AuSCR
Australian Stroke Clinical Registry

ANNUAL REPORT 2022

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ACKNOWLEDGEMENT OF COUNTRY

We acknowledge 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.

IMPROVING STROKE CARE FOR ALL AUSTRALIANS

Stroke is a significant health condition in Australia

After a stroke, more than one in three people have an ongoing disability that impacts their daily activities. In Australia, the care provided in hospital for a new stroke is not always the same and this can impact patient outcomes. Stroke is Australia's fourth leading cause of death.

The Australian Stroke Clinical Registry (AuSCR) monitors the quality of stroke care in hospitals to support quality improvement, and reduce variation in access to recommended treatments.
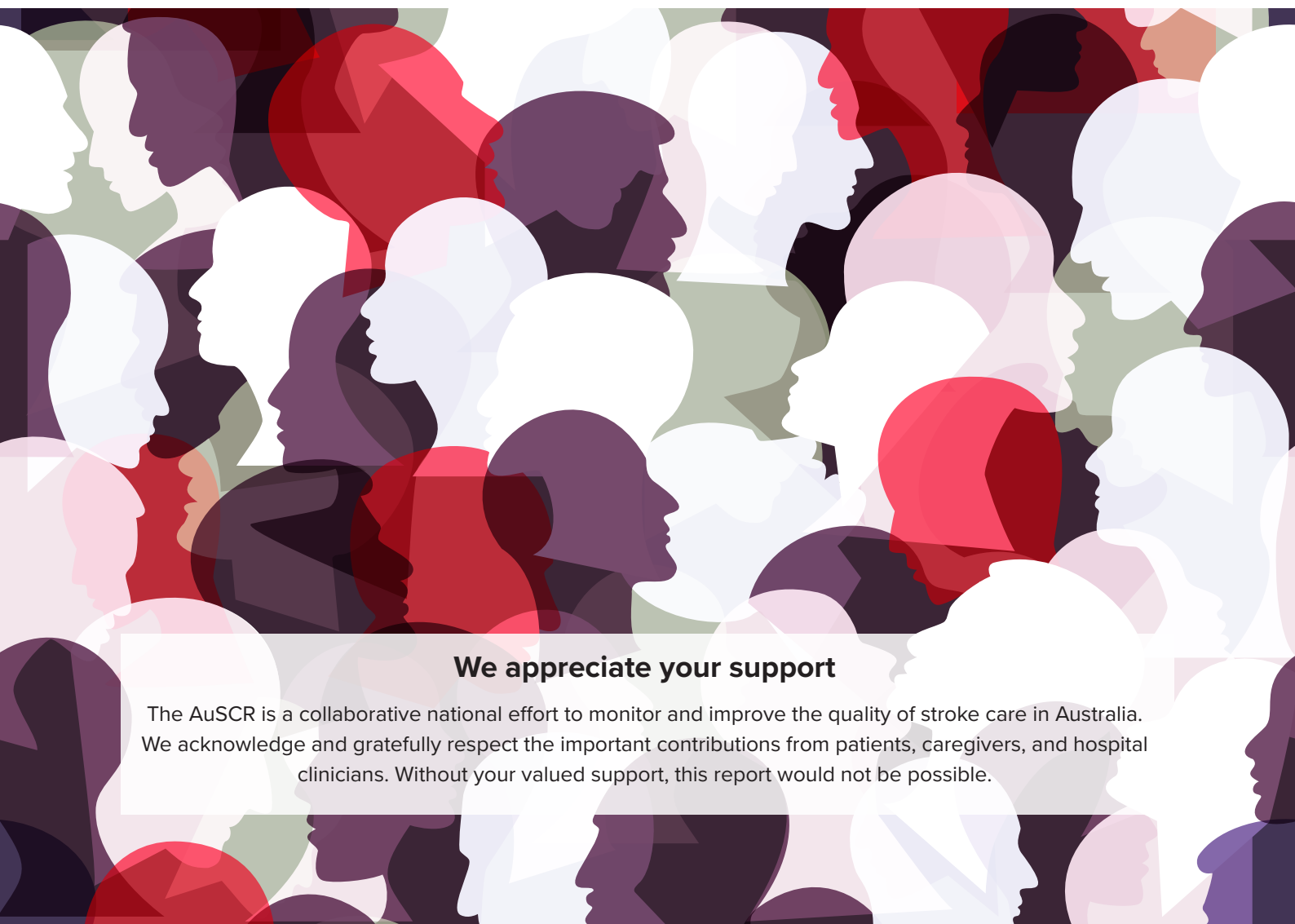
We appreciate your support

The AuSCR is a collaborative national effort to monitor and improve the quality of stroke care in Australia. We acknowledge and gratefully respect the important contributions from patients, caregivers, and hospital clinicians. Without your valued support, this report would not be possible.

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EXECUTIVE SUMMARY

HIGHLIGHTS OF 2022

- Sixty-one hospitals contributed data to the AuSCR in 2022: 48% from Victoria [VIC]; 34% from Queensland [QLD]; 5% each from South Australia [SA], Tasmania and Western Australia [WA]; and 3% from the Australian Capital Territory [ACT].

- Information is presented on 17,184 episodes of acute stroke for 15,880 patients.

- One in five patients were transferred from another hospital.

- Patient-reported outcomes between 90-180 days was completed for 61% of eligible patients, slightly less than in prior years.

HOSPITAL PERFORMANCE AGAINST STROKE CLINICAL CARE STANDARDS

- Overall provision of stroke unit care was 75% for episodes of stroke, with the achievable benchmark of 95% derived from the top performing hospitals. We also found that stroke unit care was associated with 44–63% improved survival for patients within six months. Concerningly, between 2019 and 2022, there has been a 5% absolute reduction in stroke unit care.

- Overall, 12% of patients with ischaemic stroke were provided intravenous thrombolysis compared to the achievable benchmark of 19%. This highlights concerning variation in practice between participating hospitals.

- Access to intravenous thrombolysis has stagnated since 2017, with approximately nine in ten patients with ischaemic stroke missing out on this treatment. Even when patients arrived to hospital within 4.5 hours of ischaemic stroke onset, fewer than one in four received thrombolysis.

- Of those provided with thrombolysis, less than one in three received treatment within the recommended time window (i.e., within 60 minutes of hospital arrival). A greater proportion of patients treated in a metropolitan (vs regional) hospital received thrombolysis within the recommended time window (40% vs 11%). Only six hospitals had a median door-to-needle time below 60 minutes.

- Overall, 1,374 patients at 13 hospitals received endovascular clot retrieval (ECR). The median time from hospital arrival to beginning the procedure (i.e. groin puncture) was 115 minutes for patients directly presenting to the treating hospital from the community.

- Several hospitals were found to be outside the limits set for normal variation in relation to the clinical care performance measures. Quality indicators 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.

- Although the achievable benchmark for the provision of a discharge care plan was 99% in 2022, wide variation (1–100%) was observed between hospitals. Compared to in 2021 where 75% of patients with stroke received a care plan at hospital discharge, 6% fewer received a care plan in 2022.

- In this report, changes in adherence to selected quality indicators between 2017 and 2022 were evaluated, for the 44 hospitals that participated throughout this period.

- Notably, the proportion of patients provided a swallow screen or assessment prior to oral intake significantly increased from 50% in 2017 to 68% in 2022. There were improvements in care for certain indicators (e.g. prescription of secondary prevention medications) in 2022 compared to 2020 and 2021.

QUALITY IMPROVEMENT INITIATIVES

- To support hospitals, we conducted two educational webinars and co-convened the 10th National Stroke Quality Improvement Workshop with over 150 participants across Australia.

- For the first time we present AuSCR data against the 30/60/90 National Targets that were established in August 2023 by the Australian Stroke Coalition. These targets are intended to be met by 2030. Only 14 hospitals met at least one of these targets in 2022.

HOSPITAL AND POST-DISCHARGE OUTCOMES

- Overall, 1,492 (9%) of the patients registered in the AuSCR died in hospital, similar to prior years, and 20% died within 180 days of admission.

- After discharge from acute care, 25% of patients went to rehabilitation (21% in 2021) and 46% returned to their usual residence, with or without some form of support (53% in 2020).

- Patient-reported outcome information at 90-180 days was collected for 6,904 unique stroke events. Of those completing the modified Rankin Scale (mRS), 22% reported being free of disability symptoms (i.e. mRS= 0).

- 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 31%, completion of usual activities 59%, pain/discomfort 49%, and anxiety or depression 49%. The mean Visual Analogue Scale score, representing a measure of overall wellbeing, was 67 [range: 0 – 100].

- Half of all respondents requested an information pack about stroke and support services from the Stroke Foundation, highlighting potential unmet information needs.

RESEARCH ENGAGEMENT

- In 2022, 4,204 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 26 research studies where the AuSCR office sent an invitation to eligible registrants (n=15,722) to participate in a project on behalf of investigators with approved projects.

2022 Australian Stroke Clinical Registry Office Team
L-R: Emma Campbell, A/Prof Monique Kilkenny, Dr Lachlan Dalli, Shayla Gamble, Karen Barclay Moss, Prof Dominique Cadilhac, Kate Paice, Dr Adele Gibbs, Julie Morrison, Shaun Hancock, Elizabeth Gregory, Helen Carter.

Absent for photograph: Violet Marion, Jot Ghuliani, Nancy Pompeani, Abigail Dewiso.

GOVERNANCE REPORT

Welcome to the 15th Annual Report of the Australian Stroke Clinical Registry (AuSCR). This year we report data on over 17,000 episodes of acute stroke from 61 hospitals. To better align with the Acute Stroke Clinical Care Standard,[1] we report data on stroke only.

This report highlights the ongoing variation in stroke care in Australia. Many patients are missing out on the best available, evidence-based care. For example, one in four patients are not treated in a dedicated stroke unit, which is known to improve care in hospital, and outcomes after discharge, and two in three patients are treated with thrombolysis outside the recommended 60 minutes from arrival. We welcome the recent announcement of National Stroke Targets be achieved by 2030. The AuSCR looks forward to working with organisations, such as the Stroke Foundation, Australian and New Zealand Stroke Organisation, the Australian Stroke Coalition and state health departments, to support hospitals to achieve these targets.

The AuSCR is governed by a Steering Committee chaired by Professor Sandy Middleton, and a Management Committee, chaired by Professor Helen Dewey (Appendix A). Professor Dewey took on this role in August 2022 from Professor Natasha Lannin. We sincerely thank Professor Lannin for her contributions in this role since 2016.

The day-to-day registry operations are managed centrally by staff at The Florey, with support from consortium partners the Stroke Foundation, the Australian and New Zealand Stroke Organisation and, joining in 2023, Monash University. The Data Custodian is Professor Dominique Cadilhac (The Florey and Monash University). Subcommittees include the, Reperfusion and Telemedicine Subcommittee, Paediatric Subcommittee and Research Task Group. These committees provide clinical insights, guidance on the collection and reporting of data and secondary use of data for research.

L-R: **Prof Dominique Cadilhac,** *Florey Data Custodian,* **Prof Helen Dewey,** *Chair, Management Committee,* **Prof Sandy Middleton,** *Chair, Steering Committee*

Members of these committees volunteer their time to ensure the rigorous operation and ongoing development of the Registry (Appendix B). We thank them for their valuable contributions.

The AuSCR receives funding primarily from state and territory governments to support the contribution of hospitals in their jurisdiction (Appendix C). We are also grateful to the experienced statistical team from Monash University for their expert analysis of the de-identified AuSCR data.

We were very grateful that Professor Bo Norrving, founder of the world's first stroke registry, Riksstroke in Sweden, agreed to conduct an external review of the AuSCR in 2022. We thank him for his generosity with his time and his insights into how the registry can expand and develop to better support improvement in the quality of Australian stroke care. We look forward to implementing his recommendations.

The AuSCR continued its partnership with the Australian Stroke Coalition and World Stroke Organisation in supporting hospitals to be considered for national and international awards. In October 2022, the AuSCR co-convened the 10th National Stroke Quality Improvement workshop with Monash University and the Stroke Foundation as a hybrid event attended by >150 people.

Lastly, we acknowledge the enormous efforts of staff in hospitals contributing data to the AuSCR (Appendix D), and most importantly advocating for changes to improve the quality of stroke care. We thank the patients, their caregivers and family members, for their input and time and hope this report provides insights to support further improvement in the quality of stroke care in Australia.

Prof Dominique Cadilhac, Florey Data Custodian
Prof Helen Dewey, Chair, Management Committee
Prof Sandy Middleton, Chair, Steering Committee

NATIONAL SNAPSHOT

61
hospitals

6
states and territories

17,184
episodes of stroke

3 in 4
strokes
were ischaemic

ADHERENCE TO THE ACUTE STROKE CLINICAL CARE STANDARD

1 in 4
were **not** treated in a
stroke unit

69%
received a care plan
on discharge

12%
of patients received
clot-busting therapy
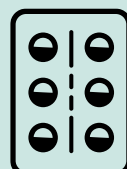
77%
discharged with
blood- pressure
lowering medications

1 in 3
received clot-busting
therapy within
target time

90%
discharged with lipid-
lowering medications

1 in 10
received clot
retrieval surgery
*Median time from arrival to
surgery:* **115 mins**

94%
discharged with
blood- thinning
medications

LONGER-TERM PATIENT OUTCOMES (3-6 MONTHS)

1 in 5
reported being
readmitted to hospital

1 in 3
reported moderate
to severe disability
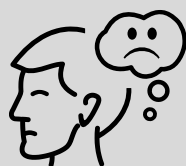
1 in 2
reported problems
with mood, mobility,
pain, or usual activities

1 in 5
were deceased

NATIONAL STROKE TARGETS

In August 2023, a new national taskforce was formed to improve stroke care in Australia. Subsequently acute targets for stroke care were endorsed by national leaders to improve access to life-saving stroke care in Australia by 2030.

The AuSCR is proud to endorse these National Stroke Targets along with other peak bodies, including the Stroke Foundation, Australian and New Zealand Stroke Organisation (formerly Stroke Society of Australasia) and the Angels Initiative.

In this Annual Report, for the first time we report performance against these National Stroke Targets in 2022. In future Annual Reports, comparisons against these baseline values will be undertaken to track progress in meeting these targets.

Quality indicator	National Stroke Target	2022 National Performance	No. of Hospitals Achieving Target‡
Endovascular clot retrieval door-to-puncture time for transfers*	**<30 mins**	**40** mins	**1**
Thrombolysis door-to-needle time*†	**<60 mins**	**74** mins	**5**
Endovascular clot retrieval door-in-door-out time* *(optional ED dataset)*	**<60 mins** (Metropolitan and inner regional hospitals)	**120** mins	**1**
	<75 mins (Outer regional road retrievals)	**234** mins	**0**
Endovascular clot retrieval door-to-puncture time for primary presenters*	**<90 mins**	**115** mins	**1**
Patients with a primary stroke diagnosis receiving certified stroke unit care	**>90%**	**75%**	**11**

Includes adult episodes only.
*Includes only ischaemic stroke
† Excludes transfers and in-hospital strokes.
‡ Of the eligible hospitals providing this indicator. Excludes hospitals with <10 eligible episodes.

INTRODUCTION

The Australian Stroke Clinical Registry (AuSCR) is a collaborative national effort to monitor and improve the quality of acute stroke care. Since 2009, the AuSCR has provided national data on consecutive patients admitted to hospital with acute stroke, which has been used to inform improvements to the health care system.[2]

The AuSCR adheres to the national guidelines for best-practice in clinical quality registries[3]. To describe the quality of acute stroke care, data are collected on the provision of evidence-based therapies in hospital, supplemented with clinical and demographic patient information.

Staff from participating hospitals enter these data manually via the web tool or by using a data import process, or 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. Tailored hospital performance reports are also provided and these detailed reports show comparisons for the quality indicators to the national average and achievable benchmarks from the best performing hospitals. For the first time, these reports in 2022 included a Stroke Performance Scorecard, where a traffic light system was used to highlight areas of excellence or requiring further improvement.

To support hospitals in the use of their data for quality improvement we provided two webinars. The first was on the importance of Stroke Unit care and the second was an overview of the results from the 2021 Annual Report to guide planning for improvement strategies. We also conducted two surveys. The first was to obtain feedback on the current data collection system and the desired new features or improvements users would like in a new system. The second was a Contributor Survey on how the data are used by hospitals to help identify training needs and the areas needed to support hospitals in use of the AuSCR data for quality improvement. Over three quarters of respondents stated that involvement with the AuSCR had led to improvements in their stroke service. The majority had focussed on swallow screening and discharge care planning. Overall, 39% reporting using the AuSCR data in a business case, mainly for requesting more staff for their stroke service.

As the registry has matured, the cumulative data permits analyses that can inform Australian policy and planning in relation to various epidemiological or health system issues, including examination of particular patient sub-groups. We convened the 10th National Stroke Quality Improvement Workshop with the Stroke Foundation and Monash University to provide updates on stroke care to a wide audience.

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*"**Fabulous opportunity for annual seminar linking Australia stroke networks – virtual/in-person mix really useful for everyone to be able to participate."***

Participant feedback from the 10th National Stroke Quality Improvement Workshop

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In this report, we present the data for 2022 and the health outcomes collected for these patients until end June 2023. The data in the main report is aligned with the [Acute Stroke Clinical Care Standard.](#) For patients with transient ischaemic attack (TIA), the data are reported in Appendix E.

METHODS

DATA COLLECTION

As recommended for national registries, an 'opt-out' model for patient inclusion is used,[4] in addition to a waiver of consent for people who die while in hospital. Data are collected in the Australian Stoke Data Tool (AuSDaT), which is a harmonised online database platform enabling standardised and systematic data collection for multiple stroke data collection programs.[5] 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.

The AuSCR facilitates the collection of information for patients with stroke across the acute treatment pathway.[2] Each hospital collects a pre-specified set of variables depending on the type of services they provide, referred to as programs (e.g. paediatrics, ECR; Appendix F). There are also two optional programs available to hospitals in addition to their main program. The optional ED program enables data to be captured for patients treated in the ED prior to transfer to another hospital. The optional Fever Sugar Swallow (FeSS) program enables the collection of data on the monitoring and management of blood glucose (Appendix G).

SUPPORTING DATA QUALITY

The AuSCR performs several quality control processes to ensure complete and accurate data, including:

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).[6]
- 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 records for a single episode or patient.

Data management activities

- Monthly database maintenance undertaken by Data Managers to check 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 2022 due to 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) with the episode data entered in the AuSCR.

The **AuSCR Annual Data Quality Report** is a summary of data quality for the final 2022 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/

PATIENT FOLLOW-UP SURVEY

Patient-reported outcomes data are obtained via a survey (including age-appropriate paediatric questions) at 90–180 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.

Follow-up 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.

For patients unable to be contacted, survival status was determined via annual data linkage with the National Death Index (NDI), made available by the Australian Institute of Health and Welfare.

PATIENT-REPORTED OUTCOME MEASURES

Functional disability is measured using the modified Rankin Scale (mRS) – a standardised instrument for reporting disability after stroke which approximates post-stroke activity limitations.[7] 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 is measured using the European Quality of Life measure of health status (EQ5D™),[8] 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 responses ranging from zero (i.e. worst imaginable health state) to 100 (i.e. best imaginable health state).

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 2022. Data entry for these acute stroke episodes, and the associated follow-up questionnaires was closed off, and data extracted, on 6 October 2023. Data cleaning and analyses were undertaken by authorised Monash University statisticians.

Hospital postcodes were mapped to the Australian Statistical Geography Standard (ASGS) Remoteness Standard (2021) available from the Australian Bureau of Statistics.[9] The ASGS divides Australia into five classes of remoteness according to relative access to services, spanning from Major Cities (ASGS 1) to Very Remote Australia (ASGS 5).

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 multiple hospitals for the same stroke event, 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 quality indicators across the care continuum. This allowed us to determine the provision of different types of reperfusion therapies along the care continuum for the same person-event.

For all analyses presented in this report, ***episodes with missing information are included in the denominator***. If the data were not provided, it was assumed that the quality indicator was not offered.

For analyses of secondary prevention medications provided at discharge, patients with contraindications were excluded from the denominator. For other time-based performance measures (e.g. door-to-puncture), erroneous times (e.g. negative or beyond 12 hours) were excluded. See Appendix H 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 >30% of data for that variable were missing. Hospitals contributing <50 episodes of care were excluded from the funnel plots of quality 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[10] which has been used and validated for stroke.[11] 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 quality 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 2022. These analyses were restricted to the 44 hospitals that consistently participated in the registry and provided data on at least 30 episodes each year.

Mean VAS scores were compared with published estimates for the normative population.[12] 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.

Survival after hospital is ascertained for registrants using linkage with 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 2021 and 2022 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.[13] 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).[14] All analyses were performed using Stata/SE 17.0 (College Station, USA, 2022).

OVERVIEW OF HOSPITALS

HOSPITAL CHARACTERISTICS

In 2022, 61 hospitals participated in the AuSCR (Table 1), including two children's hospitals. There were 26 hospitals that contributed to the optional ED dataset to capture acute care quality indicators prior to transfer to another hospital for ongoing management (e.g. ECR). Overall, 57 participating hospitals reported having provided stroke unit care, 56 provided thrombolytic therapy, and 13 provided ECR.

The median number of episodes per hospital was 262 (Q1 to Q3: 149 to 411). The minimum number of episodes registered was at a metropolitan hospital in VIC (n=7) which paused data collection in 2022. The maximum number registered was at a metropolitan hospital in VIC (n=1,415).

Table 1: Characteristics of participating hospitals

	Total	Location					
		ACT	QLD	SA	TAS	VIC	WA
Number of hospitals	61	2	21	3	3	29	3
Number of episodes*							
<75 episodes	6	0	2	0	0	4	0
75-349 episodes	35	1	14	1	2	16	1
350-499 episodes	8	0	2	1	1	3	1
≥500 episodes	12	1	3	1	0	6	1
Location#							
Major city	35	2	14	3	0	13	3
Inner Regional	19	0	5	0	2	12	0
Outer Regional	7	0	2	0	1	4	0
Stroke unit	57	2	21	3	2	26	3
Used an acute stroke telemedicine service	51	2	18	1	2	25	3
Thrombolytic therapy provided	56	2	19	3	3	26	3
Endovascular therapy provided	13	1	4	1	1	5	1
Contributed to the ED program	26	0	6	2	0	18	0
Contributed to the FeSS program	20	0	5	0	2	10	3

ACT: Australian Capital Territory; ECR: endovascular clot retrieval, ED: emergency department; FeSS: Fever, sugar, swallow optional variables; QLD: Queensland; SA: South Australia; TAS: Tasmania;
VIC: Victoria; WA: Western Australia.
* Categories as per definitions used by the Stroke Foundation National Stroke Audit reports.
# Location categorised using Australian Statistical Geography Standard Remoteness Standard 2021.[9]

COMPARISON WITH NON-PARTICIPATING HOSPITALS

Information from the 2023 Stroke Foundation Organisational Survey allows us to compare the data collected in the AuSCR to hospitals not contributing to the AuSCR. 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 ≥40 people with stroke each year within Australia. 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 2023, there were 103 public services, and four private services, that completed the Organisational Survey.[15] As shown below in Table 2, the AuSCR included ≥75% of hospitals in the following jurisdictions: Australian Capital Territory, Queensland, Tasmania and Victoria.

