooks	Interventional Radiologist, Austin Hospital [VIC]
Dr Anoop Madan	Interventional Radiologist, Alfred Health [VIC]
Ms Shahla Cowan	Stroke Nurse Navigator, Canberra Hospital [ACT]
Dr Helen Brown	Clinical Director of the Neuroscience Division, Royal Brisbane and Women's Hospital [QLD]
Dr Hamed Asadi	Consultant Interventional Neuroradiologist, Austin Health; Monash Health [VIC]

AuSCR Clinical Quality Improvement committee membership 2021

Prof Geoffrey Cloud (Chair)	**Director of Stroke Services, Alfred Health [VIC]**
Prof Dominique Cadilhac	Head, Public Health, Stroke Division, The Florey Institute of Neuroscience and Mental Health; Head, Translational Public Health Division, Stroke and Ageing Research, Monash University [VIC]
Dr Andrew Moey	Consultant Neurologist, Lyell McEwin Hospital [SA]
Ms Anne Hooper	Nurse Navigator Stroke, Mackay Base Hospital [QLD]
Ms Belinda Stojanovski	Stroke Nurse Consultant, Royal Children's Hospital [VIC]
Mr Brett Jones	Stroke Nurse Practitioner, Canberra Health Service [ACT]
Ms Aylissa Canning	Princess Alexandra Hospital [QLD]
Ms Kristine Caprecho	Stroke Liaison Nurse, Calvary Public Hospital [ACT]
Ms Katherine Jaques	A/Network Coordinator – Statewide Stroke Clinical Network [QLD]
Ms Janell Cole	North West Regional Hospital [TAS]
Dr Kathryn Colebourne	Stroke Physician, Prince Charles Hospital [QLD]
Ms Linda Edwards	Stroke Clinical Nurse Consultant, Ipswich Hospital [QLD]
A/ Prof Erin Godecke	Senior Research Fellow (Speech Pathology), School of Medical and Health Sciences, Edith Cowan University [WA]
Dr Laura Jolliffe	Lecturer in the Department of Occupational Therapy at Monash University, the Allied Health Research and Knowledge Translation Lead at Peninsula Health [VIC]
Dr Connor McInnes	Senior Physiotherapist, Logan Hospital [QLD]
Dr Caroline Baker	Speech Pathology Researcher and Clinical Practice Lead, Monash Health [VIC]
Ms Lauren Arthurson	Stroke Coordinator, Echuca Regional Health [VIC]

AuSCR Paediatric Subcommittee membership 2021

A/Prof Mark MacKay (Co-Chair)	**Paediatric Neurologist, Royal Children's Hospital, Melbourne [VIC]**
Ms Louise Sparkes (Co-Chair)	**Research Coordinator, Queensland Children's Hospital [QLD]**
Prof Dominique Cadilhac	Head, Public Health, Stroke Division, The Florey Institute of Neuroscience and Mental Health; Head, Translational Public Health Division, Stroke and Ageing Research, Monash University [VIC]
A/Prof Rohan Grimley	Conjoint Senior Lecturer, Sunshine Coast Clinical School; Clinical Chair, Queensland Statewide Stroke Clinical Network [QLD]
Ms Belinda Stojanovski	Stroke Nurse Consultant, Royal Children's Hospital [VIC]

AuSCR Research Task Group membership 2021

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.

Dr Darshan Ghia (Co-Chair)	**Consultant Neurologist and Head of Stroke Unit, Fiona Stanley Hospital [WA]**
Prof Jacqueline Close (Co-Chair)	**Geriatrician, Prince of Wales Hospital; Clinical Director, NeuRA; Conjoint Professor, University of New South Wales [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 and Health Sciences, Edith Cowan University [WA]
Dr Benjamin Clissold	Head, Inpatient 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]
Dr Daniel Schweitzer	General Neurologist, Mater Hospital and The Wesley Hospital [QLD]
Dr Karim Mahawish	Consultant in General, Geriatric and Stroke Medicine, MidCentral District Health Board [NZ]
Dr Candice Delcourt	Program Lead, Neurological Program, The George Institute of Global Health; Clinical Associate Professor, Macquarie University; Conjunct Senior Lecturer, The University of New South Wales [NSW]
A/Prof Nadine Andrew	Senior Research Fellow, Peninsula Clinical School, Monash University [VIC]
A/Prof Caleb Ferguson	Adjunct Associate Professor, School of Nursing and Midwifery, Western Sydney University [NSW]
Dr Elizabeth Lynch	Senior Research Fellow, College of Nursing and Health Sciences, Flinders University [SA]

APPENDIX C: FINANCE REPORT 2021

In 2021, the AuSCR Office was supported by funding and in-kind support from the following sources:

- The Florey Institute of Neuroscience and Mental Health
- Joint initiatives with the Stroke Foundation funded by Queensland Health and ACT Health, and contribution to the Australian Stroke Data Tool national coordination role
- Safer Care Victoria and the Victorian Agency for Health Information
- South Australian, Western Australian and Tasmanian governments
- The Agency for Clinical Innovation in New South Wales
- The NHMRC, which provides salary via fellowship awards for senior researchers
- Various researchers seeking to reuse the archived data or access registrants willing to participate in research for approved projects by the Research Task Group
- Members of the Management Committee and Steering Committee and Research Task Group provide their time 'in-kind'

INCOME SOURCES	AMOUNT
Carry forward	$412,019
Governments grants	$755,236
The Florey, Stroke Theme support	$ 26,084
Stroke Foundation*	$ 22,660
Commercial income†	$ 51,279
Available funds	$1,267,278
Expenses	$1,156,191

** Support for the Australian Stroke Data Tool in addition to maintenance costs ($33,000) paid directly to Argenti from The Stroke Foundation.*

† Income from projects approved by the AuSCR Research Task Group.