Table 2: Participation in the AuSCR vs the Stroke Foundation Audit, by jurisdiction

| | Participated in the AuSCR | |
| | Yes
N=61 hospitals | No
N=54 hospitals |
	n (%*)	n (%*)
Hospital state/territory		
Australian Capital Territory	2 (100)	0 (0)
New South Wales	0 (0)	35 (100)
Northern Territory	0 (0)	2 (100)
Queensland	21 (84)	4 (16)
South Australia	3 (60)	2 (40)
Tasmania	3 (75)	1 (25)
Victoria	29 (91)	3 (9)
Western Australia	3 (30)	7 (70)

Row percentage.

When compared with the characteristics of non-AuSCR hospitals from the Stroke Foundation Organisational Survey (Table 3), the hospitals that participated in the AuSCR in 2022 tended to have more beds, annual stroke admissions, and were more likely to offer thrombolysis and have a dedicated stroke coordinator. All other characteristics were generally similar between AuSCR and non-AuSCR hospitals.

Table 3: Characteristics of participating hospitals in active AuSCR jurisdictions

	Participated in the AuSCR		
	Yes	No	
	N=53 hospitals*	N=17 hospitals†	
	n (%)	n (%)	P value
Number of beds, median (Q1-Q3)	367 (212–548)	100 (42–250)	<0.001
Number of patients admitted with stroke in the last year, median (Q1-Q3)	294 (161–473)	82 (42–164)	<0.001
Presence of a stroke unit	50 (94)	5 (29)	<0.001
Number of stroke unit beds, median (Q1-Q3)	7 (4–12)	6 (4–16)	0.88
Offers thrombolysis to eligible patients	52 (98)	13 (76)	0.003
Dedicated stroke coordinator position	42 (79)	8 (47)	0.011
Clinical pathway for managing stroke	46 (87)	15 (88)	0.88

Q1: 25th percentile; Q3: 75th percentile.
* Includes hospitals that participated in the AuSCR and the 2023 Stroke Foundation Organisational Survey.
† Excludes hospitals from jurisdictions (NSW and NT) that did not participate in the AuSCR in 2022.

OVERVIEW OF PATIENTS

In 2022, 61 hospitals provided data for 19,694 episodes care. Of these episodes, clinicians indicated that there were 14,233 ischaemic strokes, 2,447 intracerebral haemorrhages (ICH) and 2,510 TIAs (Figure 1). There were 411 episodes of undetermined stroke type, representing 2% of all episodes (similar proportion since 2018, p=0.35). Only 93 episodes (0.5%) had a missing stroke type.

FIGURE 1: DISTRIBUTION OF STROKE DIAGNOSES

■ Ischaemic □ TIA ■ ICH □ Undetermined ■ Missing

Including TIA: 72% | 13% | 12% | 2%
Excluding TIA: 83% | 14% | 2%

Proportion of episodes (%)
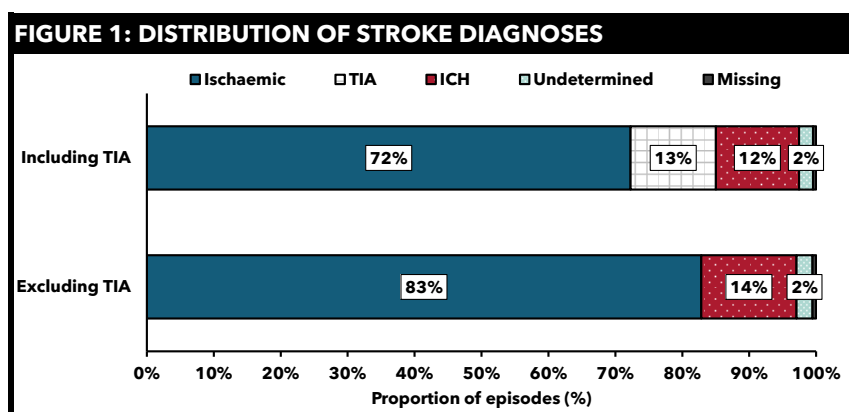
ICH: intracerebral haemorrhage; TIA: transient ischaemic attack

This report is focussed on 17,184 episodes of stroke care (see Appendix E for data on the 2,510 episodes of TIA recorded in 2022). During a calendar year, patients may have multiple admissions for stroke that are eligible for inclusion in the AuSCR. In 2022, there were 17,184 episodes of acute stroke care entered in the AuSCR for the 15,880 patients. A total of 17,122 adult episodes of stroke care were captured in the AuSCR in 2022.

Table 4: Number of episodes and patients in 2022

	All stroke episodes	Adult stroke episodes
Number of episodes (N= 61 hospitals)	17,184	17,122
Emergency Department dataset (n= 26 hospitals)	370	363
Hospital admissions	16,814	16,759
Number of individual patients	15,880	15,820
Number of unique acute stroke events	16,343	16,282

PATIENT DEMOGRAPHICS

Table 5 provides the baseline characteristics of patients, and information related to their episodes of care. Adult and paediatric episodes are presented separately. In addition to the two paediatric hospitals, 14 hospitals entering adult data also contributed paediatric episodes (patients aged <18 years) in 2022.

In total, 43% of all adult patients were female. The mean age of adult patients was 73 years (median: 75 years). There were 4,331 (28%) patients who were of working age (18 to 65 years), and 1,199 (8%) patients who were between 18 and 50 years of age.

Information on country of birth was available for 14,673 adult patients, with the majority (72%) born in Australia. The second most common place of birth was Europe (11% excluding the UK), followed by Asia (7%) and the UK (7%). The majority of the adult patients spoke English (92%). There were 345 adult patients (2%) who identified as having an Aboriginal or Torres Strait Islander background.

Table 5: Patient characteristics (adult and paediatric episodes)

Patients	Adults (n=15,820)	Paediatrics (n=60)
Episodes (N = 17,184)	**17,122**	**62**
Age in years, median (Q1 to Q3)	75 (65 to 83)	1 (0 to 9)
Female, n (%)	6,684 (43)	29 (50)
Place of birth, n (%)		
Australia	10,634 (72)	52 (93)
United Kingdom	1,046 (7)	0 (0)
Other European counties	1,640 (11)	<5 (<9)
North Africa/Middle East	128 (1)	0 (0)
Asia	1,013 (7)	<5 (<9)
Rest of Africa	201 (1)	0 (0)
Others	11 (<1)	0 (0)
Aboriginal and/or Torres Strait Islander, n (%)	345 (2)	<5 (<9)
English spoken, n (%)	12,548 (92)	47 (92)

Q1: 25th percentile; Q3: 75th percentile.

STROKE SEVERITY

In the AuSCR, two different measures of stroke severity are collected at the time of hospital arrival. The patients' ability to walk on admission was recorded in 16,204 episodes (95% of the 2022 cohort), of whom 36% 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 hospital arrival was recorded for 11,942 episodes (70% of the 2022 cohort vs 65% in 2021, $p<0.001$; Figure 2).

FIGURE 2: STROKE SEVERITY

NIHSS at baseline (N=11,942): No stroke symptoms (score 0) 9%; Minor stroke (score 1-4) 39%; Moderate stroke (score 5-15) 35%; Moderate to severe stroke (score 16-20) 8%; Severe stroke (score 21-42) 8%.
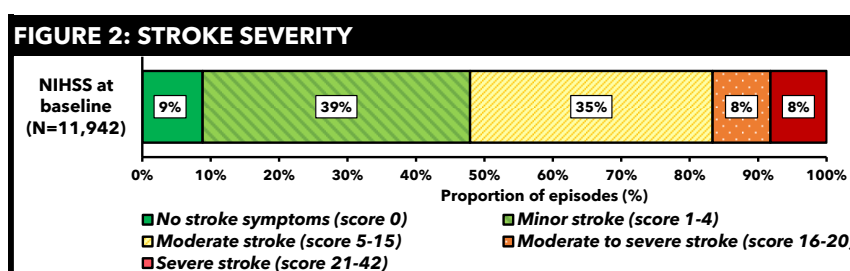
NIHSS: National Institutes of Health Stroke Scale

Patients with a diagnosis of ischaemic stroke had the lowest proportion of missing NIHSS scores (26%). Of the episodes receiving thrombolysis (N=1,430), a NIHSS score was missing for 4%. Patients treated in a stroke unit had a greater proportion of NIHSS scores recorded in contrast to those treated in alternate ward settings (75% vs 53%, $p<0.001$). Of those who were able to walk on admission, the majority (61%) had a NIHSS indicating a minor stroke.

INPATIENT STROKES

There were 602 episodes (4%) that occurred while patients were already in hospital for another condition. The proportion of inpatient strokes varied from 0% to 10% between hospitals. The majority of inpatient episodes were ischaemic (n=537, 89%) and the largest proportion of inpatient strokes (n=183, 31%) 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=13,447), valid dates and times of stroke onset and hospital arrival were available for 10,373 (77%). Of these, 5,717 (55%) arrived at hospital within 4.5 hours of symptom onset. A smaller proportion of patients with ischaemic stroke (54%) arrived at hospital within 4.5 hours of symptom onset compared to episodes of ICH or undetermined stroke type (both 63%; $p<0.001$).

MY STROKE EXPERIENCE

Stephanie was only 22 years old when she had her stroke.

She was healthy and loving life having had recently finished university and started a great new job.

She woke up one morning to find she couldn't make sense of a text message on her phone. She found the words she was saying **didn't make sense** and then **her right side collapsed**.

Her brother googled her symptoms and **suspected she was having a stroke** and rushed her to hospital.

> *"...the most ironic thing is that there are no pain receptors in the brain. There was no alarm for me to know what was happening."*

Stephanie experienced an intracerebral haemorrhage from an arteriovenous malformation.

After **transfer** to a specialist hospital, **a week** in intensive care, neurosurgery, **four weeks** in a neurosurgical ward, **transfer** to a private hospital for **two months** of inpatient rehabilitation, Stephanie was well enough to return home.

More than ten years later, her recovery journey is still ongoing. She has had to **learn how to talk, read, and walk again,** and has **ongoing impairment with her right arm**.

Stephanie **returned to work** two years after her stroke, which had been a **big goal** of hers.

Stephanie would like to **change the rhetoric** in the community that stroke only occurs in older people. **More than one in four people recorded in the registry are of working age.**

> *"I want to eradicate the idea that it's only older people who have strokes. It can happen to anyone, at any age."*

Stephanie Ho

Lived Experience Representative

AuSCR
Australian Stroke Clinical Registry

ACUTE CARE DATA

ARRIVAL BY AMBULANCE

Method of arrival to the ED was collected for 16,341 episodes. Of these, 12,762 (78%) were transported by ambulance. Of the 5,717 episodes who arrived to hospital from the community within 4.5 hours of symptom onset, 89% were transported by ambulance. The proportion of patients who arrived by ambulance was greatest for those experiencing ICH (84%).

PATIENT TRANSFERS

There were 3,182 episodes (19%) where patients were transferred from another hospital. Of these, 758 (24%) were transferred from another hospital participating in the AuSCR and both episodes were recorded in the AuSCR. The majority (77%) of patients who were transferred from another hospital arrived by ambulance. Of the transferred episodes, 2,385 (75%) had information recorded on the reason for transfer to another hospital. Transfer for thrombolysis was indicated for 2% (VIC: n=13; QLD: n=11; SA: n=13; WA: n=2; ACT: n=1; TAS: n=1) and transfer for ECR was indicated for 43% (VIC: n=563; QLD: n=251; SA: n=115; TAS: n=36; ACT: n=30; and WA: n=20) of episodes.

DOOR-IN-DOOR-OUT TIMES

A total of 363 adult episodes from 26 hospitals were captured in the optional ED program. Of these episodes initially presenting to the ED, 251 were transferred to another hospital for ECR. The median door-in-door-out time for these episodes was 124 (Q1 to Q3: 80.5 to 184.5) minutes.

TELEMEDICINE IN ACUTE STROKE CARE

Telemedicine consultations were recorded as being provided for 25 regional hospitals (16 VIC; 7 QLD; 2 TAS) for a total of 1,695 episodes (62% of regional episodes in VIC, 46% in TAS, and 27% in QLD).

There were 1,372 episodes of ischaemic stroke involving a telemedicine consultation at regional hospitals (Figure 3). Provision of thrombolysis was more common in patients with telemedicine (16% vs without 3%; p<0.001).

The median door-to-needle time for these patients was 101 (Q1 to Q3: 74 to 135) minutes.

FIGURE 3: TELEMEDICINE USE AT REGIONAL HOSPITALS, BY CLINICAL DIAGNOSIS

- Ischaemic 49%
- ICH 47%
- Undetermined 37%
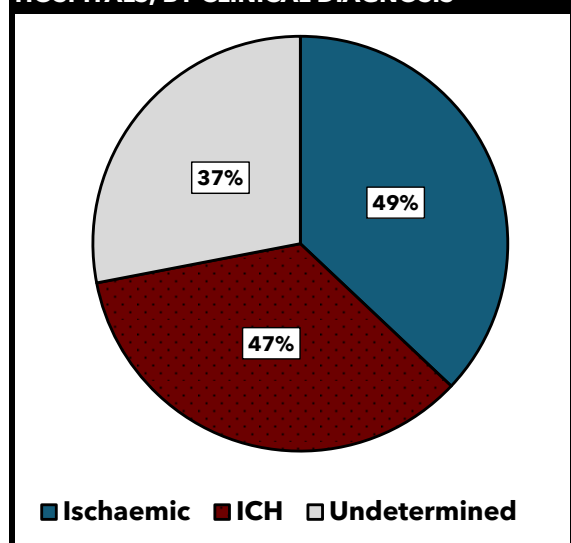
ICH: intracerebral haemorrhage.

ADHERENCE TO THE ACUTE STROKE CLINICAL CARE STANDARD

The [Acute Stroke Clinical Care Standard](#) supports the delivery of appropriate care and shared decision making between patients, carers and clinicians.[1] The standard includes quality statements describing the clinical care that patients should be offered and indicators that can be used by health services to monitor alignment with the standard.

Table 6 outlines quality indicators collected by the AuSCR in alignment with the Acute Stroke Clinical Care Standard.[1] In 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.[1]

Table 6: Adherence to the Acute Stroke Clinical Care Standard

| Indicator | Achievable Benchmark* | Adherence in the AuSCR in 2022 | | | | | | | | |
		All hospitals	Metropolitan hospitals	Regional hospitals‡	ACT	QLD	SA	TAS	VIC	WA
2a Proportion provided thrombolysis† (if an ischaemic stroke)	19%	12%	12%	11%	9%	9%	13%	13%	14%	5%
2b Proportion provided endovascular clot retrieval† (if an ischaemic stroke treated in a capable hospital)	23%	15%	16%	12%	7%	17%	23%	12%	14%	11%
2c Proportion with a door-to-needle time under 60 minutes† (if an ischaemic stroke provided thrombolysis)	63%	34%	40%	11%	40%	28%	48%	6%	36%	25%
2d Median door-to-groin puncture time for patients provided endovascular clot retrieval, in minutes†	90	115	111	170	155	133	100	179	110	56
3a Proportion managed in a stroke unit	95%	75%	80%	61%	79%	76%	82%	56%	74%	90%
5a Proportion provided antihypertensive medication at discharge§	94%	77%	77%	78%	72%	81%	66%	86%	78%	71%
5b Proportion provided lipid-lowering medication at discharge§#	97%	90%	89%	90%	86%	90%	75%	89%	93%	89%
5c Proportion provided antithrombotic medication at discharge§#	99%	94%	94%	95%	84%	95%	85%	97%	96%	98%
7a Proportion provided a care plan§	99%	69%	75%	53%	87%	58%	99%	35%	69%	88%

Modified ABC™ benchmark using data from sites with ≥50 episodes. Benchmark for door-to-groin puncture time based on international targets.
† Excludes episodes transferred from another hospital.
‡ Includes hospitals located in 'Inner Regional' or 'Outer Regional' areas according to the Australian Statistical Geography Standard Remoteness Standard 2021.[9]
§ Excludes ED episodes, episodes with documented contraindications, episodes remaining in a hospital setting and patients who left hospital against medical advice.
 # Excludes episodes of intracerebral haemorrhage.

BRAIN SCANS

In 2022, 99% of adult episodes were provided a brain scan. Fewer episodes of undetermined stroke received a brain scan (96%) compared to other stroke types (>99%; p<0.001). Of those who received a brain scan, there were 15,045 (94%) episodes where a date and time of the brain scan was recorded. Of these, 1,463 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 42 minutes, with five hospitals achieving a median time ≤25 minutes (Figure 4). Compared to metropolitan hospitals, median door to scan times were 5 minutes slower in regional hospitals (p=0.025). 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 4: MEDIAN DOOR-TO-SCAN TIME, BY HOSPITAL
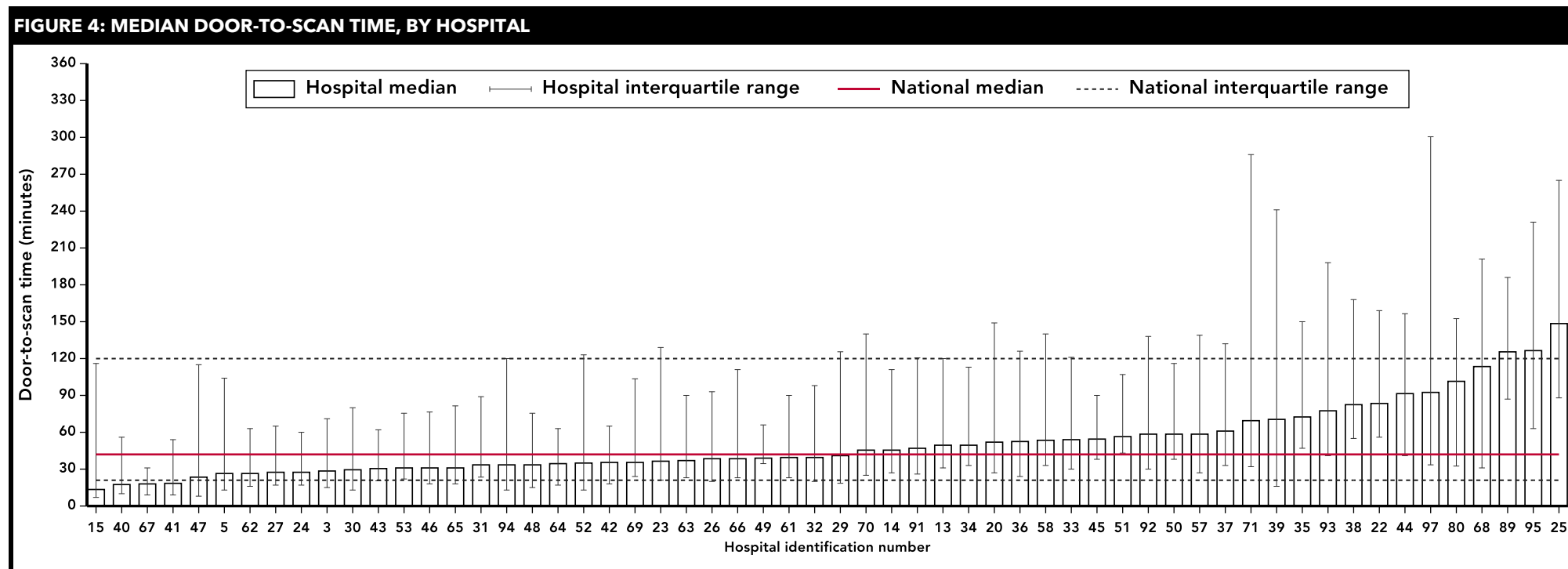
Excludes data from hospitals with >30% missing data, <5 episodes, or erroneous dates/times of brain scan (e.g. negative or after 12 hours of arrival).
Number of episodes with door-to-scan times by hospital range from 9 to 900.

OVERALL ADHERENCE TO QUALITY INDICATORS

REPERFUSION THERAPY

Of the 13,463 ischaemic events recorded, 2,389 (18%) received a type of reperfusion therapy (intravenous thrombolysis or ECR; Figure 5). 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 therapies.

FIGURE 5: REPERFUSION THERAPY IN ISCHAEMIC STROKE

■ No reperfusion ☐ IV-tPA ◨ ECR ■ IV-tPA + ECR

| 82% | 8% | 8% | 2% |

Proportion of episodes of ischaemic stroke
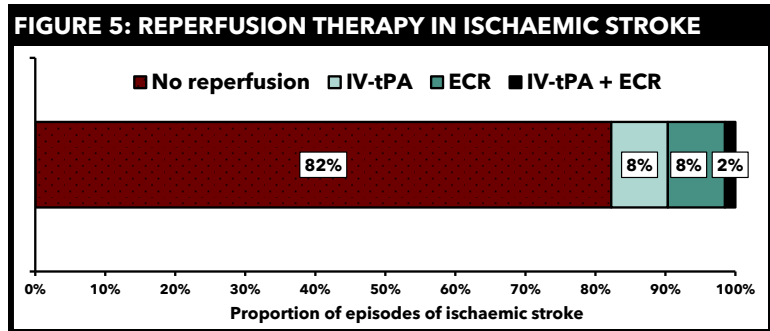
ECR: endovascular clot retrieval; IV-tPA: intravenous thrombolysis

THROMBOLYSIS TREATMENT DELIVERY

Of the episodes of ischaemic stroke presenting directly from the community to hospital (N=11,035), 1,296 (12%) received thrombolytic therapy (Figure 6). An additional 89 episodes received thrombolytic therapy for the first time after transfer from another hospital. Overall provision of therapy varied by state: VIC (14%), SA (13%), TAS (13%), ACT (9%); QLD (9%), WA (5%; p=0.001).

Provision of thrombolysis was similar between hospitals located in major cities (12%), inner regional areas (12%) or outer regional areas (9%; p=0.08). However, hospitals providing ECR had a greater provision of thrombolysis (13%) compared to hospitals that did not offer this intervention (11%; p=0.035). Of the 4,634 eligible patients with ischaemic stroke who arrived within 4.5 hours of symptom onset, 24% were provided with intravenous thrombolysis.
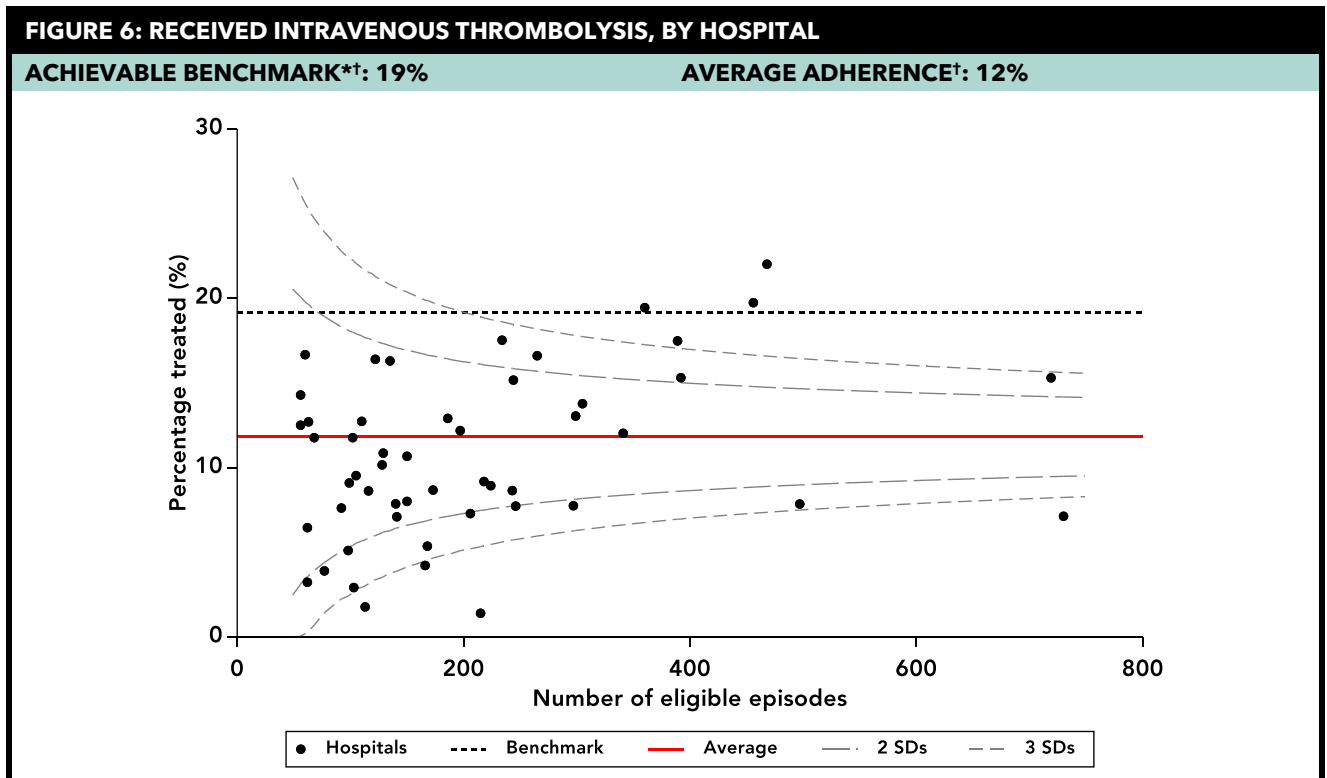
FIGURE 6: RECEIVED INTRAVENOUS THROMBOLYSIS, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 19%   **AVERAGE ADHERENCE†: 12%**

Percentage treated (%) vs Number of eligible episodes

● Hospitals   ---- Benchmark   — Average   — · 2 SDs   — — 3 SDs

Each dot represents the percentage adherence for an individual hospital.
* Modified ABC™ benchmark using data from sites with ≥50 episodes.
† Excludes in-hospital stroke and episodes transferred from another hospital.

TIMELINESS OF THROMBOLYSIS TREATMENT DELIVERY

Of the 1,296 episodes with valid dates and time of intravenous thrombolysis provision (i.e., not negative), 34% had a door-to-needle time less than 60 minutes. The median door-to-needle time was 74 minutes and median onset-to-needle time was 159 minutes.

At the individual hospital level, only six hospitals had a median door-to-needle time of 60 minutes or less in 2022 (Figure 7). Median door-to-needle were 26 minutes slower in regional vs metropolitan hospitals (95 minutes in regional hospitals *vs* 69 minutes in metropolitan hospitals). It is also noted that all hospitals with faster door-to-needle times tended to treat a greater volume of patients with intravenous thrombolysis.

FIGURE 7: DOOR-TO-NEEDLE TIMES, BY HOSPITAL
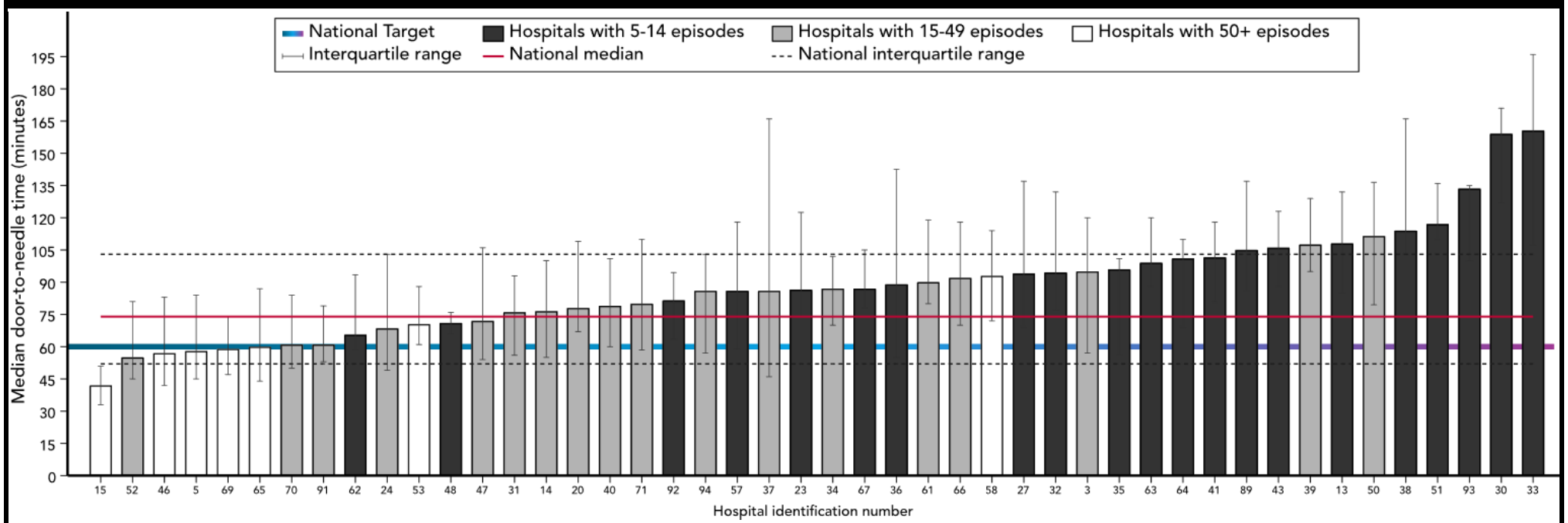
Excludes episodes where thrombolysis was provided prior to arrival or after 4.5 hours of arrival.
Number of episodes with door-to-needle times by hospital range from 5 to 101.
Excludes data from 7 hospitals with <5 episodes.

CASE STUDY 1

Improving the provision of discharge care plans

The problem

Redcliffe Hospital is a metropolitan hospital in Queensland with ≈200 acute stroke admissions per year. In early 2022, the new stroke nurse navigator reviewed the hospital's performance in past AuSCR Annual Reports and provisional data via live reports. They noticed that provision of care plans at discharge was low (55% in 2021). Many members of hospital staff were unaware of the role of the stroke nurse navigator, or the importance of discharge care planning, leading to many patients being discharged without a care plan.

The solution

To improve care planning, the role of the stroke nurse navigator and the importance of discharge care planning was promoted to hospital staff. In 2022, they delivered 35 education sessions within 7 hospital wards and clinical teams. Additionally, they ensured that any nurses backfilling the stroke nurse navigator position was informed of the importance of education and care planning.

The outcomes

More hospital staff began contacting the stroke nurse navigator for discharge input, and in 2022, 82% of patients with stroke at this hospital were discharged with a care plan.

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ENDOVASCULAR CLOT RETRIEVAL (ECR)

Overall, ECR was provided in 1,374 episodes in 2022 (10% of all ischaemic strokes included in the AuSCR). ECR was performed in 12 hospitals *(5 in VIC, 3 in QLD, and 1 each in ACT, SA, TAS and WA)*, which represented 15% of all ischaemic strokes presenting directly to these hospitals. The achievable benchmark for these ECR-capable hospitals, based on one top performing hospital, was 23%.

For episodes where times of both arrival and treatment were collected, the median time from arrival to groin puncture was 88 minutes (Q1 to Q3: 42 to 130 minutes) and the median time from arrival to recanalisation was 134 minutes (Q1 to Q3: 89 to 184 minutes).

The expanded treatment in cerebral infarction (eTICI) score is an indication of blood flow restored after thrombectomy and an indication of success. Figure 8 shows eTICI outcomes following ECR, where 2C or 3 is considered successful (i.e. >90% reperfusion).

FIGURE 8: REPERFUSION SCORES AFTER ECR
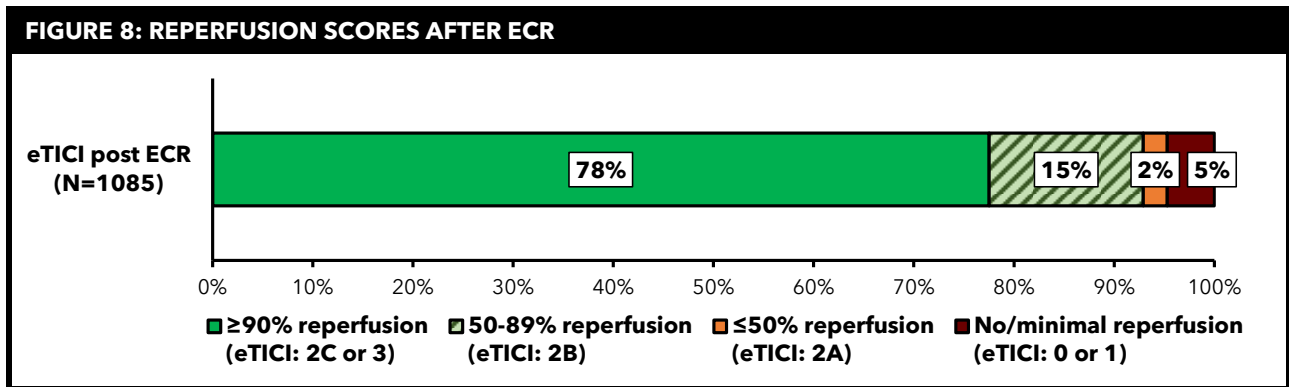
ECR: endovascular clot retrieval; eTICI: expanded treatment in cerebral infarction score.

In addition to the NIHSS score obtained at hospital arrival, hospitals participating in the AuSCR Black Program 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 9.

FIGURE 9: NIHSS SCORES BEFORE AND AFTER ECR
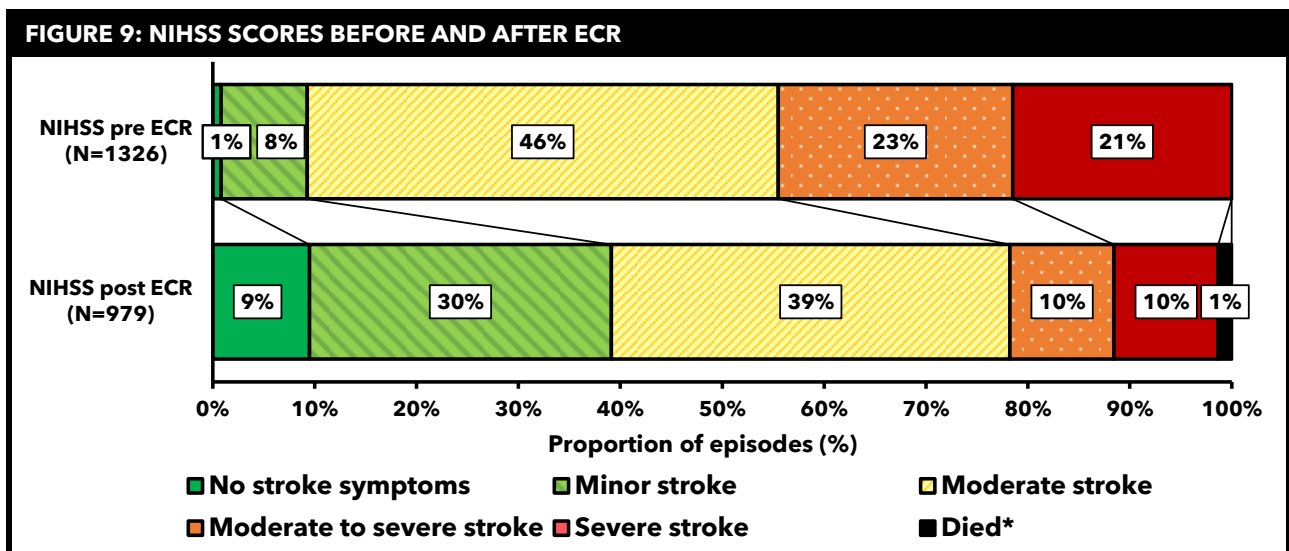
NIHSS 0: No stroke symptoms; NIHSS 1-4: Minor stroke; NIHSS 5-15: Moderate stroke;
NIHSS 16-20: Moderate to severe stroke; NIHSS 21-42: Severe stroke
*Died on the same day or day after endovascular clot retrieval and a post-procedure NIHSS score was missing.

TIMELINESS OF ECR

For episodes transferred from another hospital, the median time from arrival to groin puncture was 75 minutes faster when compared to direct admissions ($p<0.001$; Figure 10). The median time from arrival to recanalisation time was also significantly faster for transferred patients than for those admitted directly (Figure 11; $p<0.001$). Conversely, the median onset to groin puncture time was significantly longer for transferred patients at 348 minutes (Q1 to Q3: 255 to 485 minutes) compared to 255 minutes (Q1 to Q3: 175 to 316 minutes) for direct admissions ($p<0.001$).
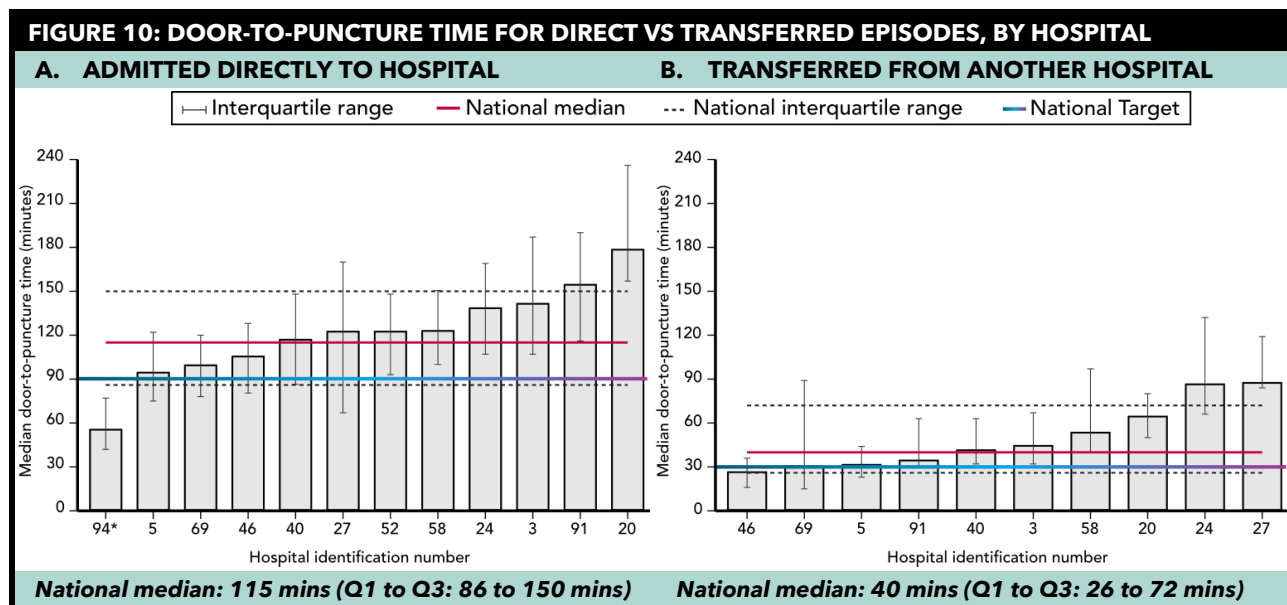
FIGURE 10: DOOR-TO-PUNCTURE TIME FOR DIRECT VS TRANSFERRED EPISODES, BY HOSPITAL

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

National median: 115 mins (Q1 to Q3: 86 to 150 mins)   *National median: 40 mins (Q1 to Q3: 26 to 72 mins)*

Includes data only from hospitals participating in the AuSCR Black data collection programs.
Excludes data from hospitals with <5 episodes and episodes with invalid door-to-puncture times (i.e. negative or >720 minutes). Sample sizes at each hospital range from 14 to 162 panel A; and from 14 to 139 in panel B.
*Hospital does not offer a 24/7 endovascular clot retrieval service.
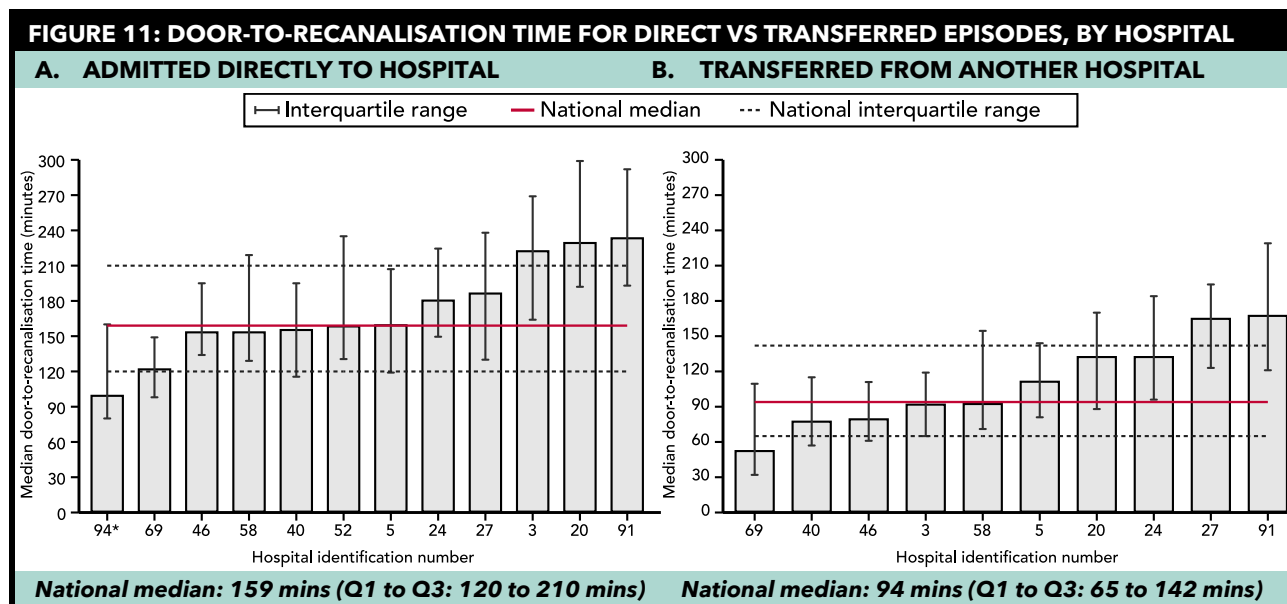
FIGURE 11: DOOR-TO-RECANALISATION TIME FOR DIRECT VS TRANSFERRED EPISODES, BY HOSPITAL

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

National median: 159 mins (Q1 to Q3: 120 to 210 mins)   *National median: 94 mins (Q1 to Q3: 65 to 142 mins)*

Includes data only from hospitals participating in the AuSCR Black data collection programs.
Excludes data from hospitals with <5 episodes and episodes with invalid door-to-recanalisation times (i.e. negative or >720 minutes). Sample sizes at each hospital range from 14 to 162 in panel A; and from 14 to 163 in panel B.
*Hospital does not offer a 24/7 endovascular clot retrieval service.

SPOTLIGHT ON STROKE UNIT CARE

Overall, 75% of episodes in 2022 were treated in a stroke unit. Patients who experienced a stroke while already in hospital for a different condition were less likely to receive stroke unit care than those who presented from the community (52% vs 77%; *p*<0.001). There were twelve hospitals that provided stroke unit care to patients in >90% of their episodes in 2022 (Figure 12).
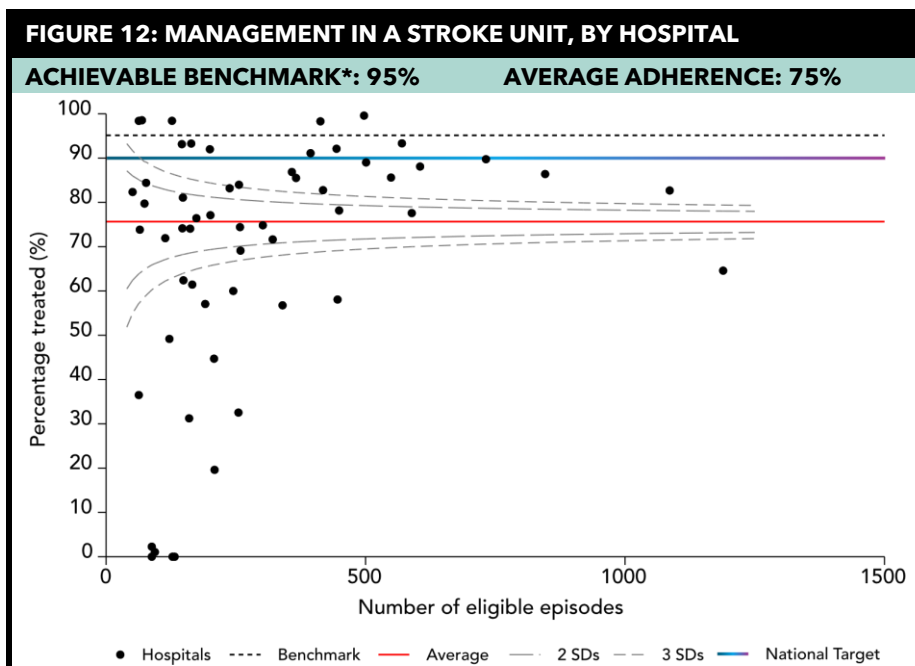
FIGURE 12: MANAGEMENT IN A STROKE UNIT, BY HOSPITAL

ACHIEVABLE BENCHMARK*: 95%   AVERAGE ADHERENCE: 75%

Each dot represents adherence for an individual hospital. Excludes ED episodes.
* Modified ABC™ benchmark using data from sites with ≥50 episodes.

After adjusting for patient factors, the likelihood of survival and being free from disability was significantly increased in hospitals that admitted more patients to their stroke unit than to alternative wards (Figure 13). Based on data from the AuSCR in 2022, every 15 people treated in a stroke unit has the potential to prevent one person dying or living with severe disability at 6 months.