APPENDIX D: ACKNOWLEDGEMENTS

ONGOING CONTRIBUTION TO THE AuSCR IN 2021

We gratefully acknowledge contributions made by:

- AuSCR staff at The Florey Institute of Neuroscience and Mental Health: Sibilah Breen, Emma Tod, Kate Paice, Karen Barclay Moss, Jot Ghuliani, Helen Carter, Adele Gibbs, Violet Marion, Nancy Pompeani, Olivia Ryan, Claire Weickhardt, Shaun Hancock, Abigail Dewiso and Shayla Gamble
- The researchers from the Stroke and Ageing Research Group, School of Clinical Sciences, Monash University: Dr Joosup Kim, A/Prof Monique Kilkenny, Dr Lachlan Dalli, Dr Muideen Olaiya, Megan Reyneke, Tharshanah Thayabaranathan
- Professor Leonid Churilov (The Florey) for expert statistical advice
- The Florey Institute Information Technology team in hosting the AuSCR server and supporting other technical processes
- Safer Care Victoria and the Victorian Agency for Health Innovation, for generous financial support of the AuSCR operations in VIC
- Queensland Health for support of the AuSCR in QLD via a joint project (QLD Stroke Quality Improvement Program) with the Stroke Foundation
- ACT Heath for support of the AuSCR in the ACT via a joint project with the Stroke Foundation
- Tasmania Health for support of the AuSCR in Tasmania via a joint project with the Stroke Foundation
- The Stroke Foundation for providing AuSCR patients with stroke information packages to patients requesting additional information at the 90-180 day follow-up
- The Australian Institute of Health and Welfare for their role in linking the AuSCR data to the National Death Index

SPECIAL MENTIONS

AuSCR Office

Dr Sibilah Breen, the AuSCR National Coordinator, was the senior program manager and coordinated the AuSCR program for the majority of 2021. Dr Teresa Howard is also acknowledged for undertaking this role for a short period of 2021.

Monash University

Dr Lachlan Dalli, Dr Joosup Kim, and A/Prof Monique Kilkenny (Stroke and Ageing Research, Monash University) developed the statistical programs used in this report and have contributed to the preparation of various AuSCR reports throughout 2021. We are most appreciative of their contributions. The majority of analyses presented in this report were undertaken by Dr Lachlan Dalli, under the supervision of Prof Dominique Cadilhac, using de-identified data supplied securely by Marcus Lester. We acknowledge the support from Megan Reyneke in data checking and validation. Methods for the analysis of risk-adjusted mortality were initially developed by A/Prof Monique Kilkenny, in consultation with Professor Leonid Churilov (The Florey).

This report would not have been possible without the efforts of doctors, nurses, ward clerks and other staff from participating hospitals who have supported data collection for the AuSCR. Lead clinical and data collection staff for each hospital participating in the AuSCR in 2021 are gratefully acknowledged below.

ACT	
Calvary Health Care	Yash Gawarikar; Kristine Caprecho
Canberra Health Service	Brett Jones; Shahla Cowans
NSW	
Blacktown Hospital	Nigel Wolfe; Jacqueline Watson
Westmead Hospital	Andrew Evans; Phoebe Banatua; Aleksandra Alavanja
QLD	
Bundaberg Base Hospital	Peter Wood; Nicole Blunt; Juliet Weicks; Helen Eaves
Caboolture Hospital	Jonnel Boco; Marnie Hollywood
Cairns Base Hospital	Ramesh Durairaj; Dijana Cukanovic-Krebs; Troy Elliot; Spencer Irvin
Gold Coast University Hospital	Meng Tan; Haylee Berrill
Gympie Hospital	Rohan Grimley; Shaji Chacko
Hervey Bay Hospital	Peter Wood; Pauline Blaney; Donna Stubbings; Sarah Leak
Ipswich Hospital	Juan Rois-Gnecco; Linda Edwards; Betzy Shaju
Logan Hospital	Alex Lau; Nicola Hall
Mackay Base Hospital	Neha Nandal; Anne Hooper
Mater Health Services	Daniel Schweitzer; Marie McCaig; Brendon Glenn
Prince Charles Hospital	Alaa Alghamry; Kathryn Colebourne; Caitlin Kearney
Princess Alexandra Hospital	Helen Brown; Emma Harrison; Amanda McKee; Aylissa Canning; Angela Adina
Queen Elizabeth II Jubilee Hospital	Amanda Siller; Jerry Wong; Aylissa Canning; Paula Jarrett
Queensland Children's Hospital	Louise Sparks
Redcliffe Hospital	Richard Geraghty; Tanya Williams; Casey Jenkins
Redland Hospital	Jenna Allen; Emma Butler
Robina Hospital	Meng Tan; Haylee Berrill
Rockhampton Hospital	Leanne Whiley
Royal Brisbane and Women's Hospital	Andrew Wong; Melissa Wood; Kara McDonald
Sunshine Coast University Hospital	Rohan Grimley; Donna Rowley; Lynette Loney
Toowoomba Hospital	Nisal Gange; Timothy Richardson
Townsville Hospital	Richard White; Sheryl Juliano; Linda Norrie; Nerida Myers
SA	
Flinders Medical Centre	Matt Willcourt; Michelle Hutchinson
Lyell McEwin Hospital	Andrew Moey; Angela Sayas
Royal Adelaide Hospital	Tim Kleinig; Lizzie Dodd; Carole Hampton
TAS	
Launceston General Hospital	Dinesh Tryambake; Carolyn Harrison
North West Regional Hospital	Nellie Cole
Royal Hobart Hospital	Helen Castley; Deirdre Broadby