FIGURE 13: ASSOCIATION BETWEEN STROKE UNIT CARE AND 180-DAY PATIENT OUTCOMES, BY HOSPITAL
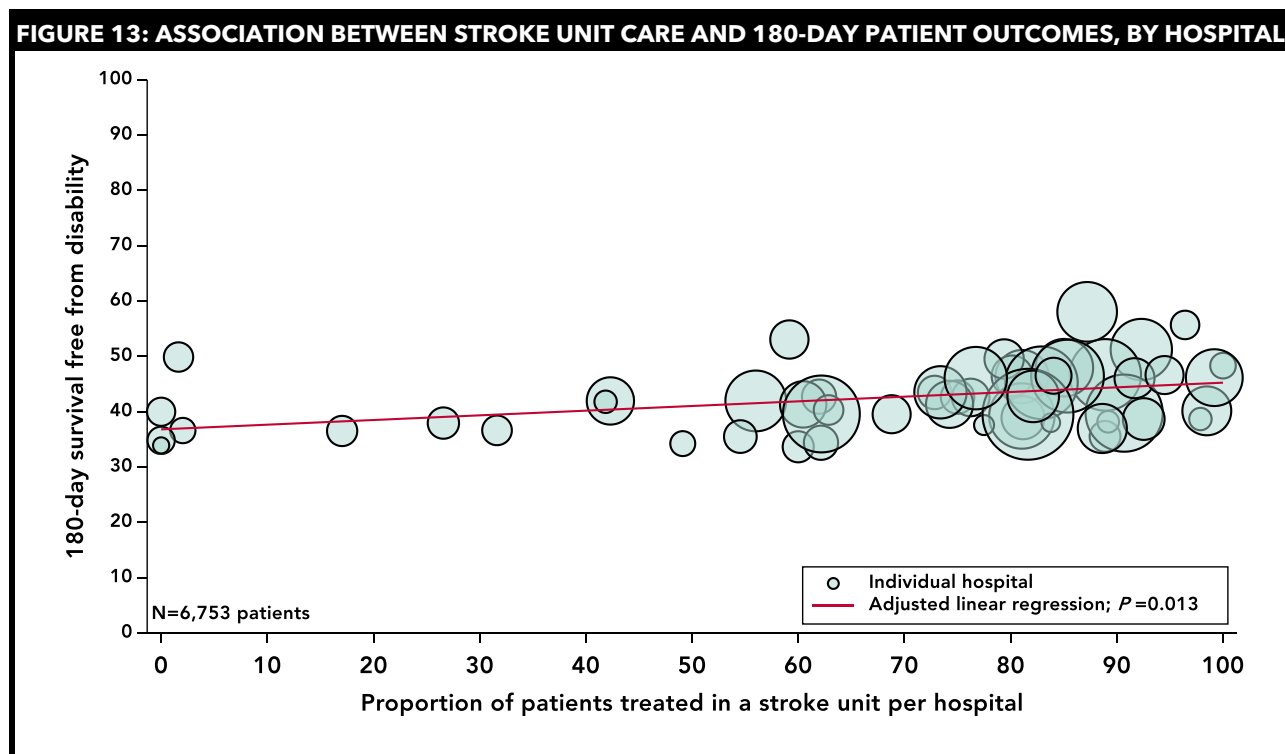
The size of bubbles represents the number of patients treated in a stroke unit at each hospital.
Disability was ascertained during AuSCR follow-up at 90-180 days and was defined as having a modified Rankin Scale score ≥3. Adjusted for age, sex, ability to walk on admission, and type of stroke.
Excludes hospitals with <30 episodes with completed follow-up data.

HYPERACUTE ANTIPLATELET THERAPY

After excluding episodes of intracerebral haemorrhage, episodes with documented contraindications, and those with delayed arrival to hospital (i.e., >48 hours post-onset), hyperacute antiplatelet therapy was provided within 48 hours of stroke onset in 82% of episodes (Figure 14).

SWALLOW SCREEN AND ASSESSMENT

A swallow screen was undertaken in two-thirds (62%) of all episodes, and a formal swallow assessment was conducted by a speech pathologist in 73% of episodes in 2022. A swallow screen or assessment was undertaken in 87% of episodes, of which 31% occurred within 4 hours (Figure 15), and 73% within 24 hours. A swallow screen or assessment occurred prior to oral intake in 66% of episodes (Figure 16).
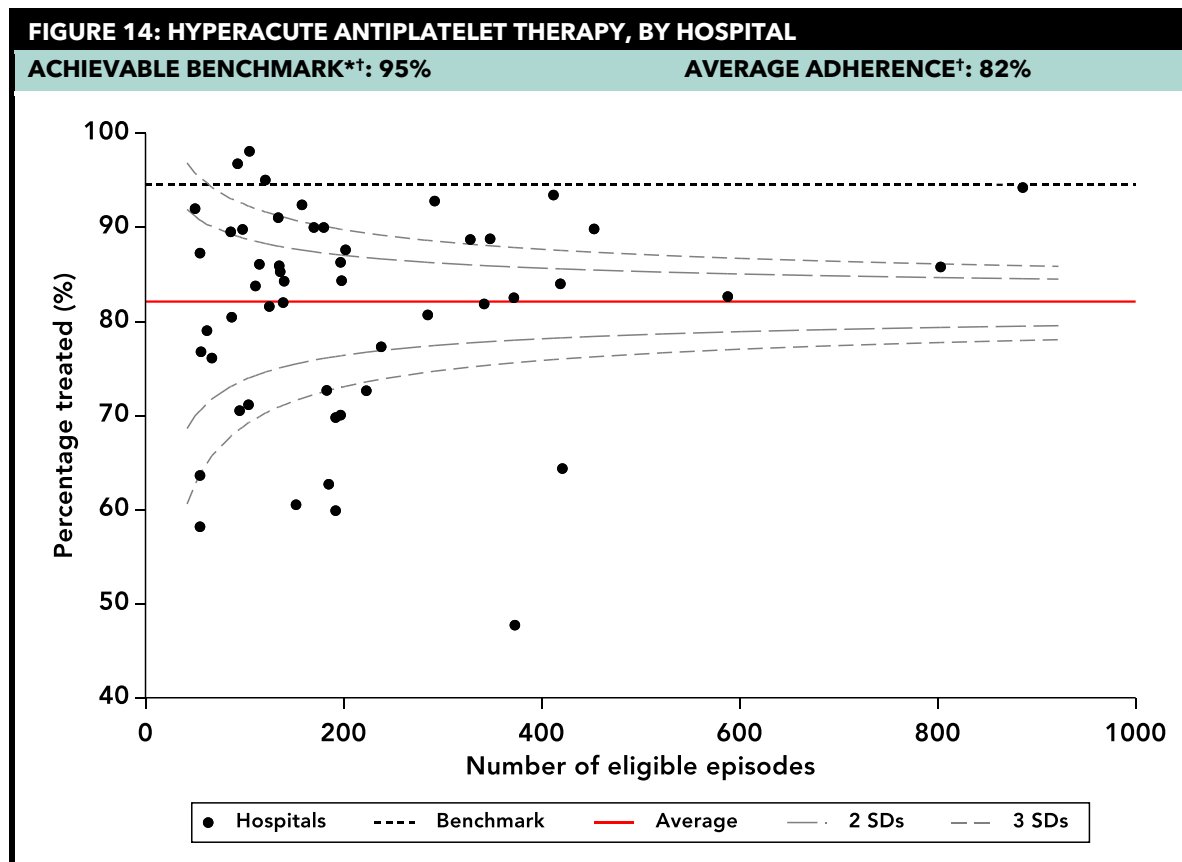
FIGURE 14: HYPERACUTE ANTIPLATELET THERAPY, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 95%   **AVERAGE ADHERENCE†: 82%**

Each dot represents adherence for an individual hospital. Excludes ED episodes.
* Modified ABC™ benchmark using data from sites with ≥50 episodes.
† Excludes episodes of intracerebral haemorrhage, episodes with contraindications, ED episodes, episodes arriving to hospital after 48 hours from stroke onset.

FIGURE 15: SWALLOW SCREEN OR ASSESSMENT WITHIN 4 HOURS OF ARRIVAL, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 56%   **AVERAGE ADHERENCE†: 31%**

Each dot represents adherence for an individual hospital. Excludes ED episodes.
* Modified ABC™ benchmark using data from sites with ≥50 episodes.
† Excludes episodes transferred from another hospital.

FIGURE 16: SCREEN OR ASSESSMENT PRIOR TO ORAL INTAKE, BY HOSPITAL

ACHIEVABLE BENCHMARK*: 91%   **AVERAGE ADHERENCE: 66%**

Each dot represents adherence for an individual hospital. Excludes ED episodes.
* Modified ABC™ benchmark using data from sites with ≥50 episodes.

MANAGEMENT OF FEVER AND BLOOD GLUCOSE

In 2022, 20 hospitals contributed optional Fever, Sugar and Swallow (FeSS) data for 3,554 episodes (median of 140 episodes per hospital; min–max: 1–494). The FeSS dataset includes the documentation of fever and hyperglycaemia in addition to swallow screen/assessment. Temperatures were recorded ≥4 times on the day of admission for 95% of episodes (Table 7). Of the 301 eligible episodes with a fever (temperature ≥37.5°C) recorded within 72 hours of admission, 37% were administered paracetamol.

The majority (72%) of the 3,554 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 749 episodes (21%) recorded blood glucose levels above 10mmol/L within 48 hours of admission. Of these, 21% 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=3,554
Temperature recorded ≥4 times on day one of ward admission	95%
Patient developed a fever of ≥37.5C in the first 72 hours following admission	10%
Where fever was present, paracetamol was administered within 1 hour of the first elevated temperature measurement*	37%
Finger prick blood glucose documented ≥4 times on day 1 of ward admission	72%
Patient developed blood glucose level above 10mmol/L within 48 hours of admission	21%
Where patient developed blood glucose level above 10mmol/L, insulin was administered within the first hour of elevated blood glucose measurement	21%

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

MOBILISATION

Among episodes with available data (N=15,858), 86% were mobilised during their admission, with most patients (65%) mobilised on the same day, or the day after, arrival to hospital (Figure 17).

FIGURE 17: MOBILISATION SAME DAY OR DAY AFTER, BY HOSPITAL
ACHIEVABLE BENCHMARK*: 80%   AVERAGE ADHERENCE: 65%

Each dot represents adherence for an individual hospital. Excludes ED episodes.
*Modified ABC™ benchmark using data from sites with ≥50 episodes.

DISCHARGE MEDICATIONS

Among the episodes of stroke discharged to the community setting (i.e., home, residential aged care, transitional care or other), 77% were prescribed an antihypertensive medication (Figure 18). Excluding episodes of ICH, antithrombotic medications were prescribed for 94% of all episodes discharged to the community (Figure 19), and lipid-lowering medications were prescribed for 90% (Figure 20).

Of the patients with ischaemic stroke, 71% were discharged on a combination of antihypertensive, antithrombotic and lipid-lowering medications. Men were more likely to receive all three medications than women (73% *vs* 67%; $p<0.001$).
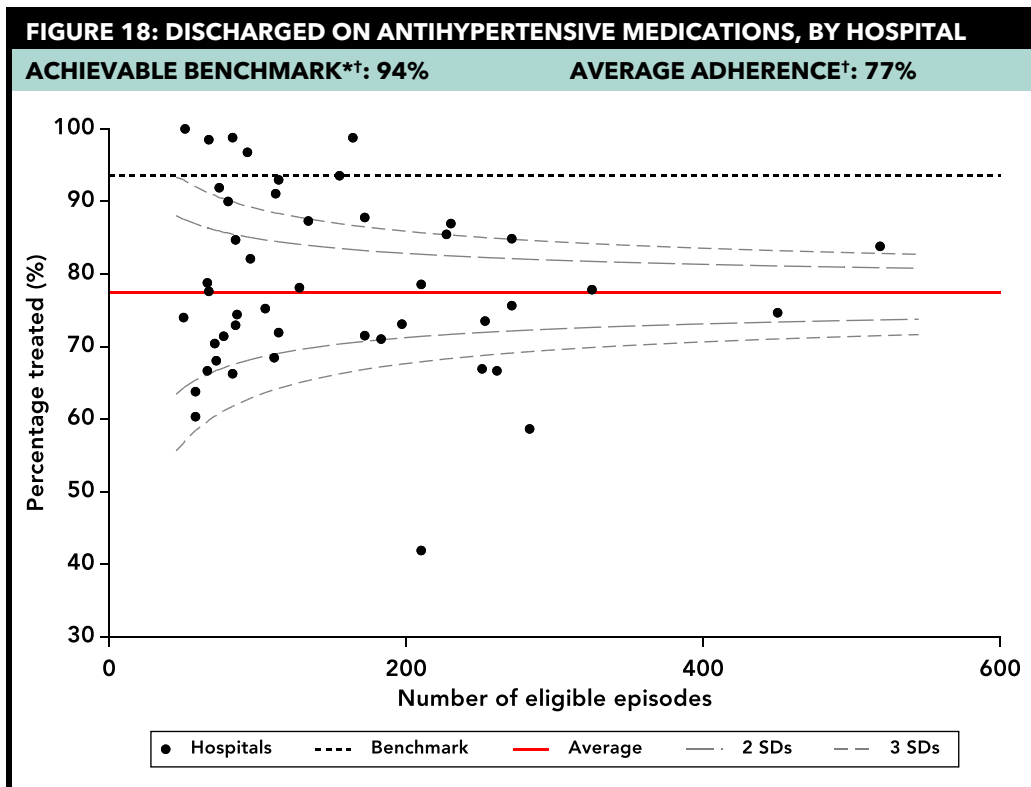
FIGURE 18: DISCHARGED ON ANTIHYPERTENSIVE MEDICATIONS, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 94%   **AVERAGE ADHERENCE†: 77%**

Each dot represents the percentage adherence for an individual hospital.
* Modified ABC^TM benchmark using data from sites with ≥50 episodes.
† Excludes episodes with documented contraindications, in-hospital deaths and episodes recorded in the ED dataset.

FIGURE 19: DISCHARGED ON ANTITHROMBOTIC MEDICATIONS, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 99%   AVERAGE ADHERENCE†: 94%
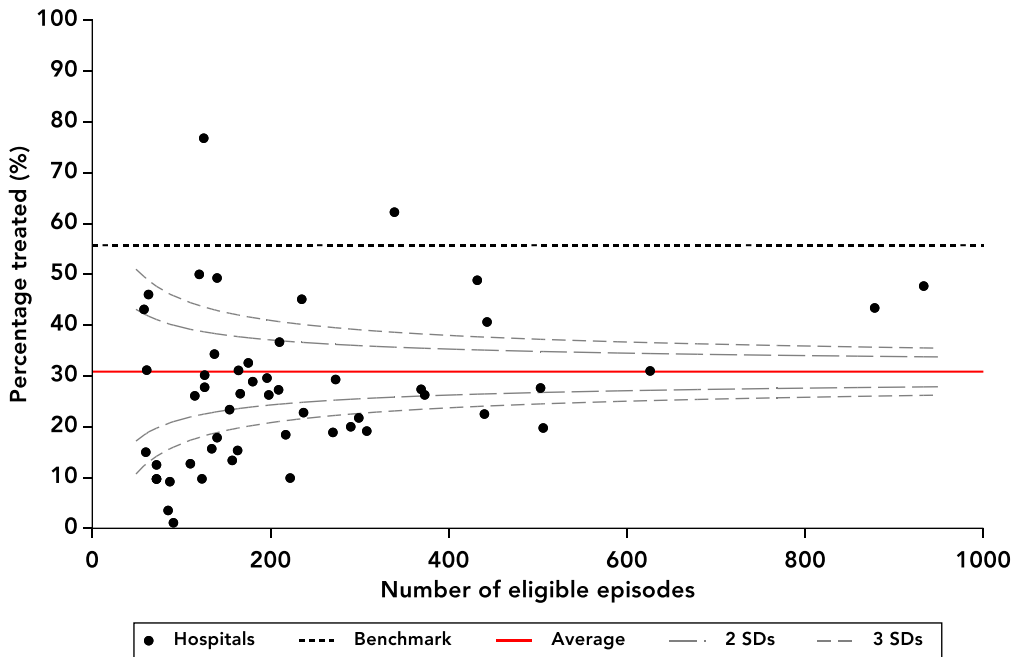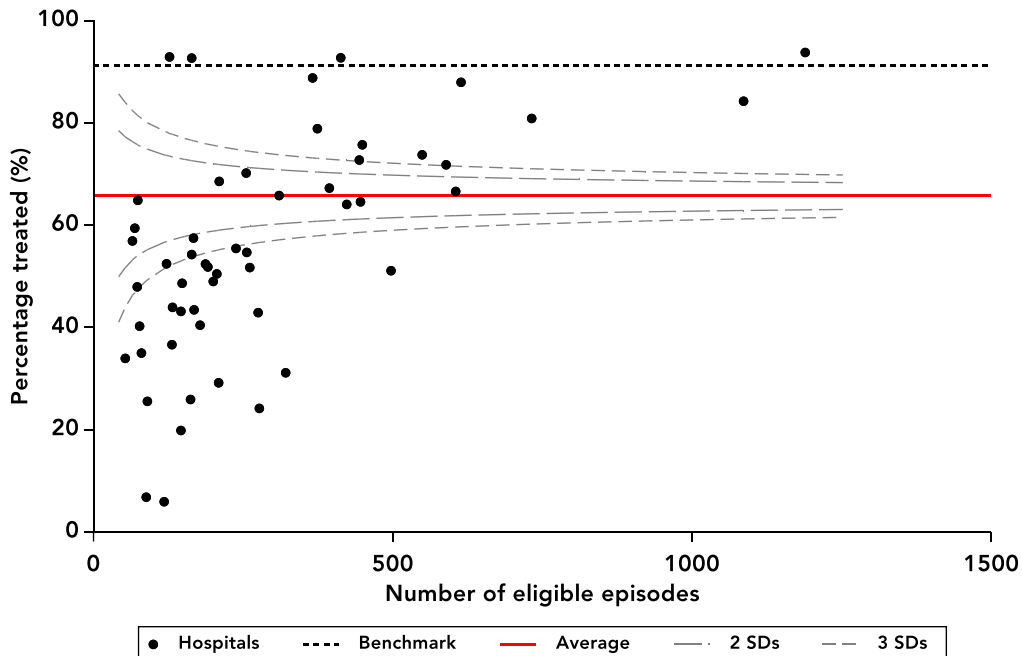
Each dot represents the percentage adherence for an individual hospital.
* Modified ABC™ benchmark using data from sites with ≥50 episodes.
† Excludes episodes of intracerebral haemorrhage, episodes with documented contraindications, in-hospital deaths and episodes recorded in the ED dataset.

FIGURE 20: DISCHARGED ON LIPID-LOWERING MEDICATIONS, BY HOSPITAL

ACHIEVABLE BENCHMARK*†: 97%   AVERAGE ADHERENCE†: 90%

Each dot represents the percentage adherence for an individual hospital.
* Modified ABC™ benchmark using data from sites with ≥50 episodes.
† Excludes episodes of intracerebral haemorrhage, episodes with documented contraindications, in-hospital deaths and episodes recorded in the ED dataset.

CASE STUDY 2

Improving the prescription of medications at discharge

The problem

The Alfred is a large metropolitan hospital in Melbourne with ≈400 acute stroke admissions per year. In 2021, the AuSCR Performance Report indicated that prescription of secondary prevention medications on discharge was below average (antihypertensive medications: 60%; antithrombotic medications: 87%; and lipid lowering medications: 73%). Following their review of AuSCR data, three practical quality improvement action plans were developed and implemented by the stroke pharmacist.

The solution

The following pharmacist-led interventions were implemented:
- Integrating pharmacists on the stroke ward round, and empowering pharmacists to take more proactive approach in reinforcing secondary stroke prevention therapies
- Providing pharmacist-led education on secondary stroke prevention therapies to new nurses, doctors and pharmacists on stroke ward
- Developing standardised template for secondary stroke prevention medications and incorporating it into the discharge summary by stroke pharmacist prior to discharge

The outcome

The 2022 AuSCR report indicated a significant improvement in the prescription of prevention medications on discharge, with performance now above the benchmark for antihypertensive and antithrombotic medications, and above the national average for lipid-lowering medications. This demonstrates the value of pharmacist-led interventions to optimise hospital-level adherence to secondary prevention medications after stroke.

AuSCR
Australian Stroke Clinical Registry

TRANSITION FROM HOSPITAL CARE

Of the 8,292 episodes resulting in discharge to the community, 69% received a care plan outlining post-discharge care in the community that was developed with the patient or their family (Figure 21).