VIC	
Albury Wodonga Health - Albury	Vanessa Crosby
Albury Wodonga Health - Wodonga	Vanessa Crosby
Alfred Hospital	Angela Dos Santos; Geoff Cloud; Kieran Taylor
Austin Hospital	Vincent Thijs; Renae Gamble
Bairnsdale Regional Health Service	Kushantha Gunarathne; Renee Herbstreit; Alison Pearce; Laura Macdonald
Ballarat Health Services	Thomas Kraemer; Ramesh Sahathevan; Casey Hair
Bass Coast Health	Cath Jones
Bendigo Health	Mark Savage; Tessa Coupland; Erin Ray
Box Hill Hospital	Helen Dewey; Tanya Frost; Karen Stephens
Central Gippsland Health Service	Krishna Mandaleson; Anne van Berkel; Howard Connor
Echuca Hospital	Lauren Arthurson
Goulburn Valley Health	Melanie Brown; Katie Connelly
Hamilton Base Hospital	Louise Starkie
Latrobe Regional Hospital	Janet May
Maroondah Hospital	Helen Dewey; Tanya Frost; Karen Stephens
Mildura Base Hospital	Ros Roberts
Monash Medical Centre	Henry Ma; Jodi Lynch; Heather Gilbert
Peninsula Health - Frankston Hospital	Ernie Butler; Liz Mackey; Kanaga Lagma
Royal Children's Hospital	Mark Mackay; Belinda Stojanovski; Adam Rozsa
Royal Melbourne Hospital	Bruce Campbell; Lauren Pesavento; Smisha Thomas; Gagan Sharma
St Vincent's Hospital Melbourne	Lauren Sanders; Patrick Scarff
Sunshine Hospital - Western Health	Tissa Wijeratne; Jennifer Bergqvist
Swan Hill District Health	Kath Curran; Robyn Bailey; Kelly Stanger
The Northern Hospital	Douglas Crompton; Anne Rodda
University Hospital Geelong	Ben Clissold; Heather Smith
Warrnambool Base Hospital	Anna Clissold; Patrick Groot
Werribee Mercy Hospital	Manny Bautista; Sharon Green; Debbie Rockliffe
West Gippsland Hospital	Mirza Baig; Lorraine Keene; Amanda Lewis
Wimmera Base Hospital	Chris Ebersohn; Fari Islam; Deidre Rennick; Leanne Taylor; Nina Roberts
WA	
Fiona Stanley Hospital	Darshan Ghia; Kerri-Ann Whittaker; Gillian Edmonds

APPENDIX E:
ASC AND WSO AWARDS

AUSTRALIAN STROKE COALITION AWARDS

In 2021, there were two Australian Stroke Coalition (ASC) award categories.

Category 1: Provision of nine quality of stroke care metrics

Participating hospitals were judged on nine processes of care within acute admissions during the period 01/07/2020 to 31/03/2021, as recorded in the AuSCR. These processes of care included:

- provision of stroke unit care
- treatment with thrombolysis OR endovascular clot retrieval (if offered by hospital)
- treatment with thrombolysis within 60 mins of hospital arrival
- treatment with endovascular clot retrieval within 90 minutes of hospital arrival
- patients mobilised on the same day or day after hospital arrival
- provision of antihypertensive medication on discharge*
- provision of antithrombotic medications on discharge*#
- provision of lipid-lowering medication on discharge* #
- provision of a discharge care plan if discharged to the community

* where not contraindicated

excluding haemorrhagic strokes

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, each hospital was required to have an overall composite score greater than or equal to 70%, an overall rate of case ascertainment greater than or equal to 70%, 30 or more episodes recorded during the period, and less than 10% missing data for award variables.

Awards were possible in two categories:

- EXCELLENCE: composite score of greater than or equal to 80%
- MERIT: composite score of greater than or equal to 70%

The following hospitals received awards:

EXCELLENCE AWARDS: Peninsula Health – Frankston Hospital (VIC); Redcliffe Hospital (QLD); Townsville Hospital (QLD); Cairns Hospital (QLD); Queen Elizabeth II Jubilee Hospital (QLD); Goulburn Valley Health (VIC); Echuca Regional Health (VIC); Wimmera Base Hospital (VIC); Port Macquarie Hospital (NSW).

MERIT AWARDS: Austin Hospital (VIC); Warrnambool Base Hospital (VIC); Box Hill Hospital (VIC); Rockhampton Hospital (QLD); Caboolture Hospital (QLD); Ipswich Hospital (QLD); Princess Alexandra Hospital (QLD); Mildura Base Hospital (VIC); Maroondah Hospital (VIC); Hamilton Base Hospital (VIC); West Gippsland Hospital (VIC); Canberra Health Service (ACT).

HONOURABLE MENTIONS were given to the following hospitals that had a composite score of greater than or equal to 80% but had a rate of case ascertainment between 60 to 69% OR more than 10% missing data for one variable used in the calculation of the composite score: Royal Brisbane and Women's Hospital (QLD); Gold Coast University Hospital (QLD); Royal Melbourne Hospital (VIC); Calvary Health Care (ACT).

Category 2: Provision of timely reperfusion treatments

MERIT AWARDS required hospitals to have a case ascertainment of ≥70% and <10% missing data for variables used in calculating these awards and must have also provided data for a minimum of 15 patients for the award period. These were given to hospitals that had a median door-to-needle time for thrombolysis of less than 60 minutes: Box Hill Hospital (VIC), Austin Hospital (VIC), Royal Melbourne Hospital (VIC); and whose median door-to-groin time for ECR is less than 90 minutes: Royal Melbourne Hospital (VIC), Royal Adelaide Hospital (SA).

HONOURABLE MENTIONS were given to hospitals that have: a median door-to-needle time for thrombolysis of less than 60 minutes OR whose median door-to-groin time for ECR is less than 90 minutes and that had either case ascertainment between 60-69% or more than 10% missing data for one variable used in the calculations. For median door-to-groin time for ECR less than 90 minutes: Royal Brisbane and Women's Hospital (QLD), Westmead Hospital (NSW). There were no honourable mentions for median door-to-needle time for thrombolysis of less than 60 minutes.

WORLD STROKE ORGANISATION ANGELS AWARDS

In 2021 for the first time, in partnership with the Australian Stroke Coalition, hospitals that submitted a minimum of 40 consecutive admissions to the AuSCR from 01/07/2020 to 31/03/2021 were eligible for consideration in the WSO Angels Awards. The award categories were Gold status, Platinum status or Diamond status.

Award criteria included the proportion of:

- ischaemic strokes thrombolysed and with a door-to-needle time < 60 minutes*
- ischaemic strokes undergoing clot retrieval and with a door-to-groin time < 120 minutes*
- ischaemic strokes thrombolysed and with door-to-needle time < 45 minutes*
- ischaemic strokes undergoing clot retrieval and with a door-to-groin time < 90 minutes*
- ischaemic strokes receiving either thrombolysis or clot retrieval*
- all suspected stroke patients undergoing CT or MRI imaging procedure
- all stroke patients undergoing a swallow screen or assessment
- ischaemic stroke patients discharged with antiplatelet medication#
- stroke patients discharged with anticoagulant medication#
- stroke patients treated in a dedicated stroke unit during their hospital stay

* excluding transfers

where not contraindicated

Gold status: Albury Wodonga Health – Albury (VIC/ NSW), Austin Hospital (VIC), Echuca Regional Health (VIC), Port Macquarie Hospital (NSW).

APPENDIX F: RESEARCH TRANSLATION

Journal Publications

1. Amminadab EL, Cadilhac, DA, Kim, J, Andrew, NE, Bladin,CF, Grimley, R, Dewey, HM, Donnan, GA, Hill, K, Levi, CR, Middleton, S, Anderson, CS, Lannin, NA, Kilkenny, MF on behalf of the AuSCR consortium partners and Stroke123 investigators. Factors associated with arrival by ambulance for patients with stroke: A multicentre, national data linkage study. Australasian Emergency Care 2021; 24(3):167-173. doi.org/10.1016/j.auec.2021.01.002
2. Andrew NE, Cadilhac DA, Sundararajan V, Thrift AG, Anderson P, Lannin NA, Kilkenny MF. Linking Australian Stroke Clinical Registry data with Australian government Medicare and medication dispensing claims data and the potential for bias. Australian and New Zealand Journal of Public Health 2021; 45(4):364-369. doi.org/10.1111/1753-6405.13079
3. Cadilhac DA, Kim J, Tod EK, Morrison JL, Breen SJ, Jaques K, Grimley R, Jones B, Cloud GC, Kleinig T, Hillier S, Castley H, Lindley RI, Lannin NA, Middleton S, Yan B, Hill K, Clissold BB, Mitchell PJ, Anderson CS, Faux SG, Campbell BCV. COVID-19 Pandemic Impact on Care for Stroke in Australia: Emerging Evidence From the Australian Stroke Clinical Registry. Frontiers in Neurology 2021, 12 (230):621495. doi.org/10.3389/fneur.2021.621495
4. Cadilhac, DA, Sheppard, L, Kim, J, Tan, E, Gao, L, Sookram, G, Dewey, HM, Bladin, CF, Moodie, M. Economic Evaluation Protocol and Statistical Analysis Plan for the Cost-Effectiveness of a Novel Australian Stroke Telemedicine Program; the Victorian Stroke Telemedicine (VST) program. Frontiers in Neurology 2021, 11:602044. doi.org/10.3389/fneur.2020.602044
5. Dalli LL, Andrew NE, Cadilhac DA, Kim J, Sanfilippo FM, Kilkenny MF. Agreement between pharmaceutical claims data and patient-reported medication use after stroke. International Journal of Pharmacy Practice 2021;29(4)397-399. doi.org/10.1093/ijpp/riab032
6. Dalli LL, Kim J, Cadilhac DA, Greenland M, Sanfilippo FM, Andrew NE, Thrift AG, Grimley R, Lindley RI, Sundararajan V, Crompton DE, Lannin NA, Anderson CS, Whiley L, Kilkenny MF. Greater Adherence to Secondary Prevention Medications Improves Survival After Stroke or Transient Ischemic Attack: A Linked Registry Study. Stroke 2021;52(11):3569-3577. doi.org/10.1161/STROKEAHA.120.033133
7. Dalli LL, Kim J, Thrift AG, Andrew NE, Sanfilippo FM, Lopez D, Grimley R, Lannin NA, Wong L, Lindley RI, Campbell BCV, Anderson CS, Cadilhac DA, Kilkenny MF. Patterns of use and discontinuation of secondary prevention medications after stroke. Neurology, 2021; 96(1): e30-e41. doi.org/10.1212/WNL.0000000000011083
8. Dwyer, M, Francis, K, Peterson, G.M, Ford, K.M, Gall, S, Hoang, TP, Castley, H, Wong, L, White, R, Ryan, F, Arthurson, L, Kim, J, Cadilhac, DA, Lannin, NA. Regional Differences in the Care and Outcomes of Acute Stroke Patients in Australia: An Observational Study using Evidence from the Australian Stroke Clinical Registry (AuSCR). BMJ Open, 2021;11(4): e040418. doi.org/10.1136/bmjopen-2020-040418
9. Kilkenny MF, Phan HT, Lindley RI, Kim J, Lopez D, Dalli LL, Grimley R, Sundararajan V, Thrift AG, Andrew NE, Donnan GA, Cadilhac DA. Utility of the Hospital Frailty Risk Score Derived from Administrative Data and the Association with Stroke Outcomes. Stroke 2021;52(9):2874-2881. doi.org/10.1161/STROKEAHA.120.033648
10. Kilkenny, MF, Bravata, DM. Advances in Stroke: Quality Improvement. Stroke 2021;52:1866–1870 doi.org/10.1161/STROKEAHA.121.033451
11. Cadilhac D.A & Prvu Bettget. J. Health Policy and Health Services Delivery in the Era of COVID-19. Stroke;52:2177–2179. doi.org/10.1161/STROKEAHA.121.033292
12. Mosalski S, Shiner CT, Lannin NA, Cadilhac DA, Faux SG, Kim J, Alexander T, Breen S, Nilsson M, Pollack M, Bernhardt J, Simmonds F, Dewey HM, Grimley R, Hillier S, Kilkenny MF. Increased relative functional gain and improved stroke outcomes: a linked registry study of the impact of rehabilitation.