This is significantly lower than the proportion discharged with a care plan in 2021 (75%; p<0.001).
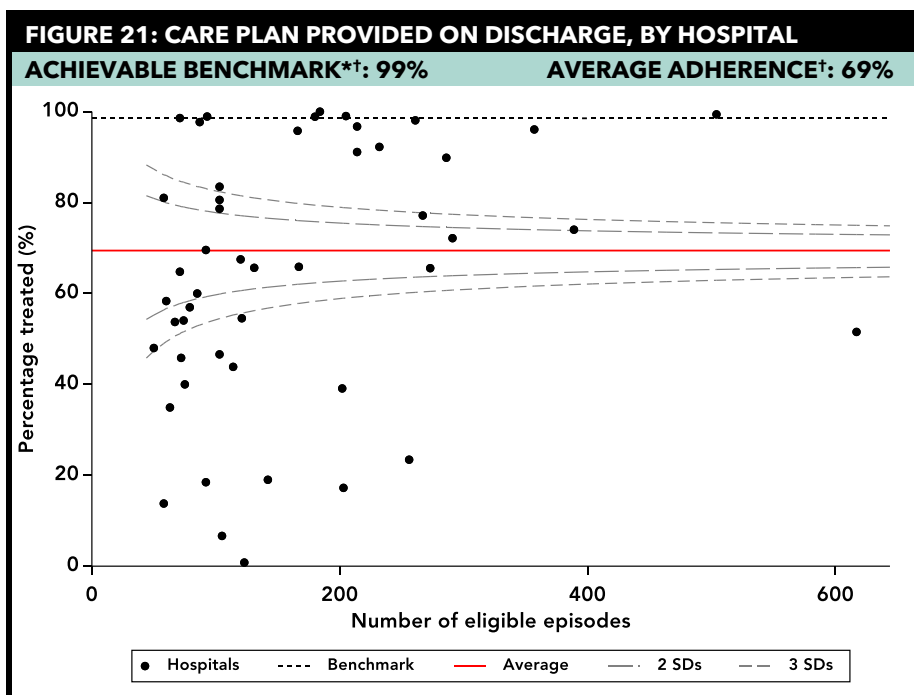
FIGURE 21: CARE PLAN PROVIDED ON DISCHARGE, BY HOSPITAL

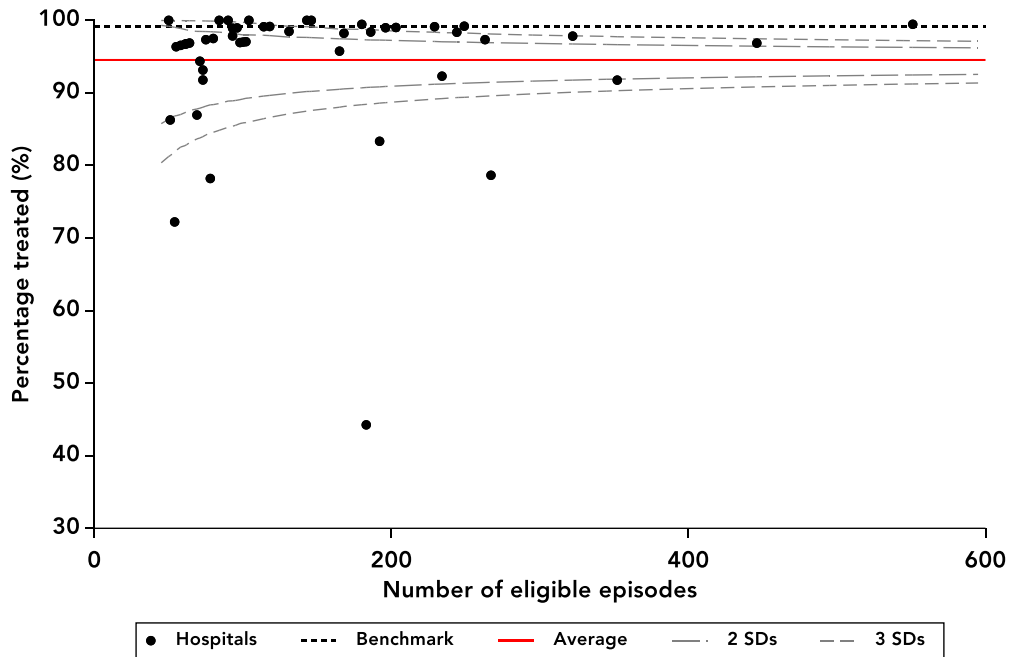**ACHIEVABLE BENCHMARK*†: 99%   AVERAGE ADHERENCE†: 69%**

Each dot represents the percentage adherence for an individual hospital.
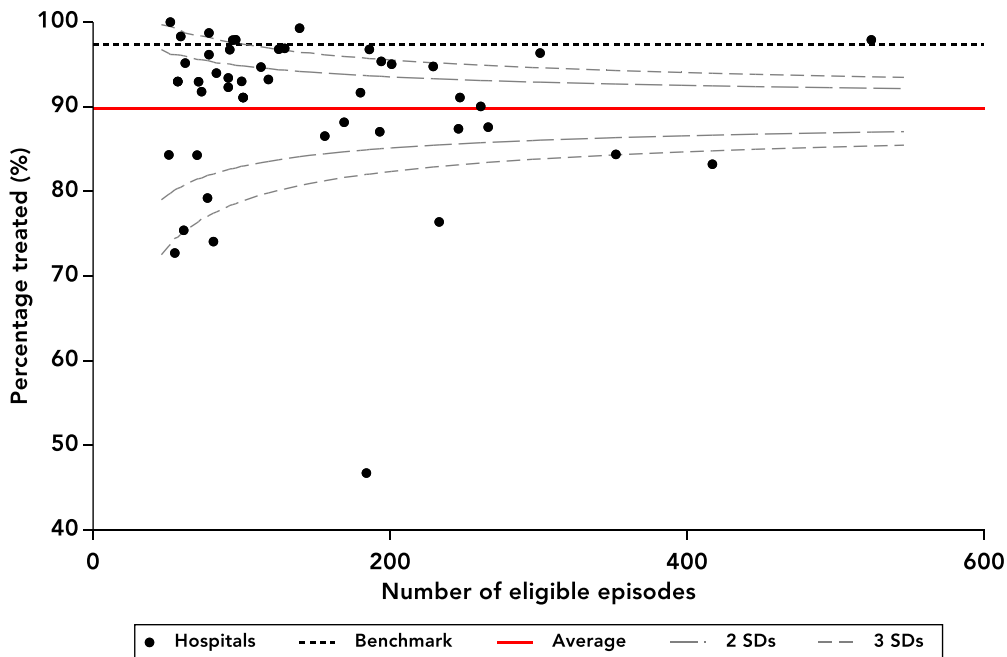* Modified ABC™ benchmark using data from sites with ≥50 episodes.
† Calculated for episodes discharged directly to the community setting.

Table 8: Stroke evaluation and therapy, overall and by stroke type

	All episodes	Ischaemic	ICH	UND
Stroke unit care	75%	78%	68%	52%
Antiplatelet therapy within 48 hours of stroke onset*	82%	82%	-	80%
Mobilised during episode	86%	89%	67%	88%
Mobilised same day or day after arrival	65%	70%	40%	75%
Swallow screen conducted	62%	64%	51%	53%
Swallow assessment conducted	73%	76%	64%	60%
Swallow screen or assessment conducted	87%	90%	77%	73%
Swallow screen or assessment within 4 hours †	31%	32%	25%	29%
Swallow screen or assessment within 24 hours †	73%	77%	62%	60%
Swallow screen or assessment prior to oral intake	66%	67%	66%	40%
Discharged to the community with:				
Antihypertensive medication ‡	77%	78%	80%	67%
Antithrombotic medication ‡§	94%	95%	-	88%
Lipid-lowering medication ‡§	90%	90%	-	82%
Combination of prevention medications ‡§#	70%	71%	-	61%
Care plan outlining post-discharge care	69%	71%	66%	47%

ICH: intracerebral haemorrhage; UND: undetermined stroke type.
* Excludes episodes arriving to hospital after 48 hours from onset.
† Excludes episodes transferred from another hospital.
‡ Excludes episodes with documented contraindications.
§ Excludes episodes of intracerebral haemorrhage.
# A combination of antihypertensive, antithrombotic and lipid-lowering medications.

CHANGES OVER TIME

There were 44 hospitals that participated in the AuSCR since 2017, with ≥30 episodes of stroke entered each year. This provided an important opportunity to assess the influence of participation in the AuSCR for these hospitals over time (Figure 22). Notable improvements were observed for the provision of hyperacute antiplatelet therapy and use of swallow screens or assessments. However, the provision of thrombolysis has remained unchanged at 11%, and stroke unit care appears to have gradually declined.

FIGURE 22: CHANGES IN ADHERENCE TO SELECTED QUALITY INDICATORS SINCE 2017

A. Hyperacute care

- Hyperacute antiplatelet therapy*†
- Door-to-needle time <60 mins if an ischaemic stroke
- Received thrombolysis if an ischaemic stroke

B. Acute care

- Managed in a stroke unit
- Swallow screen or assessment prior to oral intake
- Swallow screen or assessment within 4 hours

C. Discharge medications

- Antithrombotics†‡
- Lipid-lowering†‡
- Antihypertensives‡
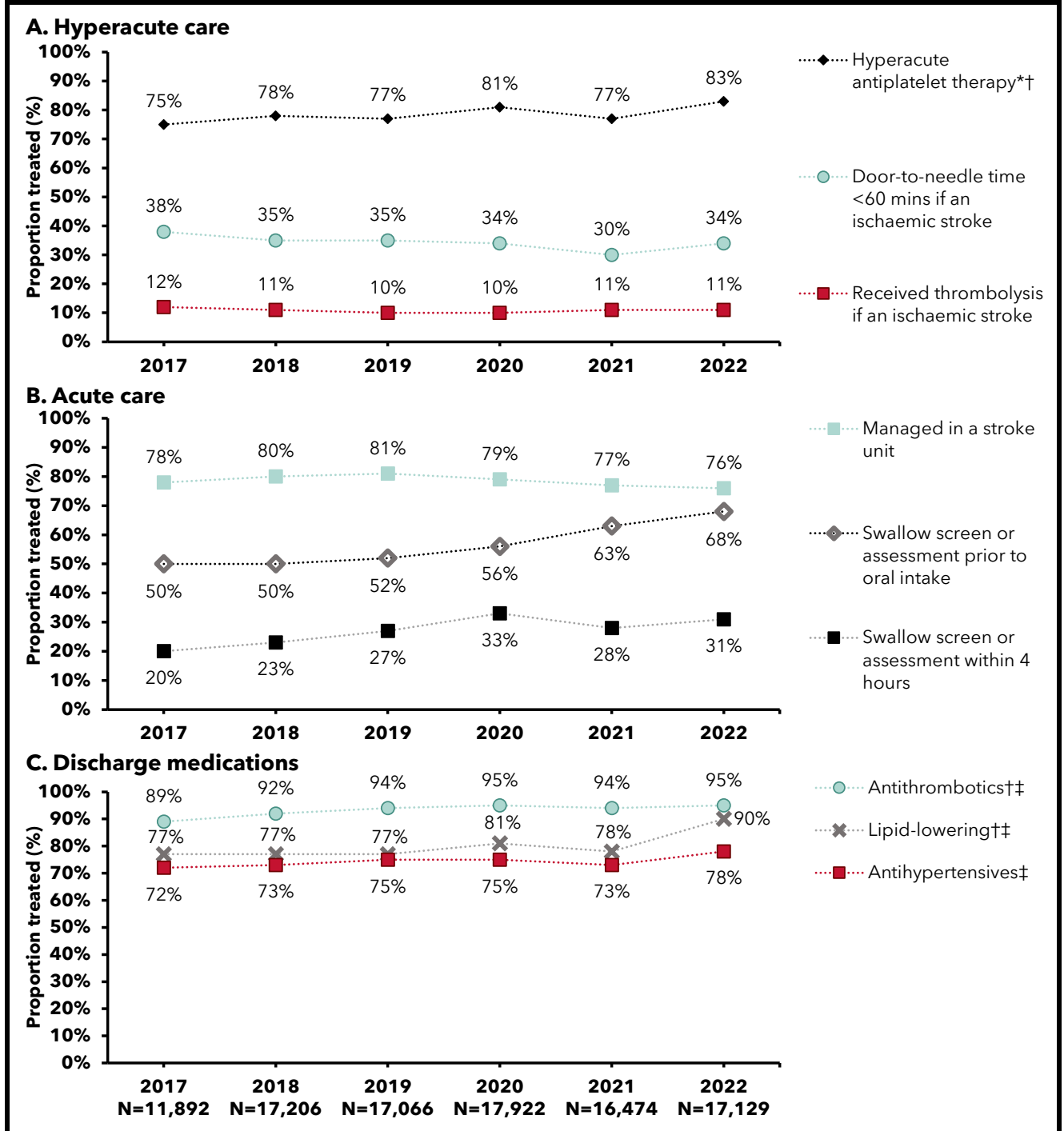
Excludes episodes arriving to hospital after 48 hours from onset and those with contraindications.
† Excludes episodes of intracerebral haemorrhage.
‡ Includes episodes discharged to the community without contraindications.

DISCHARGE INFORMATION

LENGTH OF STAY

Of the 15,181 admissions where the patient was known to be alive at the time of hospital discharge, 15,013 had valid information provided on length of stay. The median length of stay was five days (Q1 to Q3: 2 to 9 days) and 926 (6%) stayed 21 days or longer. Patients treated in a stroke unit experienced significantly longer length of stay than those in alternative wards (median 5 days, Q1 to Q3: 2 to 9 days *vs* median 4 days, Q1 to Q3: 2 to 8 days, p<0.001).

Table 9: Median length of stay

	Median length of stay in days (Q1, Q3)
All episodes	5 (2, 9)
Ischaemic	4 (2, 8)
Intracerebral haemorrhage	7 (3, 13)
Undetermined	3 (1, 7)

IN-HOSPITAL DEATHS

Among the 15,820 adult patients with stroke, 1,492 patients (9%) died while in hospital. Patient mortality was similar between men and women after adjustment for age, stroke type and severity (p=0.23). Case fatality was greater for episodes of ICH (26%) than ischaemic (7%) or undetermined stroke (6%; p<0.001). There were two paediatric in-hospital deaths reported.

DISCHARGE DESTINATION

In 2022, excluding in-hospital deaths, approximately half of the admitted episodes of care resulted in patients being discharged to their usual residence (n=6,959; 46%), with the majority of these patients requiring support (Figure 23).

Patients managed in a stroke unit were 85% more likely to be discharged to a rehabilitation facility than those managed in an alternate ward (odds ratio 1.85, 95% confidence interval 1.66–2.06, 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 (35% *vs* 24% unable to walk on admission, p<0.001; 15% *vs* 8% able to walk on admission, p<0.001).

FIGURE 23: DISCHARGE DESTINATION
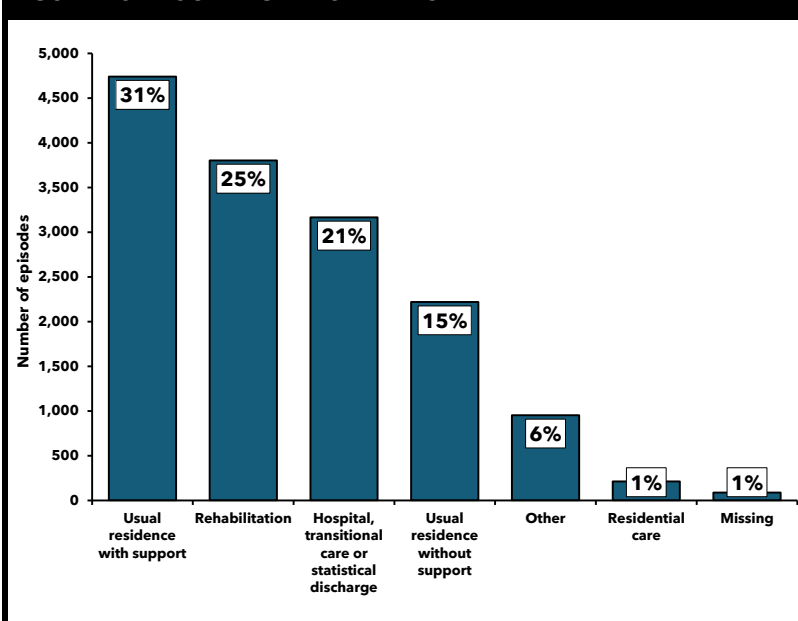
N=15,181 episodes.
Excludes ED episodes and in-hospital deaths.
The definition of support provided within a usual residence may include regular care and assistance by health professionals, council services or volunteers including spouse or family members who may or may not be living in the same residence.

POST-DISCHARGE HEALTH INFORMATION

RESPONSE RATES

In 2022, there were 11,269 unique stroke events eligible to complete a follow-up survey among 11,226 adult patients (i.e. there were 43 recurrent events for the same person which were both eligible for follow-up in the same calendar year). Of these, 6,904 (61%) registrants living with stroke, or their proxies (i.e. next of kin or nominated contact person), provided information about their health status (Figure 24).

Responders tended to be slightly older in age, admitted for a less severe stroke, and were more often managed in a stroke unit (Table 10). There were also 61 events occurring in patients under the age of 18, of which 44 were eligible for follow-up. Follow-up surveys were completed by 28 (64%) of the eligible patients, or their proxies. The median time to completion of follow-up- for adult responders was 141 days following admission (Q1 to Q3: 108 to 168 days).

FIGURE 24: FOLLOW-UP OF PATIENT EVENTS IN 2022 (EXCLUDING PAEDIATRIC EPISODES)

16,282 adult acute stroke events in 2022

Ineligible for follow-up*
Opted out of follow-up: 56
Refused follow-up at outset: 40
Died in hospital†: 1,558
Died between discharge and 90 days of admission‡: 1,298
Registered >180 days after admission: 1,512
Event in the previous 180 days: 471
Event registered in ED dataset only: 78

11,269 events eligible for follow-up

Unable to follow-up*
Refused follow-up: 631
Lost to follow-up§: 3,398
Died between 91 and 180 days of admission‡: 336

6,904 (61%) events with follow-up survey completed

* 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 posted surveys and 1 telephone ± SMS attempt).

Table 10: Characteristics of adult patients with and without post discharge information

	Completed (n=6,882)	Not completed (n=4,344)	p
Age in years, mean (SD)	72 (13)	70 (15)	<0.001
Age in years, median (Q1–Q3)	74 (65–82)	72 (60–82)	<0.001
Female, n (%)	2,749 (41)	1,784 (42)	0.17
Aboriginal and/or Torres Strait Islander, n (%)	111 (2)	150 (4)	<0.001
Clinical diagnosis, n (%) *Ischaemic* *Intracerebral haemorrhage* *Undetermined*	6,015 (88) 688 (10) 155 (2)	3,687 (85) 502 (12) 130 (3)	0.001
Able to walk on admission, n (%)	2,986 (46)	1,605 (39)	<0.001
Length of hospital admission in days, median (Q1–Q3)	5 (3–10)	4 (2–8)	<0.001
Treated in a stroke unit, n (%)	5,575 (81)	3,335 (76)	<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, 22% were free from disability (mRS= 0) and 22% had no significant disability despite symptoms (mRS=1; Figure 25).

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 2 *vs* 4; p<0.001).

FIGURE 25: UNADJUSTED MODIFIED RANKIN SCALE SCORE BY CLINICAL DIAGNOSIS AT FOLLOW-UP
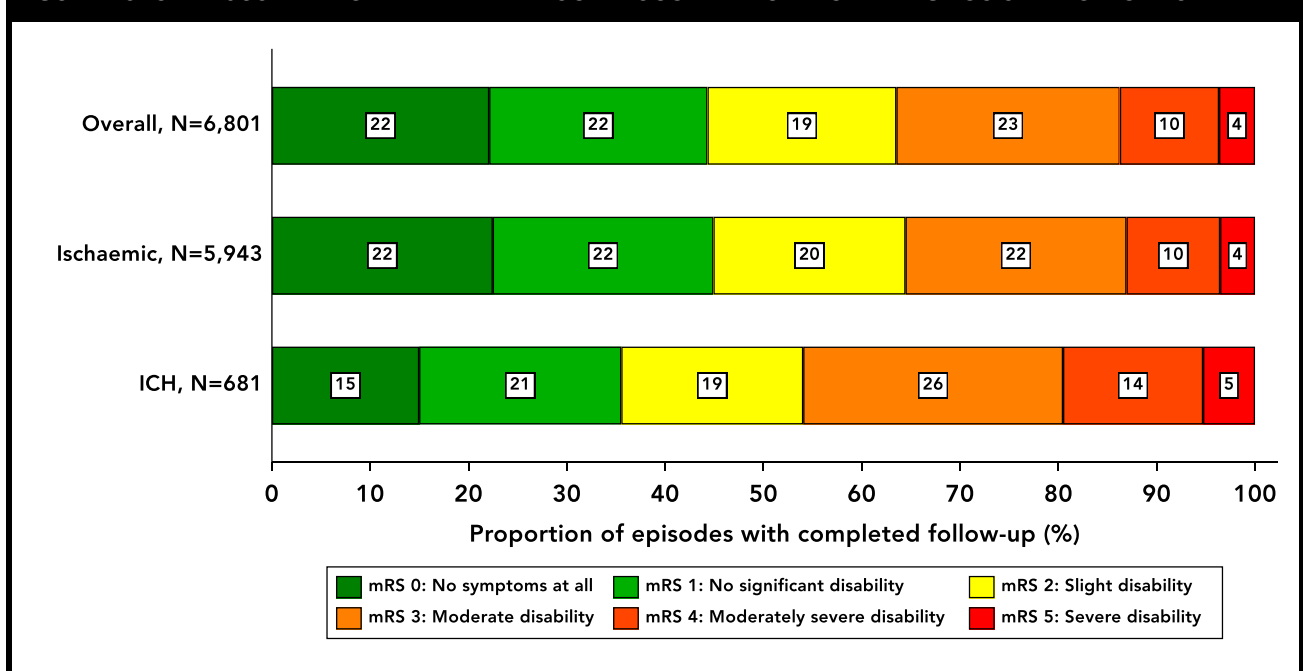
mRS: modified Rankin Scale; ICH: intracerebral haemorrhage.

READMISSIONS AND LIVING ARRANGEMENTS

At follow-up, approximately one in five adult patients reported hospital readmissions (Table 11), with stroke or TIA the most common reason given.

Most patients who provided follow-up information were living at home (86%), 25% of whom were living alone. There were 600 (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 26). Three out of four (75%) responders reported problems with ≥1 dimension of the EQ-5D-3L.

FIGURE 26: UNADJUSTED PROPORTION OF PATIENTS REPORTING PROBLEMS WITH EQ-5D-3L DIMENSIONS
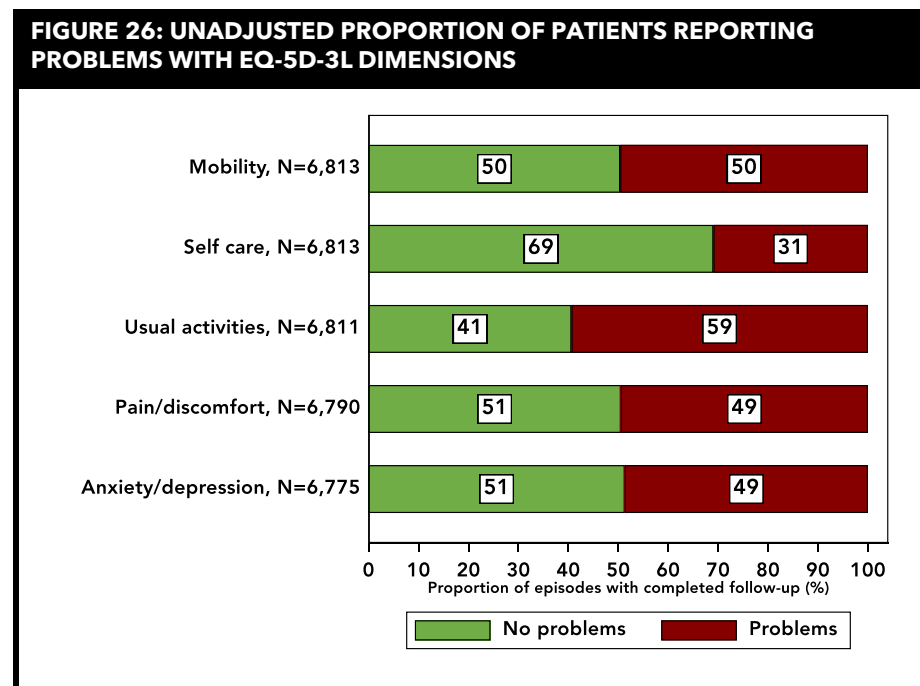
Table 11: Recurrent strokes, readmissions and living arrangements

	N=6,904
	n (%)
Had a recurrent stroke	356 (5)
Readmitted to hospital	1,451 (21)
Time to readmission (days), median (Q1–Q3)	79 (35–118)
Reason for readmission	**N=1,451**
Stroke or transient ischaemic attack	245 (17)
Cardiovascular disease	244 (17)
Injury	152 (11)
Elective surgery	106 (7)
Infection	76 (5)
Gastrointestinal disease	67 (5)
Other neurological condition	67 (5)
Respiratory disease	51 (4)
Other	436 (30)
Location at time of follow-up interview	**N=6,806**
Home	5,868 (86)
Living alone	1,423 (25)
Living with others	4,397 (76)
With care support	2,856 (49)
Without care support	3,012 (51)
Institutional care or other setting	938 (14)
In hospital	81 (1)
Transitional care services	72 (1)
Low level care (hostel care)	20 (<1)
High level care (nursing home)	580 (9)
Inpatient rehabilitation	69 (1)
Other	116 (2)

Missing responses excluded from denominators.

35

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 12). The mean Visual Analogue Scale (VAS) score, which represents patients' self-reported overall health, was 67 (median: 70; min–max: 0–100). Compared to the mean VAS of the normative population (83 in the United Kingdom),[12] 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 27). Overall, one in four respondents (76%) reported having problem(s) with one or more dimension of the EQ-5D-3L at follow-up.