Journal of Stroke and Cerebrovascular Diseases 2021; 30(10):106015. doi.org/10.1016/j.jstrokecerebrovasdis.2021.106015

13. Olaiya MT, Cadilhac DA, Kim J, Thrift AG, de Courten B, Andrew NE, Grimley R, Anderson CS, Sundararajan V, Lannin NA, Levi C, Dewey HM, Kilkenny MF. Quality of care and one-year outcomes in patients with diabetes hospitalized for stroke or TIA: a linked registry study. Journal of Stroke and Cerebrovascular Diseases 2021; 30(11):106083. doi.org/10.1016/j.jstrokecerebrovasdis.2021.106083
14. Phan HT, Gall SL, Blizzard CL, Lannin NA, Thrift AG, Anderson CS, Kim J, Grimley R, Castley HC, Kilkenny MF, Cadilhac DA. Sex differences in quality of life after stroke were explained by patient factors, not clinical care: evidence from the Australian Stroke Clinical Registry. European Journal of Neurology 2021 Feb;28(2):469-47. doi.org/10.1111/ene.14531
15. Phan HT, Gall SL, Blizzard CL, Lannin NA, Thrift AG, Anderson CS, Kim J, Grimley R, Castley HC, Kilkenny MF, Cadilhac DA. Sex Differences in Causes of Death After Stroke: Evidence from a National, Prospective Registry. Journal of Women's Health 2021; 30(3):314-323. doi.org/10.1089/jwh.2020.8391
16. Ryan OF, Riley M, Cadilhac DA, Andrew NE, Breen S, Paice K, Shehata S, Sundararajan V, Lannin NA, Kim J, Kilkenny MF. Factors associated with stroke coding quality: a comparison of registry and administrative data. Journal of Stroke and Cerebrovascular Diseases 2021;30(2):105469. doi.org/10.1016/j.jstrokecerebrovasdis.2020.105469
17. Thayabaranathan T, Andrew NE, Grimley R, Stroil-Salama E, Grabsch B, Hill K, Cadigan G, Purvis T, Middleton S, Kilkenny MF, Cadilhac DA. Understanding the Role of External Facilitation to Drive Quality Improvement for Stroke Care in Hospitals. Healthcare 2021;9(9):1095. doi.org/10.3390/healthcare9091095
18. Ung D, Dalli LL, Lopez D, Sanfilippo FM, Kim J, Andrew NE, Thrift AG, Cadilhac DA, Anderson CS, Kilkenny MF. Assuming one dose per day yields a similar estimate of medication adherence in patients with stroke: An exploratory analysis using linked registry data. British Journal of Clinical Pharmacology 2021; 87, 1089-1097. doi.org/10.1111/bcp.14468

Online Reports

1. Cadilhac DA, Dalli LL, Morrison J, Lester M, Paice K, Moss K, Carter H, Campbell B, Cloud G, Anderson CS, Kilkenny M, Faux S, Dewey H, Hill K, Donnan G, Grimley R, Middleton S, Lannin NA; *on behalf of the AuSCR Consortium*. The Australian Stroke Clinical Registry Annual Report 2020. The Florey Institute of Neuroscience and Mental Health; Dec 2021, Report No. 13, 64 pages. www.auscr.com.au/about/annual-reports

Presentations and Posters

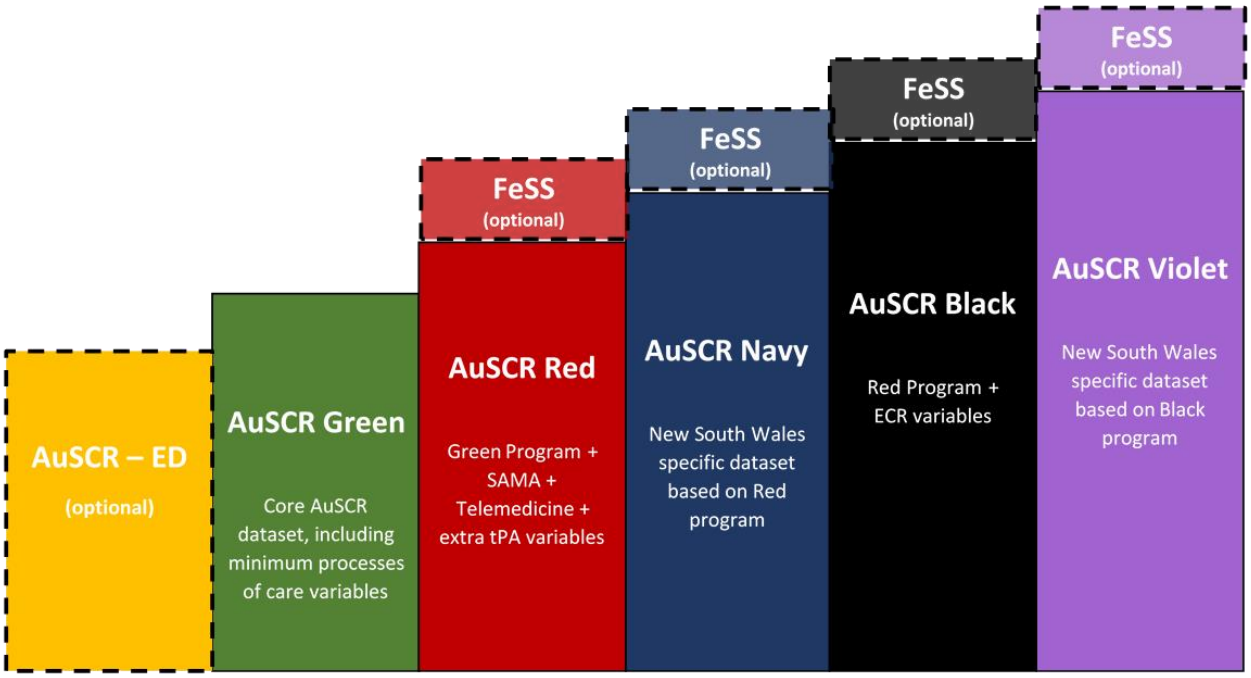
1. Andrew NE, Churilov L, Kim J, Cadilhac D, Sundararajan V, Thrift A, Lannin N, Nelson M, Srikanth V, Kilkenny M. Incentivising primary care practitioners to provide comprehensive chronic disease management improves survival following stroke: a target trial approach using linked registry data. 13th World Stroke Congress. Virtual. 28-29 Oct 2021.
2. Cadilhac D, Kim J, Cloud G, Anderson C, Tod E, Breen S , Faux S , Kleinig T , Castley H, Lindley R, Middleton S, Yan B, Hill K, Jones B, Shah D, Jaques K, Clissold B, Campbell B, Lannin N. Quality of acute stroke care provided outside of stroke units declined during the COVID-19 pandemic in Australia (E-Poster). 7th Annual European Stroke Organisation Conference. Virtual. 1-3 Sep 2021.
3. Cadilhac D, Kim J, Cloud G, Anderson C, Tod E, Breen S, Faux S, Kleinig T, Castley H, Lindley R, Middleton S, Yan B, Hill K, Jones B, Shah D, Jaques K, Clissold B, Campbell B, Lannin N. The detrimental impact of not maintaining access to stroke units during the COVID-19 pandemic. 13th World Stroke Congress. Virtual. 28-29 Oct 2021.
4. Cadilhac DA, Hall N. Addressing variation improves stroke care: Dominique Cadilhac and Nicola Hall. Better Care Everywhere, Healthcare Variation in Practice program Webinar series. Australian Commission on Safety and Quality in Healthcare. Virtual. 23 Feb 2021.

5. Cadilhac DA. Clinical disease registries for facilitating real-world data science and comparative effectiveness research: lesson from stroke. Neuroscience Seminar Series, The Florey Institute of Neuroscience and Mental Health. Virtual. 30 Mar 2021.
6. Cadilhac D.A. Data Collection and Analysis. Stroke in Low-Resource Settings Virtual Forum Call, McMaster University, Canada. Virtual. Oct 2021.
7. Cadilhac D.A. Does improving care for patients after acute stroke make a difference? The power of Learning Health Systems: connecting data, research, translation and healthcare improvement, Monash Partners Webinar. Virtual. 18 Aug 2021.
8. Cadilhac D.A. Does improving care for patients after acute stroke make a difference? The power of Learning Health Systems: connecting data, research, translation and healthcare improvement, Monash Partners Webinar. Virtual. 18 Aug 2021.
9. Cadilhac D.A. Factors that influence stroke outcomes and research to improve support after discharge from hospital. 2021 Joint Virtual Seminar Series Hudson Institute/Department of Medicine Monash University. Virtual. 17 Jun 2021.
10. Cadilhac D.A. Improving adherence to clinical processes of care: lessons learnt. RAVIE partners. Ravie Workshop Webinar. Virtual. 8 Jun 2021.
11. Cadilhac D.A. Quality of Acute Care provided outside of stroke units declined during the COVID-19 pandemic in Australia (E-Poster). 7th European Stroke Organisation Conference. Virtual. 1-3 Sep 2021.
12. Cadilhac D.A. Quality of acute stroke care during the COVID-19 pandemic in Australia. Stroke Society of Australasia Annual Scientific Meeting. Perth. 13-15 Oct 2021.
13. Cadilhac D.A. Future of Clinical Quality Registries. 3rd Annual Victorian Heart Institute Virtual Symposium. Virtual. Nov 4 2021.
14. Cadilhac DA, Kim J, Cloud G, Anderson CS, Tod EK, Breen SJ, Faux S, Kleinig T, Castley H, Lindley R, Middleton S, Yan B, Hill K, Jones B, Shah D, Jaques K, Clissold B, Campbell B, Lannin NA. Quality of acute stroke care during the COVID-19 pandemic in Australia. Stroke Society of Australasia Annual Scientific Meeting. Perth. 13-15 Oct 2021.
15. Dalli LL. Patient understanding of medications is associated with improved medication adherence and risk factor control after stroke. 13th World Stroke Congress. Virtual. 28-29 Oct 2021.
16. Grimley R, Collyer T, Dewey H, Gee R, Andrew N. Cadilhac D. Risk of emergency department re-presentation following introduction of ambulant care for suspected TIA. 13th World Stroke Congress. Virtual. 28 -29 Oct 2021.
17. Kilkenny M, Dalli L, Kim J, Cadilhac D, Sanfilippo F, Olaiya M, Thrift A, Nelson M, Ung D, Sundararajan V, Andrew N. Financial incentives for chronic disease management after stroke improves medication adherence: linked data from a national stroke registry. 13th World Stroke Congress. Virtual. 28 -29 Oct 2021.
18. Kilkenny MF. Australian Stroke Data Linkage Program: using data to improve outcomes. International Conference on Neurology and Epidemiology. Virtual. 19-20 Mar 2021.
19. Kilkenny MF. Development and evaluation of stroke coding/ clinical documentation education program. STOPStroke Synergy grant meeting. Virtual. Feb 2021.
20. Kilkenny MF. The worldwide spread and impact of national and international stroke quality registries. International Stroke Conference. Virtual. 17-19 Mar 2021.
21. Thayabaranathan T, Wallace S, Kim J, Brogan E, Baker C, Godecke E, Copland D, Rose M, Cadilhac D. Factors associated with aphasia following stroke using linked clinical registry and hospital data. 13th World Stroke Congress. Virtual. 28-29 Oct 2021.
22. Ung D, Wang Y, Sundararajan V, Lopez D, Kilkenny MF, Cadilhac DA, Thrift AG, Nelson MR, Andrew NE. Determining the optimal measurement for general practitioner encounters following stroke using linked data from the Australian Stroke Clinical Registry. Stroke Society of Australasia Annual Scientific Meeting. Perth. 13-15 Oct 2021.