Table 12: Unadjusted health-related quality of life, by diagnosis

Reported problems with EQ-5D-3L dimension:	Ischaemic N=6,035	ICH N=689	Undetermined N=156
Mobility	49%	58%	44%
Self-care	30%	41%	30%
Usual activities	59%	69%	46%
Pain/Discomfort	49%	56%	47%
Anxiety/Depression	49%	52%	40%
VAS mean (SD)	67 (22)	64 (24)	69 (23)
VAS median (Q1–Q3)	70 (50–85)	70 (49–80)	75 (50–86)

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

FIGURE 27: HEALTH-RELATED QUALITY OF LIFE SCORES ACCORDING TO THE ADJUSTED VAS AT FOLLOW-UP, BY HOSPITAL
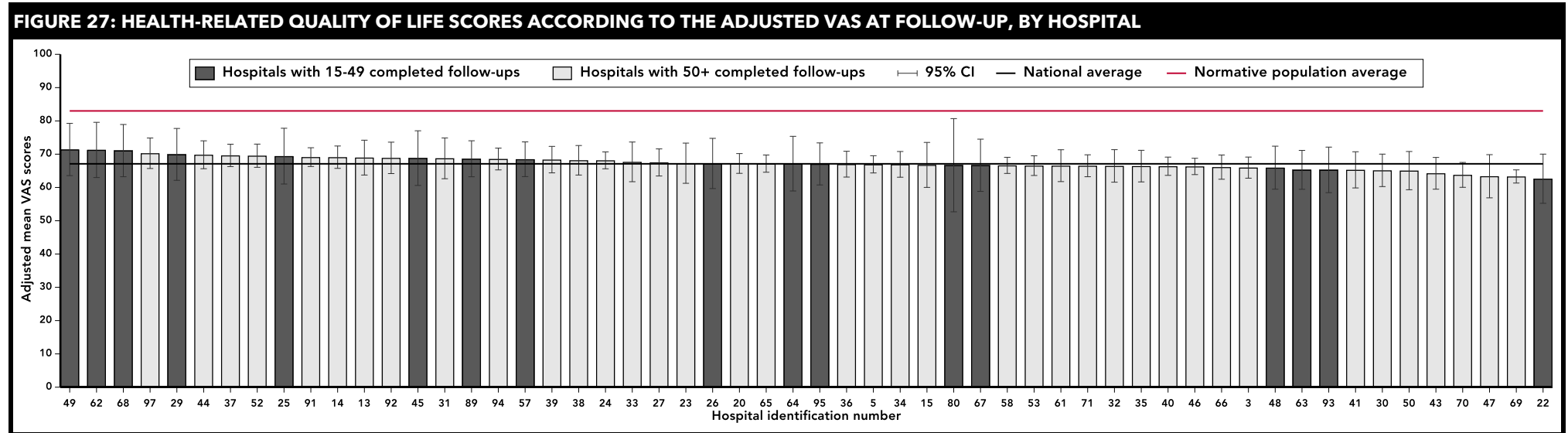
Excludes hospitals with <15 episodes with completed follow-up data. Normative population average of 83 is for the United Kingdom, as Australia-specific estimates are unavailable.[12]

PILOT COLLECTION OF PATIENT OUTCOME DATA USING SMS

Piloted January – June 2022

1,008 people randomised from **27** hospitals

AuSCR

505 to the standard follow-up process

503 to the new SMS process*
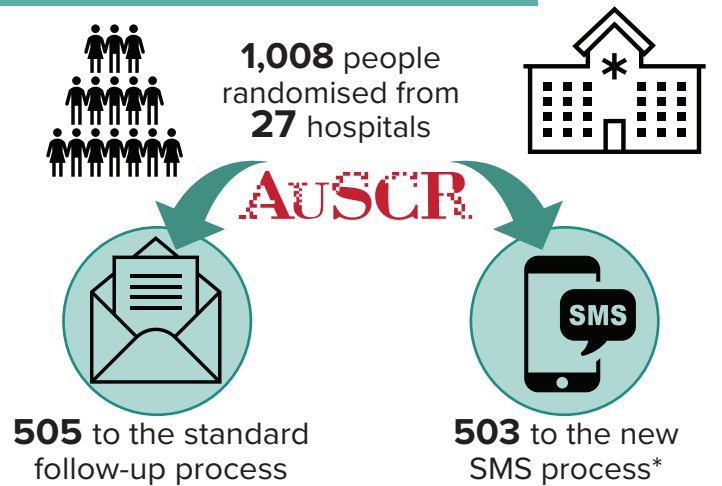
Link to complete follow-up survey sent by SMS 4 weeks after the initial mail attempt
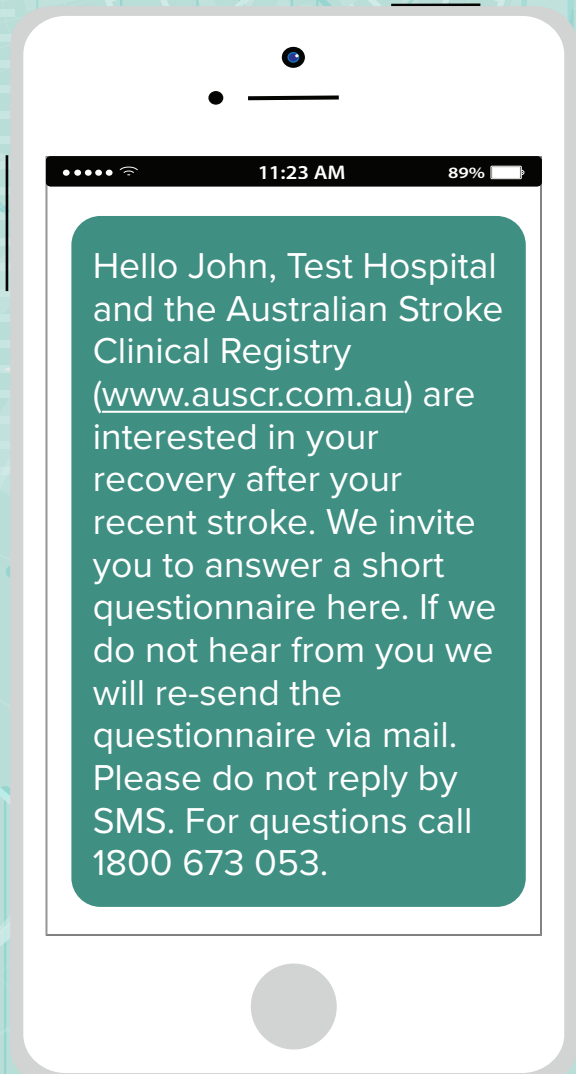
Quantitative Results

18% completed the follow-up survey via the SMS link

11% more responses from the SMS *vs* standard group

SMS responses were **14 days faster** than the standard group

Responders in the SMS group were **younger (69** vs **74** years**)**

11:23 AM 89%

Hello John, Test Hospital and the Australian Stroke Clinical Registry (www.auscr.com.au) are interested in your recovery after your recent stroke. We invite you to answer a short questionnaire here. If we do not hear from you we will re-send the questionnaire via mail. Please do not reply by SMS. For questions call 1800 673 053.

Qualitative Results

Participants from the SMS group were surveyed and they reported the SMS was easy to use, read, understand and follow the link. Some respondents preferred the paper forms.

"Absolutely prefer electronic, wouldn't mail back a paper form"

"Had the paper form still but did the SMS due to the immediacy of it"

"The paper is a hassle to mail back but I prefer it"

Following the success of this trial, a follow-up attempt via SMS was added to the standard AuSCR follow-up protocol in 2022

PARTICIPATION IN RESEARCH

Among the 6,535 adult patients with stroke who answered the question about whether they would be willing to be contacted to participate in future research, 4,204 (64%) replied affirmatively, similar to previous years. Compared to those who did not reply in the affirmative, these patients were younger (median age 73 *vs* 77 years, *p*<0.001) and more often male (62% *vs* 38%, *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. Similar to in 2021, 50% (n=3,245) of the 6,501 adult patients who answered this question in 2022 indicated that they would like to receive such information from the Stroke Foundation.

SURVIVAL

Survival status was ascertained for the entire AuSCR cohort using data linkage with the National Death Index. Of the total registrants in 2022, 9% died prior to hospital discharge, 8% 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 44% lower hazard of death at 180 days after admission than treatment on an alternate ward (hazard ratio 0.56, 95% confidence interval 0.51–0.62, *p*<0.001; Figure 28). The observed effect of stroke unit care on survival was greater for patients with ICH (hazard ratio 0.37, 95% confidence interval 0.31–0.41, *p*<0.001). These analyses were adjusted for age, sex, ability to walk on admission, in-hospital stroke and transfer from another hospital.

FIGURE 28: CUMULATIVE HAZARD OF DEATH, BY TREATMENT IN A STROKE UNIT

A. ISCHAEMIC STROKE — B. INTRACEREBRAL HAEMORRHAGE
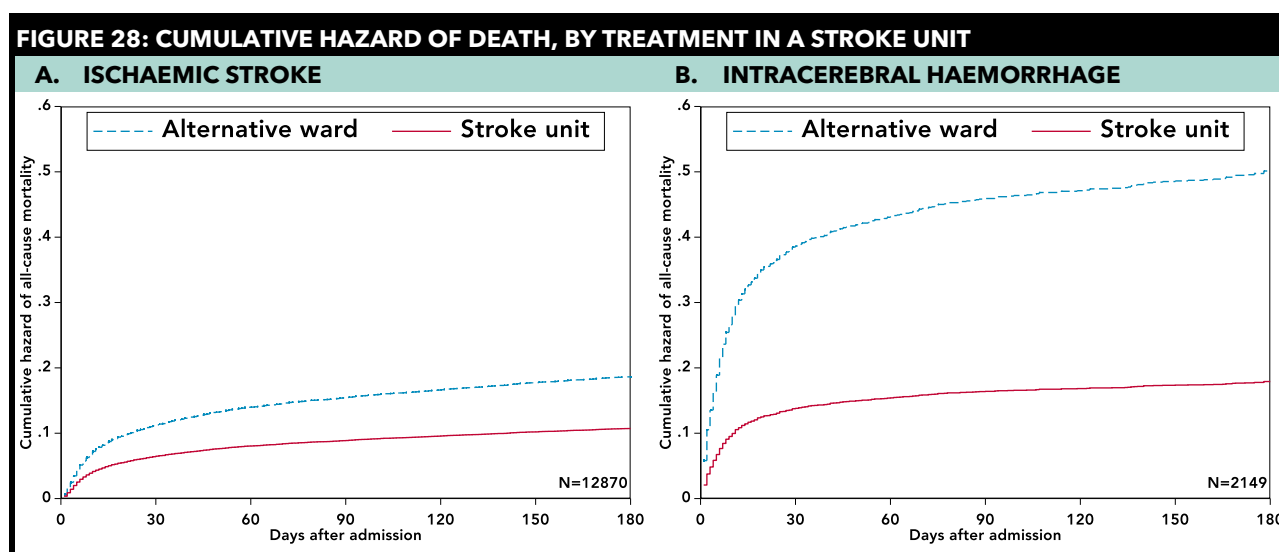
RISK ADJUSTED MORTALITY

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 29 and Figure 30). Further information on the RAMR methods is outlined on page 9.

FIGURE 29: 30-DAY RISK ADJUSTED MORTALITY FOR ISCHAEMIC STROKE
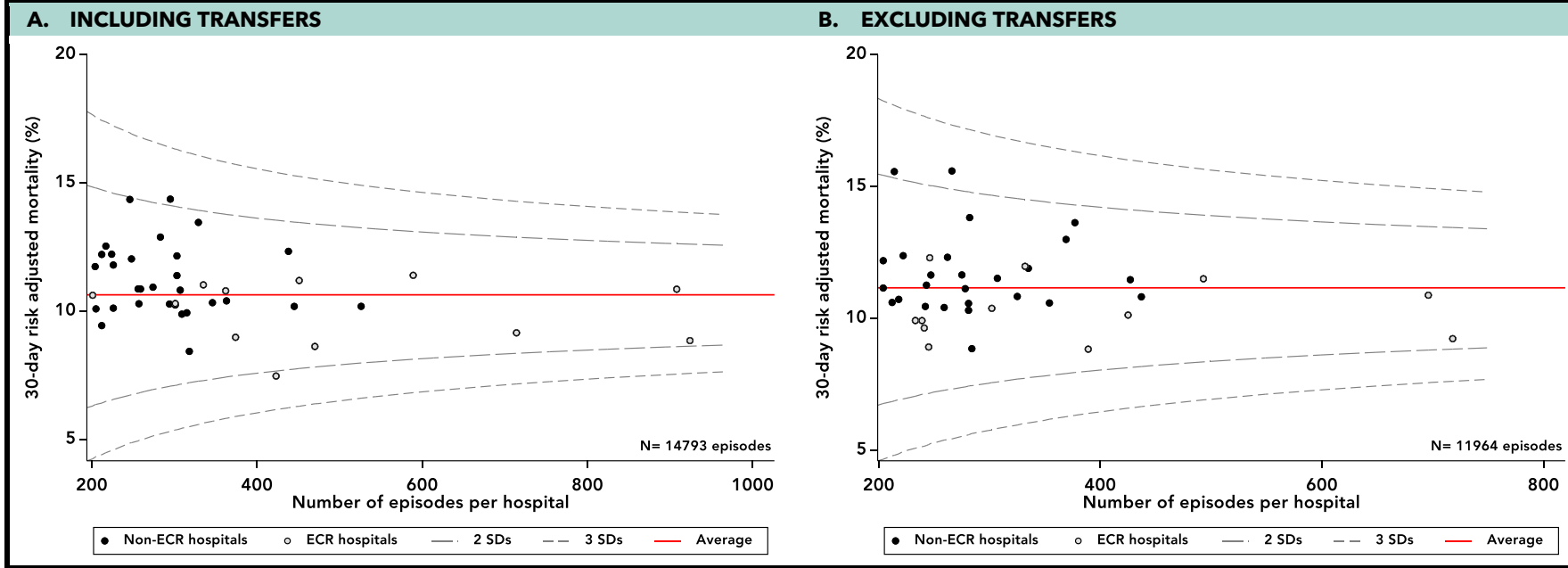
A. INCLUDING TRANSFERS

B. EXCLUDING TRANSFERS

N= 14793 episodes

N= 11964 episodes

Non-ECR hospitals   ECR hospitals   2 SDs   3 SDs   Average

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 <200 episodes for ischaemic stroke.

ECR (endovascular clot retrieval) hospitals are usually larger, well-resourced hospitals.

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

A. INCLUDING TRANSFERS

B. EXCLUDING TRANSFERS

N= 2559 episodes

N= 2068 episodes

Non-ECR hospitals   ECR hospitals   2 SDs   3 SDs   Average

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 <50 episodes for intracerebral haemorrhage.

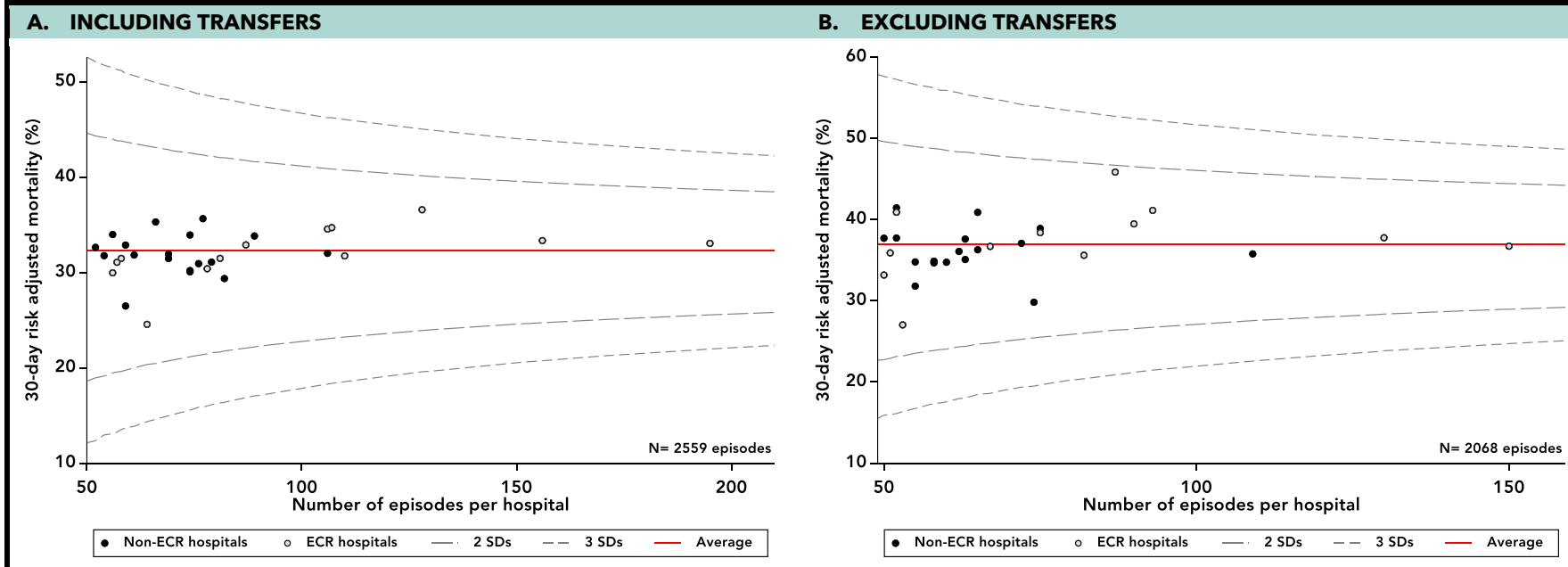*ECR (endovascular clot retrieval) hospitals are usually larger, well-resourced hospitals.*

DISCUSSION

In the 2022 AuSCR Annual Report, we present information on 17,184 episodes of stroke collected at 61 hospitals across six states and territories.

Participation highlights

In 2022, many Australian hospitals were recovering from the challenges created by the COVID-19 pandemic. For some hospitals in the first half of 2022, stroke units were closed to shift resources for the COVID-19 pandemic. In the contributor survey we undertook between March and May 2022, 83% of hospitals reported impacts on stroke care or AuSCR participation associated with the COVID-19 pandemic.

Compared to 2021, a similar number of hospitals contributed to the AuSCR – with one additional hospital joining from WA and two ceasing from NSW. Based on data from the Stroke Foundation Acute Audit, the AuSCR was found to include at least 75% of acute stroke hospitals from ACT, QLD, TAS and VIC. The AuSCR is actively working with hospitals around Australia to increase coverage in other jurisdictions.

The optional Fever, Sugar and Swallow (FeSS) and Emergency Department (ED) programs both had a greater number of hospitals contributing to them this year. Twenty hospitals contributed data to the FeSS program (five more than in 2021); and twenty-six hospitals (four greater than in 2021). Data captured in the ED program for episodes prior to transfer to another hospital provided additional information on care throughout a patient's journey in the health system.

The Reperfusion and Telemedicine subcommittee continued to provide important support to the AuSCR. This committee reviews hospital-identifiable data to discuss potential issues with data capture and share experiences to improve care. Advice was also provided on reporting reperfusion variables and updating the data dictionary to ensure consistency in reporting between hospitals. One important change included tightening the definition of a telemedicine consult to include a review of brain scan images and a written treatment plan. We welcomed an additional member to this committee from WA.

The AuSCR paediatric subcommittee, established in 2021 with co-chairs Mark Mackay (VIC) and Louise Sparkes (QLD), met four times and progressed the participation of two paediatric hospitals. In 2022, the largest number of paediatric episodes were entered in the AuSCR since its establishment (n=62; almost 2-fold more episodes than in 2021). This may reflect improved case ascertainment of paediatric episodes and the implementation of new clinical pathways for paediatric stroke.

Following the renewal of the data custodianship of the AuSCR, the Steering Committee commissioned an external review of the registry. This was undertaken by Professor Bo Norrving, founder of the world's first stroke registry, Riksstroke in Sweden. The findings from this review will help shape the future of the registry in the next 2–5 years.

Professor Helen Dewey (Director of Neurosciences, Eastern Health, Victoria) commenced the role as Chair of the AuSCR Management Committee in August 2022. We have benefited from her extensive experience in stroke care, research and clinical leadership.

The AuSCR routinely provides high-level snapshots of acute stroke care to hospital CEOs. These reports are designed to encourage discussions between clinical and executive teams, with the goal of enhancing stroke services and patient care. In 2022, the Management Committee recommended these reports be provided to all participating hospital CEOs, rather than just for hospitals where this is specifically part of the contract deliverables.

As part of our role in fostering national, data-driven conversations about stroke care, in October 2022, we hosted the 10th National Stroke Quality Improvement Workshop, in partnership with the Stroke Foundation and Monash University. Over 150 people attended this workshop from around Australia (in person or virtually) to discuss the AuSCR data for QI and priorities to support better hospital care for stroke.

National Stroke Targets

Data from 44 hospitals that consistently participated between 2017 and 2022 has highlighted stagnating provision of stroke unit care, hyperacute antiplatelet therapy, and swallow screens/assessments. These findings were presented to the Australian Stroke Coalition and during the Stroke 2023 scientific meeting (Melbourne August, 2023).

In response, a new national taskforce collaborated to set new 30/60/90 National Stroke Targets to improve access to reperfusion treatments and stroke units by 2030. In this Annual Report, we present for the first time, the status of AuSCR hospitals in meeting these targets. Only 14 hospitals met at least one of the 30/60/90 targets.

Reperfusion therapies

The median time from hospital arrival to thrombolysis treatment was 74 minutes. Only five hospitals delivered thrombolysis within the national target of 60 minutes on average, four of which treated >50 patients. This provides further evidence of a volume-outcome relationship, whereby hospitals with higher volumes of thrombolysis activity achieve faster administration of thrombolysis.[17] Even when patients arrived to hospital within 4.5 hours, only 1 in 4 received intravenous thrombolysis. This lags behind the United Kingdom where >85% of eligible patients are provided thrombolysis.[18]

Among all episodes of ischaemic stroke in 2022, only 10% received ECR. Data from a systematic review suggests that 21% of ischaemic strokes represent a large vessel occlusion and may be treated with ECR.[19] This type of ischaemic stroke produces the worst outcomes, accounting for 34% of death and dependence within 3–6 months.[19] Only two hospitals met the ECR national targets: one hospital for primary presenters (door-to-treatment <90 minutes) and one hospital for transfers (door-to-treatment <30 minutes).

Stroke unit care

Access to stroke units, the cornerstone of ensuring access to best practice stroke care, was provided to 75% of patients. When comparing proportion of patients treated in a stroke unit over time, there has been a downward trend since 2019, which may partially reflect impacts due to the COVID-19 pandemic. This is concerning given the well-established benefits of stroke unit care in reducing death and dependence post-stroke. In this report, we also undertook new analyses to demonstrate that increasing the proportion of patients treated in stroke units can improve 90–180 day patient outcomes (i.e. survival free from disability) at each hospital.

In an effort to advocate for improved stroke unit access, we facilitated a webinar with presentations from stroke nurses to highlight the importance of stroke units in both metropolitan and regional hospitals. Over 50 people attended and all respondents found the webinar valuable. Following this webinar, we established partnerships between high- and low-performing hospitals to facilitate sharing of information and improvements in care.