APPENDIX G:
AUSCR PROGRAM BUNDLES

In 2021, 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, whilst the Green program was only used at a specialised children's hospital.

The FeSS (Fever, Sugar, Swallow) dataset is an optional add-on to a hospital's usual AuSCR acute data collection program.



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

VARIABLES COLLECTED IN THE AUSCR*

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
- Inpatient 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
- Telemedicine consultation
- Date and time of thrombolysis
- Adverse event related to thrombolysis
- Swallow screen and formal speech pathologist assessment
- Hyperacute antithrombotic therapy
- Mobilisation during admission
- *Mood assessment*
- Discharged on antithrombotic medication
- Discharged on antihypertensive medication
- Discharged on lipid-lowering medication
- Care plan provided at discharge (documented in the medical record)

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

EMERGENCY DEPARTMENT DATASET (OPTIONAL DATASET FROM 2019 ONWARDS)
• Date and time of discovery • Pre-hospital notification • Date and time of transfer • Triage category • Advanced imaging • Date and time stroke telemedicine consultation conducted • Drug used for thrombolysis
FESS (FEVER, SUGAR, SWALLOW) DATASET (OPTIONAL DATASET FROM 2019 ONWARDS)
• Swallowing – captured with other programs • Assessment and management of fever • Was temperature recorded at least four times on day one of ward admission? • In the first 72 hours following admission did the patient develop a fever ≥ 37.5 0C • Was paracetamol for the first elevated temperature administered within 1 hour? • Assessment and management of hyperglycaemia • Was a finger-prick blood glucose level recorded at least four times on day one of ward admission? • In the first 48 hrs following ward admission did the patient develop a finger-prick glucose level of greater or equal to 10 mmols/L? • Was insulin administered within 1 hour of the first elevated finger-prick glucose (≥ 10 mmol/L)?

***** 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 I: RESEARCH APPLICATIONS

In 2021, there were three external applications reviewed by the Research Task Group:

- An investigator-initiated and conducted, prospective, multicentre, randomised outcome-blinded study of antiplatelet monotherapy in patients with a history of stroke due to intracerebral haemorrhage (ASPIRING) (PIs: Prof Graeme Hankey, Prof Craig Anderson, Prof Rustam Al-Shahi Salman, AIs: Dr Ramesh Sahathevan, Dr Andrew Wong, Dr Nawaf Yassi, Dr Carlos Garcia Esperon, A/Prof Timothy Kleinig, Dr Darshan Ghia, Prof Vincent Thijs, Dr Dennis Cordato, Dr Alvaro Cervera, Dr Jeremy Christley, Dr Fintan O'Rourke; University of Western Australia).
- A prospective multicentre, phase 2b randomised controlled double-blind trial, to determine the safety and efficacy of perispinal etanercept on quality of life at 28 days post treatment (PESTO) (PI: Prof Vincent Thijs; The Florey Institute of Neuroscience and Mental Health).
- Generating new evidence to BEtter guide long-term mAnagemenT of Stroke for Tasmanians (BEATStrokeTas) (PI: Dr Hoang Phan, AIs: A/Prof Seana Gall, Dr Helen J Castley, Prof Dominique Cadilhac, A/Prof Monique Kilkenny, Dr Joosup Kim, Ms Alex Yichao Sun; University of Tasmania).

APPENDIX J:
DERIVING QUALITY INDICATORS

Indicator*	Numerator	Denominator	Comments	Applicable program					
				BLACK	NAVY	VIOLET	RED	GREEN	ED
Received stroke unit care	Yes	Yes + No + Unknown + Missing		✓	✓	✓	✓	✓	
Received intravenous thrombolysis	Yes	Yes + No + Unknown + Missing	Includes ischaemic strokes only Excludes episodes provided thrombolysis before arrival to hospital, unless this occurred in a Mobile Stroke Unit	✓	✓	✓	✓	✓	✓
Received brain scan	Yes	Yes + No + Unknown + Missing		✓	✓	✓	✓	✓	✓
Antithrombotic therapy within 48 hours of stroke onset	Yes	Yes + No + Unknown + Missing	Excludes patients with intracerebral haemorrhage, missing stroke type, or if contraindicated	✓	✓	✓	✓		
Received intravenous thrombolysis within 60 minutes of arrival	Yes	Yes + No + Unknown + Missing	Includes ischaemic strokes provided thrombolysis during the current episode only.	✓	✓	✓	✓		✓
Received endovascular clot retrieval	Yes	Yes + No + Unknown + Missing	Includes ischaemic strokes only	✓		✓			
Received groin puncture for endovascular clot retrieval within 90 minutes of arrival	Yes	Yes + No + Unknown + Missing	Includes ischaemic strokes only	✓		✓			
Swallow screen conducted	Yes	Yes + No + Unknown + Missing		✓	✓	✓	✓		✓
Swallow screen or assessment conducted	Yes	Yes + No + Unknown + Missing		✓	✓	✓	✓		
Swallow screen or assessment within 4 hours	Yes	Yes + No + Unknown + Missing		✓	✓	✓	✓		
Swallow screen or assessment prior to oral intake	Yes	Yes + No + Unknown + Missing		✓	✓	✓	✓		✓
Mobilised during episode	Yes	Yes + No + Unknown + Missing		✓			✓		
Mobilised same day or day after arrival	Yes	Yes + No + Unknown + Missing		✓			✓		
Discharged on antihypertensive medications	Yes	Yes + No + Unknown + Missing	Includes discharged patients without contraindications	✓	✓	✓	✓	✓	
Discharged on antithrombotic medications	Yes	Yes + No + Unknown + Missing	Includes discharged patients without intracerebral haemorrhage or contraindications	✓	✓	✓	✓		
Discharged on lipid-lowering medications	Yes	Yes + No + Unknown + Missing	Includes discharged patients without intracerebral haemorrhage or contraindications	✓	✓	✓	✓		
Care plan provided if discharged to the community	Yes	Yes + No + Unknown + Missing	Includes patients discharged home or to a residential aged care facility	✓	✓	✓	✓	✓	

* All indicators exclude data from hospitals where >30% of data for the relevant indicator are missing.

APPENDIX K: SUMMARY OF EMERGENCY DEPARTMENT DATA

Additional Table I: Baseline and clinical characteristics of adult patients in the ED Dataset

	N=258 adult patients
	n (%)
Age in years, mean (SD)	68 (15)
Age in years, median (Q1 to Q3)	70 (61 to 78)
Female	102 (40)
Born in Australia	209 (81)
Aboriginal and/or Torres Strait Islander	<5 (<2)
	N=258 adult episodes
Clinical diagnosis	
Ischaemic	202 (78)
Intracerebral haemorrhage	40 (16)
Transient ischaemic attack	<5 (<2)
Undetermined	11 (4)
Able to walk on admission*	32 (14)
National Institutes of Health Stroke Scale (NIHSS) categories	
No stroke symptoms (0)	12 (5)
Minor stroke (1-4)	57 (22)
Moderate stroke (5-15)	112 (43)
Moderate to severe stroke (16-20)	25 (10)
Severe stroke (21-42)	17 (7)
Missing	35 (14)
Modified Rankin Scale prior to stroke	
0 – No symptoms at all	187 (72)
1 – No significant disability despite symptoms	36 (14)
2 – Slight disability	16 (6)
3 – Moderate disability	9 (3)
4 – Moderately severe disability	<5 (<2)
5 – Severe disability	<5 (<2)
Missing	<5 (<2)
Triage category	
1	33 (13)
2	206 (80)
3	15 (6)
4	<5 (<2)
5	0 (0)
Missing	<5 (<2)

SD: standard deviation; Q1: 25th percentile; Q3: 75th percentile.
* Excludes missing responses (12%).

Additional Table II: Care provision in the Emergency Department and reason for transfer

	N=258 adult episodes
	n (%)
Arrival by ambulance	222 (86)
Arrival within 4.5 hours of symptom onset	157 (61)
Pre-hospital notification by paramedics	141 (55)
Brain scan after stroke	240 (99)
Advanced Imaging Performed	
CT angiography	217 (84)
CT perfusion	167 (65)
Diffusion weighted imaging	<5 (<2)
MR angiography	<5 (<2)
Perfusion weighted imaging	0 (0)
None	22 (9)
Median time to brain scan, minutes (Q1 to Q3)*	27 (12 to 48)
Provision of thrombolysis if ischaemic stroke	81 (43)
Adverse event related to thrombolysis occurred	<5 (<2)
Telemedicine consultation (if the patient presented at a regional hospital)	161 (88)
Swallow screen conducted	43 (19)
Swallow screen prior to oral intake	58 (26)
Reason for transfer	
Need for intravenous thrombolysis	<5 (<2)
Need for stroke unit care	53 (21)
Need for specialist medical assessments	89 (35)
Need for surgical interventions	49 (20)
Need for diagnostic tests	31 (12)
Need for endovascular therapy	151 (59)
Unknown	18 (7)
Other	20 (11)

CT: computed tomography; MR: magnetic resonance.
* Excludes missing responses (<8%).

APPENDIX L: ABBREVIATIONS

ABC™	Achievable benchmarks of care
ACT	Australian Capital Territory
AF	Atrial fibrillation
APF	Adjusted performance fraction
ASC	Australian Stroke Coalition
ASGS	Australian Statistical Geography Standard
AuSCR	Australian Stroke Clinical Registry
AuSDaT	Australian Stroke Data Tool
CT	Computed Tomography
ECR	Endovascular clot retrieval
ED	Emergency Department
EQ-5D-3L™	European Quality of Life - five dimension, three level instrument
FeSS	Fever Sugar Swallow
HRQoL	Health-related quality of life
ICD-10	International Classification of Diseases (Version 10)
ICH	Intracerebral haemorrhage
MRFF	Medical Research Future Fund
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
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
VAHI	Victorian Agency for Health Innovation
VAS	Visual Analogue Scale
VIC	Victoria
VST	Victorian Stroke Telemedicine
WA	Western Australia

AuSCR

Australian Stroke Clinical Registry