Intracerebral haemorrhage

Greater attention to the acute management of ICH is warranted given its significant health burden. Within 90–180 days post-admission, people with ICH reported greater levels of disability at follow-up (mRS 0-1 [none to slight disability] ICH 36% vs 44% ischaemic stroke) and were more likely to have died. People who had an ICH reported problems more often in all domains of health-related quality of life than other types of stroke. However, quality indicators were less often provided to people with ICH than those with ischemic stroke, with the exception of being discharged on antihypertensive medications.

More needs to be done to ensure people with ICH are accessing stroke units, having their swallowing ability assessed, and receiving a discharge care plan. For people with ICH, we showed stroke unit care was associated with a 63% reduction in the risk of 180-day mortality. In a landmark study using AuSCR data published in 2017,[20] we also illustrated the importance of four major quality indicators (stroke unit care, prescription of antihypertensive medications at discharge, and provision of a discharge care plan) to enhance survival and quality of life in people with ICH.

Outcomes of hospital care

Overall, 9% of people after stroke died in hospital, similar to previous years, and there was no significant variation in risk-adjusted 30-day mortality between hospitals.

Length of stay was on average five days, similar to previous years. Overall, one in four patients were discharged to rehabilitation, providing evidence

of a return to pre-COVID-19 pandemic levels (25% in 2019; 21% in 2021). Importantly, patients who are treated in a stroke unit are more likely to be assessed for rehabilitation.[21] This is of concern as inpatient rehabilitation is essential to supporting recovery for a range of impacts caused by stroke. In the Stroke123 project (AuSCR linked with hospital administrative data),[22] people who received inpatient rehabilitation (*vs* those discharged directly home) were less likely to have been readmitted and reported fewer problems with mobility between 90–180 days after stroke. These results are aligned with the [Living Clinical Guidelines for Stroke Management](#), whereby the ongoing rehabilitation needs of all patients with stroke should be assessed and rehabilitation offered regardless of their discharge destination.

Longer-term outcomes

For the 2022 cohort, the overall rate of follow-up completion for eligible patients was 61% – representing nearly 7,000 participants. This is a testament to the hard work and refined protocols of the AuSCR office.

We found that three in four people reported problems in at least one domain of quality of life (e.g. usual activities, self-care, mobility, pain or discomfort, and anxiety or depression). Our data illustrate the large proportion of people in the community living with the impacts of stroke with ongoing health needs within the first six months of stroke.

To address this ongoing unmet health need post-stroke, a 2-year Medical Research Future Fund grant was awarded for the A-LISTS feasibility study (AuSCR- LIfe after Stroke Tailored Support study). In this study, we have worked with clinicians and people living with stroke to codesign a registry-based follow-up service for people who report extreme problems in quality-of-life between 90–180 days after stroke. The service is now being tested in a [feasibility randomised controlled trial, led by the AuSCR office,](#) with up to 100 eligible registrants from four participating hospitals. We expect to present the results from this trial in the 2023 Annual Report.

In 2022, we piloted an electronic version of the follow up survey sent as a SMS reminder for people who had not replied to the initial postal survey and had a mobile number recorded. We found that ≈1 in 5 people chose to complete the survey electronically following the reminder SMS. Compared to the posted surveys, the SMS survey led to 11% more people responding and more timely outcome data. Following the success of this trial SMS reminders were implemented as a standard part of the AuSCR follow-up protocol. This important initiative provides additional options for registrants to complete the follow-up survey and will reduce cost associated with obtaining follow-up outcomes.

In 2022, the number of people registered in the AuSCR who were alive and willing to receive invitations for research studies grew by 4,828. Since the establishment of the AuSCR in 2009, there are now >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 for approved third parties to access aggregated, anonymised data to address their own research questions, or to recruit participants (Appendix I). Up to the end of 2022, there had been 26 research studies where the AuSCR office had sent an invitation to eligible AuSCR registrants to participate in a study on behalf of investigators for approved projects.

Data quality highlights

The AuSCR office continues to work with hospital staff to ensure correct interpretations of the variables and data are as complete and accurate as possible. A full report on Data Quality is published as a [separate report](#). Highlights included improvements in the completeness of stroke severity variables (baseline NIHSS 69% complete in 2022 vs 65% complete in 2021) and capture of a very high proportion of eligible episodes (median case ascertainment of 92% in 2022 vs 88% in 2021).

Adherence to the Acute Stroke Clinical Standard was outlined by geographical location. These data highlight the variability across the country in meeting the standards. The participation level and data quality may be a limitation for some locations (e.g. WA) that recently joined AuSCR so those data should be interpreted with caution. Nonetheless, there are recognised challenges in various states and territories with each having [unique geographical and resource constraints](#). Initiatives to develop and establish acute tele-stroke services in WA and QLD will be game-changing in supporting patients to be assessed

and treated with reperfusion therapies. These data also highlight the need to support regional hospitals in the provision of stroke unit care and also discharge care plans.

AuSCR State Coordinators will continue to work with hospitals to understanding their data provided in their Hospital Performance Reports. In 2022 we also collaborated with analysts from Monash University to co-design a new Stroke Performance Scorecard with clinicians and members of the AuSCR Management Committee. This scorecard provides hospitals with a simple, one-page visual overview of their performance on 12 quality indicators against previous years, national averages and benchmarks (Appendix J). In our survey of participating hospitals, 64% indicated the tailored hospital report (i.e. Hospital Performance Report or Stroke Performance Scorecard) had been reviewed internally, with 68% indicating they communicated results or undertook improvement activities. These new scorecards will be routinely provided to hospitals to complement other standard reporting methods used by the AuSCR consortium.

Engagement initiatives

Throughout 2022, various quality improvement initiatives were undertaken with individual sites, or across the AuSCR hospital network via educational webinars. Summarised data were also provided to state governments and hospital executives, as requested. In creating greater clinician-led support in use of AuSCR data for quality improvement, the Chair of the AuSCR Clinical QI subcommittee initiated meetings with State Clinical leaders and this group met three times in 2022.

In 2022, the AuSCR pioneered the development of new, interactive data dashboards. These dashboards allow hospital clinicians to securely access their data in near real-time to explore opportunities to improve stroke care in greater detail. Through co-design with clinicians, a series of prototypes and features were initially prioritised to guide the dashboard development. As at November 2023, the dashboards had been accessed by hospital staff from >50 participating hospitals across Australia. Further details on the development and implementation of these dashboards will be reported in the 2023 AuSCR Annual Report.

Participating hospitals had their data analysed for two awards programs vetted by the Australian Stroke Coalition:
• Australian Stroke Coalition awards of Excellence in Quality of Stroke Care (assesses adherence to the National Acute Stroke Clinical Care Standard)
• World Stroke Organization (WSO) Angels Imitative Awards

Each hospital was provided with a tailored report with their results to help focus on areas of quality improvement to increase the opportunity for an award in future. Congratulations to all recipients and we hope that these awards will inspire further quality improvement activities (Appendix K).

In 2023, in partnership with the Angels Initiative in Australia, we will be creating a data dashboard to track adherence to the WSO Angels awards criteria. This will enable AuSCR hospitals to be recognised for awards every quarter in alignment with the international program.

Summary

The findings in this report provide important insights into various aspects of acute stroke care in Australia. We report essential, standardised evidence in support of national clinical guidelines, standards of care expected for acute stroke. We highlighted areas where Australian hospitals have made improvements, and others that should be improved including the urgent need to improve the quality of care for people experiencing ICH. Collectively, these findings underpin the continued importance of actively addressing practice gaps and ensuring access to evidence-based care. The benefits of stroke units were highlighted and we must ensure that all patients with stroke are treated in stroke units.

It is essential that quality improvement programs are supported and that the data from AuSCR are used proactively. We have innovated in different areas of data feedback methods to support clinicians to understand their data, and have informed conversations with hospital executives. Our extensive network and collaborations have supported new national initiatives and policy direction in stroke. The AuSCR data will continue to provide the essential evidence to monitor progress against the new national stroke targets.

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APPENDIX A:
GOVERNANCE & COLLABORATIONS

In 2022, the AuSCR program was managed by a leading academic research institute, The Florey Institute of Neuroscience and Mental Health (Stroke Division; AuSCR Data Custodian) with support for data analysis and data curation for approved research projects by Monash University. The consortium partners include The Florey and two leading non-government organisations, the Stroke Foundation and the Australian and New Zealand Stroke Organisation (formerly Stroke Society of Australasia [SSA]). Collectively, these organisations represent a broad section of the Australian clinical and scientific stroke community. Consultation with clinicians and professional associations for the AuSCR initiative has also occurred through the Australian Stroke Coalition (ASC), including the provision of data to support hospitals to receive National Stroke Quality Awards or World Stroke Organisation Angels awards facilitated through the ASC. Monash University joined the consortium group in 2023.

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 2022. The Management Committee includes representatives from the consortium partner organisations, and various clinicians with 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 continued her role as Chair of the Management Committee at the start 2022 and stepped down in July. She was succeeded by Professor Helen Dewey who commenced the role of Chair in August 2022 (see Appendix B for committee membership lists).

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

Collaborations are continuing with the Australian Institute of Health and Welfare and the Australian Rehabilitation Outcomes Centre to enable the linkage of patient-level AuSCR data with other health datasets (e.g. admitted hospital data) to more efficiently ascertain long-term outcomes of all patients. Monash University also provided a secure analysis environment (SeRP) for approved users to access AuSCR data remotely from other institutions (including from the Australian Catholic University, University of Western Sydney and University of Tasmania). The Florey is also leading two Medical Research Future Fund grant projects. The first is directly emanating from the AuSCR to address ongoing health needs within the first six months of stroke identified from the 90-180 days follow-up survey data (A-LISTS project). The second will be in support of establishing Australia's first Young Stroke Service, whereby referral pathways from the AuSCR are being explored. The projects increase the utility of the AuSCR and engagement with diverse groups of clinicians, academics, and consumers, to improve stroke care and patient outcomes.

We co-convened the 10th National Stroke Quality Improvement workshop with the Stroke Foundation and Monash University. We appreciated the sponsorship support from the Angels Initiative, Bristol Myers Squibb, Stroke Foundation and Monash University 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 and discussions to enhance stroke care and outcomes. In 2022, we continued to host the National Stroke Data Linkage Interest Group (>60 members) and the Australian and New Zealand Stroke Coding Working Group (>15 members), being led by Management Committee member A/Prof Monique Kilkenny and colleagues.

Peak bodies, including the Australian Cardiovascular Alliance, Population Health Research Network and Murdoch Children's Institute invited AuSCR leaders to present to their members or committees about the AuSCR and its progress as a leading exemplar of a national Clinical Quality Registry.

APPENDIX B:
COMMITTEE MEMBERSHIP

AuSCR Steering Committee 2022

Prof Sandy Middleton (Chair)	**Director, Nursing Research Institute, St Vincent's Health Australia (Sydney) & Australian Catholic University [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 & Co-Director, Stroke and Ageing Research, Monash University [VIC]
Dr Helen Castley	Neurologist, Royal Hobart Hospital & Co-chair, Clinical Advisory Group (Neurology & Stroke) [TAS]
Prof Geoffrey Donnan	Professor of Neurology, The University of Melbourne [VIC]
Prof Rohan Grimley	Geriatrician & Stroke Clinician, Sunshine Coast University Hospital & Professor, School of Medicine and Dentistry, Griffith University [QLD]
Prof Susan Hillier	Dean, Research (and Research Education), Division of Health Sciences, University of South Australia [SA]
Prof Natasha Lannin	Group Leader, Brain Recovery and Rehabilitation Group, Department of Neuroscience, Central Clinical School, 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]
Dr Andrew Wesseldine	Geriatrician and Stroke Physician, St John of God Subiaco & State Stroke Director [WA]
Prof Bernard Yan	Endovascular Neurointerventionist and Neurologist, Royal Melbourne Hospital [VIC]
Dr Lisa Murphy	Executive Director Stroke Services and Research, Stroke Foundation [VIC]
Dr Ross Clifton	Director, Australasian Rehabilitation Outcomes Centre, University of Wollongong [NSW]

AuSCR Management Committee 2022

Prof Natasha Lannin (Chair Jan - July)	**Group Leader, Brain Recovery and Rehabilitation Group, Department of Neuroscience, Central Clinical School, Monash University [VIC]**
Prof Helen Dewey (Chair August – December)	**Director of Neurosciences, Eastern Health & Professor, Eastern Health Clinical School, Monash University [VIC]**
Prof Dominique Cadilhac	Head, Public Health, Stroke Division, The Florey Institute of Neuroscience and Mental Health & Co-Director, Stroke and Ageing Research, Monash University [VIC]
Prof Geoffrey Cloud	Director of Stroke Services, Alfred Health [VIC]
Prof Geoffrey Donnan	Professor of Neurology, The University of Melbourne [VIC]
Prof Steven Faux	Director, Department of Pain Medicine, St Vincent's Hospital, Sydney [NSW]
Prof Rohan Grimley	Geriatrician & Stroke Clinician, Sunshine Coast University Hospital & Professor, School of Medicine and Dentistry, Griffith University [QLD]
Mr Kelvin Hill	National Manager, Stroke Treatment, Stroke Foundation [NSW]
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 2022

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 Dominique Cadilhac	Head, Public Health, Stroke Division, The Florey Institute of Neuroscience and Mental Health & Co-Director, Stroke and Ageing Research, Monash University [VIC]
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 Rebecca Scroop	Interventional Neuroradiologist, Royal Adelaide Hospital [SA]
A/Prof Andrew Wong	Neurologist, Royal Brisbane and Women's Hospital & Co-chair, Queensland Statewide Stroke Clinical Network [QLD]
Dr Darshan Shah	Stroke Physician, 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	Deputy Director-General, Clinical Excellence Queensland, Clinical Director of the Neuroscience Division, Royal Brisbane and Women's Hospital and Director of the Neurosciences Research Institute at Metro North Health [QLD]
A/Prof Hamed Asadi	Consultant Interventional Neuroradiologist, Austin & Monash Health [VIC]
Dr Patrick Salvaris	General Physician & Stroke Physician, St John of God Midland Public and Private Hospitals [WA]
Dr Martin Banez	Interventional Neuroradiologist, Royal Hobart Hospital [TAS]

AuSCR State Clinical Leads and Representatives 2022

Prof Dominique Cadilhac (Chair)	**Head, Public Health, Stroke Division, The Florey Institute of Neuroscience and Mental Health & Co-Director, Stroke and Ageing Research, Monash University [VIC]**
Prof Geoffrey Cloud	Director of Stroke Services, Alfred Health [VIC]
A/Prof Ben Clissold	Stroke Clinical Lead, Safer Care Victoria & Head, In-patient Services (Neurosciences), Barwon Health & Stroke Neurologist, University Hospital Geelong and Monash Medical Centre [VIC]
Prof Geoffrey Donnan	Professor of Neurology, The University of Melbourne [VIC]
Ms Shahla Cowans	Stroke Nurse Navigator, Canberra Hospital [ACT]
Prof Sandy Middleton	Director, Nursing Research Institute, St Vincent's Health Australia (Sydney) & Australian Catholic University [NSW]
Dr Helen Brown	Deputy Director-General, Clinical Excellence Queensland, Clinical Director of the Neuroscience Division, Royal Brisbane and Women's Hospital and Director of the Neurosciences Research Institute at Metro North Health [QLD]
Prof Rohan Grimley	Geriatrician & Stroke Clinician, Sunshine Coast University Hospital & Professor, School of Medicine and Dentistry, Griffith University [QLD]
Prof Tim Kleinig	Head, Neurology, Royal Adelaide Hospital [SA]
Dr Helen Castley	Neurologist, Royal Hobart Hospital & Co-chair, Clinical Advisory Group (Neurology & Stroke) [TAS]
Dr Andrew Wesseldine	Geriatrician and Stroke Physician, St John of God Subiaco & State Stroke Director [WA]
Prof Helen Dewey	Director of Neurosciences, Eastern Health & Professor, Eastern Health Clinical School, Monash University [VIC]
Prof Natasha Lannin	Group Leader, Brain Recovery and Rehabilitation Group, Department of Neuroscience, Central Clinical School, Monash University [VIC]
Mr Kelvin Hill	National Manager, Stroke Treatment, Stroke Foundation [NSW]

AuSCR Paediatric Subcommittee 2022

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 & Co-Director, Stroke and Ageing Research, Monash University [VIC]
Prof Rohan Grimley	Geriatrician & Stroke Clinician, Sunshine Coast University Hospital & Professor, School of Medicine and Dentistry, Griffith University [QLD]
Ms Belinda Stojanovski	Stroke Nurse Consultant, Royal Children's Hospital [VIC]
Ms Jot Ghuliani	Australian Stroke Data Tool (AuSDaT) Program Manager, AuSCR Coordinator, and AuSCR Data Manager [VIC]

AuSCR Research Task Group 2022

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 & Health Sciences, Edith Cowan University [WA]
A/ Prof Benjamin Clissold	Stroke Clinical Lead, Safer Care Victoria & Head, In-patient Services (Neurosciences), Barwon Health & Stroke Neurologist, University Hospital Geelong and Monash Medical Centre [VIC]
Dr Philip Choi	Consultant Neurologist, Department of Neurosciences, Eastern Health [VIC]
Prof Suzanne Kuys	National Head, School of Physiotherapy, Australian Catholic University & Principal Research Fellow, Queensland Health [QLD]
Prof Bernard Yan	Endovascular Neurointerventionist and Neurologist, Royal Melbourne Hospital [VIC]
Dr Daniel Schweitzer	General Neurologist, Mater Hospital & The Wesley Hospital [QLD]
Dr Karim Mahawish	Consultant in General, Geriatric and Stroke Medicine, Mid Central 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 2022

In 2022, 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 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	$62,342
Governments grants	$812,148
The Florey, Stroke Theme support	$25,663
Stroke Foundation*	$23,340
Commercial income†	$130,653
Available funds	$1,054,147
Expenses	$1,002,929

*There was also additional support for the Australian Stroke Data Tool in maintenance costs ($34,735) paid directly to Amazon Web Services or Argenti by the Stroke Foundation.
† Income from projects approved by the AuSCR Research Task Group.

APPENDIX D:
ACKNOWLEDGEMENTS

We also gratefully acknowledge:

- 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
- Stephanie Ho for sharing her story of her stroke and recovery journey with us for inclusion in this report

This report would not have been possible without the efforts of doctors, nurses, ward clerks and other staff from participating hospitals that contributed data to the AuSCR. Lead clinical and data collection staff for each hospital participating in the AuSCR during 2022 are gratefully acknowledged below.

ACT	
Canberra Health Service	Shahla Cowans
North Canberra Hospital	Ronak Patel; Yash Gawarikar; Pallavi Singh; Kristine Caprecho; Sheryl Javier
QLD	
Bundaberg Hospital	Peter Wood; Nicole Blunt; Juliet Weicks; Simone Rogers
Caboolture Hospital	Marnie Hollywood
Cairns Hospital	Ramesh Durairaj; Spencer Irvin; Elise Bertram; Troy Elliott
Gold Coast University Hospital	Saman Heshmat; Haylee Berrill
Hervey Bay Hospital	Peter Wood; Alison Fuller; Sarah Leak; Tara Ryton-Malden; Donna Stubbings; Heidi Brown; Lauren Murphy
Ipswich Hospital	Juan Rois-Gnecco; Linda Edwards; Betzy Shaju
Logan Hospital	Alex Lau; Nicola Hall; Stephanie Wigan
Mackay Base Hospital	Anne Hooper
Mater Hospital Brisbane	Rodrigo Tomazini Martins; Brendon Glenn
Prince Charles Hospital	Kathryn Colebourne; Caitlin Kearney
Princess Alexandra Hospital	Laura Clarke; Melissa Brooks; Angela Adina; Amanda McKee
Queen Elizabeth II Jubilee Hospital	Amanda Siller; Aylissa Canning; Jerry Wong; Evelyn Anino
Queensland Children's Hospital	Adriane Sinclair; Louise Sparkes
Redcliffe Hospital	Richard Geraghty; Lee Moylan
Redland Hospital	Jenna Allen; Emma Butler
Robina Hospital	Saman Heshmat; Haylee Berrill
Rockhampton Hospital	Leanne Whiley
Royal Brisbane and Women's Hospital	Andrew Wong; Melissa Wood
Sunshine Coast University Hospital	Rohan Grimley; Donna Rowley
Toowoomba Hospital	Nisal Gange; Timothy Richardson
Townsville University Hospital	Ravindra Urkude; Andrea Reeks; Nerida Myers; Linda Norrie
SA	
Flinders Medical Centre	Matthew Willcourt; Michelle Hutchinson
Lyell McEwin Hospital	Andrew Moey; Tej Chuwan; 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 & Wodonga Campus)	Vanessa Crosby; Kate Wiesner
Alfred Hospital	Geoffrey Cloud; Angela Dos Santos; Danny Kinsella; Kieran Taylor; Elaine Cheung
Austin Hospital	Vincent Thijs; Ben Metherell; Renae Gamble; Kristen Rowe
Bairnsdale Regional Health Service	Kushantha Gunarathne; Renee Herbstreit; Alison Pearce; Simone Gibbs
Bass Coast Health	Cath Jones; Ben Shields
Bendigo Health	Mark Savage; Lucille Monahan; Erin Ray; Tessa Coupland
Box Hill Hospital	Helen Dewey; Tanya Frost; Karen Stephens
Central Gippsland Health Service	Jun Dai; Anne van Berkel
Echuca Regional Health	Lauren Arthurson
Goulburn Valley Health	Katie Connelly
Grampians Health Ballarat	Thomas Kraemer; Casey Hair; Shannon Walker
Grampians Health Horsham	Fari Islam; Deidre Rennick
Hamilton Base Hospital	Courtney Rowe; Louise Starkie
Latrobe Regional Health	Janet May
Maroondah Hospital	Helen Dewey; Tanya Frost; Karen Stephens
Mildura Base Public Hospital	Ros Roberts
Monash Medical Centre	Henry Ma; Berzenn Urbi; Parry Desai; Heather Gilbert
Northern Hospital	Douglas Crompton; Anne Rodda
Peninsula Health - Frankston Hospital	Ernie Butler; Liz Mackey
Royal Children's Hospital	Mark Mackay; Belinda Stojanovski; Adam Rozsa
Royal Melbourne Hospital	Bruce Campbell; Gagan Sharma; Lauren Pesavento
St Vincent's Hospital Victoria	Lauren Sanders; Patrick Scarff
Sunshine Hospital - Western Health	Tissa Wijeratne; Jennifer Bergqvist
Swan Hill District Health	Kath Curran; Kelly Stanger; Cathy McLaughlin; Robyn Bailey
University Hospital Geelong	Ben Clissold; Michelle Hiddleston
Warrnambool Base Hospital	Anna Clissold; Patrick Groot; Trisha Patt
Werribee Mercy Hospital	Manny Bautista; Daniel Goldberg; Debbie Rockliffe
West Gippsland Hospital	Mirza Baig; Nicole Caddy; Lorraine Keene
WA	
Fiona Stanley Hospital	Darshan Ghia; Gillian Edmonds; Kerri-Ann Whittaker
Royal Perth Hospital	Lay Kun Kho; Kala Fernandez
Joondalup Health Campus	Shivlal David; Glynis Porter; Cherie Ingvarson

APPENDIX E: TRANSIENT ISCHAEMIC ATTACK DATA

PATIENT AND CLINICAL CHARACTERISTICS

In 2022, there were 2509 episodes of transient ischaemic attack (TIA) recorded for 2370 patients.

Table III: Characteristics of adult TIA patients

Demographics	Patients N=2370
Median age (25th–75th percentile), in years	75 (64–83)
Female	45%
Hospital stroke care	**Episodes N=2509**
Stroke unit care	48%
Antiplatelet therapy within 48 hours of onset*	87%
Mobilised during episode	93%
Mobilised same day or day after arrival	88%
Swallow screen or assessment conducted	72%
Swallow screen or assessment within 4 hours†	29%
Swallow screen or assessment before oral intake	43%
Discharged to the community with:	
Antihypertensive medication ‡	71%
Antithrombotic medication ‡§	93%
Lipid-lowering medication ‡§	86%
Combination of medications ‡§#	64%
Care plan outlining post-discharge care	47%

Excludes episodes arriving to hospital after 48 hours from onset.
† Excludes episodes transferred from another hospital.
‡ Excludes episodes with documented contraindications.
§ Excludes episodes of intracerebral haemorrhage.
 # Antihypertensive, antithrombotic and lipid-lowering medication.

POST-DISCHARGE HEALTH INFORMATION

Among the 2370 adult patients, there were 2,495 unique TIA events eligible for follow-up (i.e., 125 recurrent TIAs for the same person also eligible for follow-up in the same calendar year). We received responses from 62% (n=1258) patients or their proxies (i.e., next of kin or nominated contact person). The median time to completion of follow-up was 143 days post-admission (Q1 to Q3: 107 to 174 days).

Table IV: Outcome information from episodes of TIA

	N=1.258
	n (%)
Living at home at the time of follow-up interview	1139 (92)
Had a recurrent stroke	74 (6)
Readmitted to hospital	264 (22)
Median time to readmission (25th–75th percentile), in days	72 (41–108)
Reason for readmission	
Stroke or transient ischaemic attack	44 (17)
Cardiovascular disease	41 (16)
Functionally dependent (modified Rankin Scale ≥3)	244 (20)
Reported problems with EQ-5D-3L dimension:	
Mobility	42%
Self-care	18%
Usual activities	43%
Pain/Discomfort	46%
Anxiety/Depression	42%
Visual Analogue Scale mean (standard deviation)	72 (20)
Visual Analogue Scale median (25th–75th percentile)	75 (60–87)

Missing responses excluded from denominators.

In 2022, hospitals participated in one of three core AuSCR programs:

• 46 hospitals contributed to the AuSCR Red program

• 13 hospitals performing endovascular clot retrieval (ECR) contributed to the AuSCR Black program

• Two paediatric hospitals contributed to the AuSCR Paediatrics program

Hospitals could choose to also participate in the two optional programs:

• 26 hospitals contributed to the AuSCR ED (Emergency Department) program

• 20 hospitals contributed to the AuSCR FeSS (Fever Sugar Swallow) program
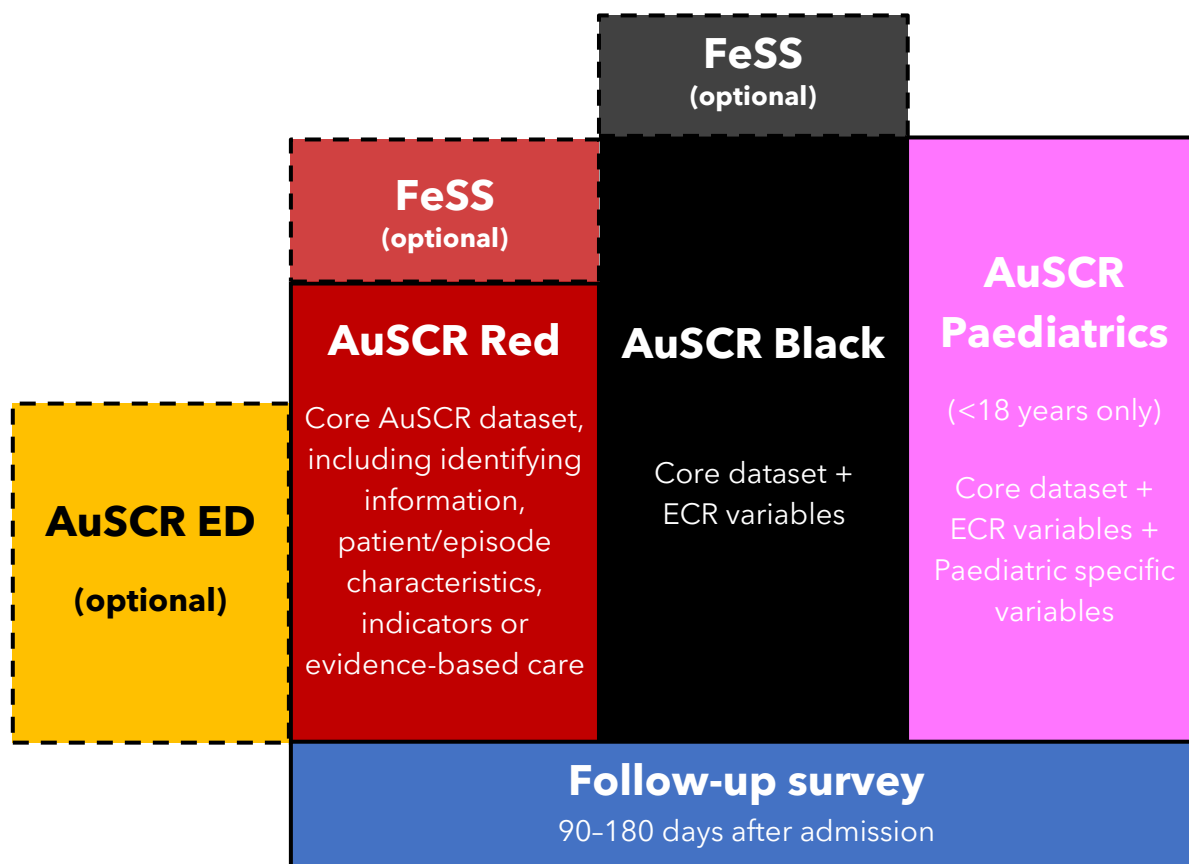
ED: Emergency Department   **ECR:** Endovascular Clot Retrieval   **FeSS:** Fever, Sugar, Swallow

Each colour represents a different amount or type of variables in which AuSCR hospitals choose to collect data based on their quality-of-care objectives. The follow-up survey is collected on behalf of hospitals by AuSCR Office.

APPENDIX G:
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
- Mechanism of stroke (P)
- Date and time of stroke onset
- 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
- History of known risk factors

Indicators of evidence-based care
- Treatment in a stroke unit
- Imaging details
- 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
- Discharged on antithrombotic medication
- Discharged on antihypertensive medication
- Discharged on lipid-lowering medication
- Care plan provided at discharge (documented in the medical record)

Endovascular clot retrieval (ECR) variables
- 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

Follow-up variables 90 to 180 days after admission
- Survivor status
- Place of residence
- Living alone status
- Subsequent stroke since discharge
- Readmission to hospital
- Paediatric stroke outcome measure (PSOM) (P)
- Quality of life
- Modified Rankin Scale
- Would like an information pack from the Stroke Foundation
- Willingness 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)#

- Was temperature recorded ≥4 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?
- Was a finger-prick blood glucose level recorded ≥4 times on day one of ward admission?
- In the first 48 hrs following ward admission did the patient develop a finger-prick glucose level ≥10 mmol/L?
- Was insulin administered within 1 hour of the first elevated finger-prick glucose (≥ 10 mmol/L)?

AuSCR programs allow hospitals to collect a bundle of variables depending on hospital resources and priorities.

(P) Collected only as part of the paediatric dataset.

 # Swallowing is captured in core AuSCR programs.

APPENDIX H: DERIVING QUALITY INDICATORS

Indicator*	Numerator	Denominator	Comments	Program BLACK	RED	ED
Door-in-door-out time for endovascular stroke therapy	ED transfer date/time – ED arrival date/time		**Includes episodes transferred for endovascular therapy**			✔
Endovascular stroke therapy (ischaemic strokes only)	Yes	Yes + No + Unknown + Missing	**Excludes episodes transferred from another hospital**	✔		
Door-to-groin time	Groin puncture date/time – ED arrival time/time (or date/time of admission if missing)		**Excludes episodes transferred from another hospital**. Excludes negative times or those >720 minutes.	✔		
Thrombolytic delivery (ischaemic strokes only) **(Indicator 2a)**	Yes	Yes + No + Unknown + Missing	**Excludes in-hospital strokes or episodes transferred from another hospital.**	✔	✔	✔
Door-to-needle time	Thrombolytic delivery date/time – ED arrival date/time (or date/time of stroke onset for in-hospital strokes)		**Excludes in-hospital strokes or episodes transferred from another hospital.** Excludes negative times or those >270 minutes.	✔	✔	✔
Received stroke unit care **(Indicator 3a)**	Yes	Yes + No + Unknown + Missing		✔	✔	
Antithrombotic therapy within 48 hours of stroke onset	Yes (antiplatelet or other antithrombotic provided)	Yes + No + Unknown + Missing	Excludes patients with intracerebral haemorrhage, missing stroke type, if contraindicated, **or those who arrived >48hrs from onset.**	✔	✔	
Mobilised during episode	Yes	Yes + No + Unknown + Missing		✔	✔	
Mobilised same day or day after arrival†	Yes	Yes + No + Unknown + Missing		✔	✔	
Swallow screen or assessment conducted	Yes	Yes + No + Unknown + Missing		✔	✔	
Swallow screen or assessment within 4 hours of arrival†	Yes	Yes + No + Unknown + Missing	Excludes episodes transferred from another hospital.	✔	✔	
Swallow screen or assessment prior to oral intake	Yes	Yes + No + Unknown + Missing	Must be yes for both oral medication and food/fluids	✔	✔	✔
Antihypertensive medications prescribed if discharged to the community **(Indicator 5a)**	Yes	Yes + No + Unknown + Missing	Includes patients without contraindications **discharged to home, aged care, transitional care or other**	✔	✔	
Antithrombotic medications prescribed if discharged to the community **(Indicator 5d)**	Yes	Yes + No + Unknown + Missing	Includes patients without intracerebral haemorrhage or contraindications **discharged to home, aged care, transitional care or other**	✔	✔	
Lipid-lowering medications prescribed if discharged to the community **(Indicator 5b)**	Yes	Yes + No + Unknown + Missing	Includes patients without intracerebral haemorrhage or contraindications **discharged to home, aged care, transitional care or other**	✔	✔	
Care plan provided if discharged to the community **(Indicator 7a)**	Yes	Yes + No + Unknown + Missing	Includes patients without contraindications **discharged to home, aged care, transitional care or other**	✔	✔	

All indicators exclude data from hospitals where >30% of relevant data are missing.
† Or from date of stroke onset for patients with in-hospital stroke.
Bold used to indicate new changes to calculation method in 2022.
Red indicates relevant Acute Stroke Clinical Care Standard Indicator.[1]

APPENDIX I:
RESEARCH APPLICATIONS

In 2022, there were three external applications reviewed by the Research Task Group:

- Fever, Hyperglycaemia (Sugar), Swallow (FeSS) clinical guidelines adherence: analysis of national audit data and stroke registry data (PIs: Ms Kelly Coughlan, Prof Sandy Middleton, Dr Oyebola Fasugba, Ms Simeon Dale; Australian Catholic University).

- Feasibility study of a multicomponent digital Care Assistant and support Program for people after Stroke or transient ischaemic attack: CAPS (PI: Dr Jan Cameron, AIs: Prof Dominique Cadilhac, Prof Natasha Lannin, Dr Tharshanah Thayabaranathan, Dr David Silvera, Dr Marlien Varnfield, Dr Jane Li, Dr Christian Redd, Ms Vanessa Smallbon; Monash University).

- SAFER-AUS: Screening for Atrial Fibrillation with ECG to Reduce stroke – a randomised controlled trial (PI: Prof Ben Freedman, AIs: Prof Mark Nelson, Prof Charlotte Hespe, Prof Chris Reid, Dr Nicole Lowres, Prof Dominique Cadillhac, Prof Vincent Thijs, Assoc Prof Monique Kilkenny, Prof Anthony Keech, Prof John Simes, Prof Jonathan Mant; University of Sydney).

APPENDIX J:
STROKE PERFORMANCE SCORECARD

In 2022, we piloted the Stroke Performance Scorecard to provide hospitals with a simple colour-coded summary of their performance to AuSCR quality indicators over time, and against achievable benchmarks.

STROKE PERFORMANCE SCORECARD

AuSCR — Australian Stroke Clinical Registry

Sample Hospital		2021 N= 1056	2022 N= 1092
Case ascertainment		100%	100%
Quality indicator	2022 Benchmark*	% Adherence	% Adherence
Endovascular stroke therapy (ischaemic strokes presenting directly only)†	23%	17	24
Median door-to-groin time, in minutes	115‡	96	93
Thrombolytic delivery (ischaemic strokes only)	17%	11	15
Median door-to-needle time, in minutes	75‡	65	59
Door-to-needle within 60 minutes	79%	50	55
Stroke unit care	95%	84	90
Antithrombotic therapy within 48 hours of stroke onset†	94%	64	82
Mobilised same day or day after arrival	80%	60	55
Swallow screen or assessment prior to oral intake	92%	65	85
Swallow screen or assessment within 4 hours	56%	44	50
Antihypertensive medications prescribed (if discharged to the community)†	94%	80	74
Antithrombotic medications prescribed (if discharged to the community)†	99%	96	99
Lipid-lowering medications prescribed (if discharged to the community)†	98%	45	90
Care plan provided (if discharged to the community)†	99%	97	99

Key to colour-coded scoring system §			
● (red)	● (orange)	● (light green)	✦ (dark green)
Low outlier in the relevant time period #	Below the national average in the relevant time period	Above the national average in the relevant time period	At, or above, the benchmark in the relevant time period

* Achievable benchmarks relate to the 2022 year and are derived using a modified ABC™ method for stroke episodes only.
† Updated calculation method in 2022 (see further details on the next page).
‡ 2022 national median presented in lieu of a benchmark.
§ Coloured circles are not shown if your hospital did not collect data on the quality indicator or >30% of data were missing.
# Red is also only assigned if >50 episodes contributed to the denominator and ≤30% of data were missing.

APPENDIX K:
ASC AND WSO AWARDS

AUSTRALIAN STROKE COALITION AWARDS

In 2022, 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 01/07/2021 to 31/03/2022, 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); Townsville Hospital (QLD); Rockhampton Hospital (QLD); Cairns Hospital (QLD); Princess Alexandra Hospital (QLD); Mackay Hospital (QLD); Echuca Regional Health (VIC); Wimmera Base Hospital (VIC); West Gippsland Hospital (VIC); Canberra Health Service (ACT); Calvary Health Care (ACT); Mater Hospital Brisbane (QLD).

MERIT AWARDS: Logan Hospital (QLD); Bendigo Health (VIC); St Vincent's Hospital Victoria (VIC); Ipswich Hospital (QLD); Caboolture Hospital (QLD); Albury Wodonga Health - Albury Campus (VIC/NSW); Toowoomba Hospital (QLD); Redcliffe Hospital (QLD); Latrobe Regional Hospital (VIC); Goulburn Valley Health (VIC); Warrnambool Base Hospital (VIC); Mildura Base Hospital (VIC); Hamilton Base Hospital (VIC); Bundaberg Hospital (QLD); Swan Hill District Health (VIC); Central Gippsland Health Service (VIC).

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 Melbourne Hospital (VIC); Gold

Coast University Hospital (QLD); Royal Brisbane and Women's Hospital (QLD); Queen Elizabeth II Jubilee Hospital (QLD); Westmead Hospital (NSW).

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: 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), Canberra Health Service (ACT), Princess Alexandra Hospital (QLD), 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). There were no honourable mentions for median door-to-needle time for thrombolysis of less than 60 minutes.

WORLD STROKE ORGANISATION ANGELS AWARDS

In 2022, in partnership with the Australian Stroke Coalition, hospitals that submitted a minimum of 30 consecutive admissions to the AuSCR from 01/07/2021 to 31/03/2022 were eligible for consideration in the WSO Angels Awards. The award categories were Gold status, Platinum status or Diamond status. Data were extracted from the AuSDaT on 22 Aug 2022 for these analyses.

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: Echuca Regional Health (VIC) and Central Gippsland Health Service (VIC)

APPENDIX L:
RESEARCH TRANSLATION

Journal Publications

1. Barclay KM, Kilkenny MF, Breen SJ, Ryan OF, Bagot KL, Lannin NA, Thijs V, Cadilhac DA. Denial of Cerebrovascular Events in a National Clinical Quality Registry for Stroke: A Retrospective Cohort Study. J Stroke Cerebrovasc Dis 2022;31: 106210.
doi.org/10.1016/j.jstrokecerebrovasdis.2021.106210.

2. Bladin CF, Bagot KL, Vu M, Kim J, Bernard S, Smith K, Hocking G, Coupland T, Pearce D, Badcock D, Budge M, Nadurata V, Pearce W, Hall H, Kelly B, Spencer A, Chapman P, Oqueli E, Sahathevan R, Kraemer T, Hair C, Stub D, Cadilhac DA. Real-world, feasibility study to investigate the use of a multidisciplinary app (Pulsara) to improve prehospital communication and timelines for acute stroke/STEMI care. BMJ Open 2022;12: e052332. doi.org/10.1136/bmjopen-2021-052332.

3. Cadilhac DA, Cameron J, Kilkenny MF, Andrew NE, Harris D, Ellery F, Thrift AG, Purvis T, Kneebone I, Dewey H, Drummond A, Hackett M, Grimley R, Middleton S, Thijs V, Cloud G, Carey M, Butler E, Ma H, Churilov L, Hankey GJ, English C, Lannin NA. Protocol of a randomized controlled trial investigating the effectiveness of Recovery-focused Community support to Avoid readmissions and improve Participation after Stroke (ReCAPS). Int J Stroke 2022;17: 236-41.
doi.org/10.1177/17474930211022678.

4. Cadilhac DA, Kim J, Cloud G, Anderson CS, Tod EK, Breen SJ, Faux S, Kleinig T, Castley H, Lindley RI, Middleton S, Yan B, Hill K, Jones B, Shah D, Jaques K, Clissold B, Campbell B, Lannin NA. Effect of the Coronavirus Disease 2019 Pandemic on the Quality of Stroke Care in Stroke Units and Alternative Wards: A National Comparative Analysis. J Stroke 2022;24: 79-87. doi.org/10.5853/jos.2021.02530.

5. Cadilhac DA, Marion V, Andrew NE, Breen SJ, Grabsch B, Purvis T, Morrison JL, Lannin NA, Grimley RS, Middleton S, Kilkenny MF. A Stepped-Wedge Cluster-Randomized Trial to Improve Adherence to Evidence-Based Practices for Acute Stroke Management. Jt Comm J Qual Patient Saf 2022;48: 653-64. doi.org/10.1016/j.jcjq.2022.09.003.

6. Cameron J, Lannin NA, Harris D, Andrew NE, Kilkenny MF, Purvis T, Thrift AG, Thayabaranathan T, Ellery F, Sookram G, Hackett M, Kneebone I, Drummond A, Cadilhac DA. A mixed-methods feasibility study of a new digital health support package for people after stroke: the Recovery-focused Community support to Avoid readmissions and improve Participation after Stroke (ReCAPS) intervention. Pilot Feasibility Stud 2022;8: 241. doi.org/10.1186/s40814-022-01197-8.

7. Clancy B, Bonevski B, English C, Baker AL, Turner A, Magin P, Pollack M, Callister R, Guillaumier A. Access to and Use of Internet and Social Media by Low-Morbidity Stroke Survivors Participating in a National Web-Based Secondary Stroke Prevention Trial: Cross-sectional Survey. J Med Internet Res 2022;24: e33291. doi.org/10.2196/33291.

8. Dalli LL, Andrew NE, Kim J, Cadilhac DA, Sanfilippo FM, Thrift AG, Nelson MR, Lannin NA, Olaiya MT, Ryan OF, Booth B, Gall S, Kilkenny MF. Understanding of medications and associations with adherence, unmet needs, and perceived control of risk factors at two years post-stroke. Res Social Adm Pharm 2022;18: 3542-49. doi.org/10.1016/j.sapharm.2022.01.007.

9. Eliakundu AL, Cadilhac DA, Kim J, Kilkenny MF, Bagot KL, Andrew E, Cox S, Bladin CF, Stephenson M, Pesavento L, Sanders L, Clissold B, Ma H, Smith K. Determining the sensitivity of emergency dispatcher and paramedic diagnosis of stroke: statewide registry linkage study. J Am Coll Emerg Physicians Open 2022;3: e12750. doi.org/10.1002/emp2.12750.

10. Eliakundu AL, Smith K, Kilkenny MF, Kim J, Bagot KL, Andrew E, Cox S, Bladin CF, Cadilhac DA. Linking Data From the Australian Stroke Clinical Registry With Ambulance and Emergency Administrative Data in Victoria. Inquiry 2022;59: 469580221102200.
doi.org/10.1177/00469580221102200.

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doi.org/10.1159/000520823.

12. Kim J, Grimley R, Kilkenny MF, Cadigan G, Johnston T, Andrew NE, Thrift AG, Lannin NA, Sundararajan V, Cadilhac DA. Costs of acute hospitalisation for stroke and transient ischaemic attack in Australia. Health Inf Manag 2023;52: 176-84. doi.org/10.1177/18333583221090277.

13. Olaiya MT, Andrew NE, Dalli LL, Ung D, Kim J, Cadilhac DA, Wood P, May J, Clissold B, Kilkenny MF. Real-World Effectiveness of Lipid-Lowering Medications on Outcomes after Stroke: Potential Implications of the New-User Design. Neuroepidemiology 2022;56: 365-72. doi.org/10.1159/000526071.

14. Olaiya MT, Andrew NE, Dalli LL, Ung D, Kim J, Sundararajan V, Cadilhac DA, Thrift AG, Nelson MR, Churilov L, Kilkenny MF. Does a History of Cancer Influence the Effectiveness of Statins on Outcomes After Stroke? Stroke 2022;53: 3202-05. doi.org/10.1161/strokeaha.122.038829.

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16. Ryan OF, Hancock SL, Marion V, Kelly P, Kilkenny MF, Clissold B, Gunzburg P, Cooke S, Guy L, Sanders L, Breen S, Cadilhac DA. Feedback of aggregate patient-reported outcomes (PROs) data to clinicians and hospital end users: findings from an Australian codesign workshop process. BMJ Open 2022;12: e055999. doi.org/10.1136/bmjopen-2021-055999.

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Presentations and Posters

1. Cadilhac DA. Support to prevent future strokes and facilitate self-management facilitated by eHealth to reduce inequities. International Stroke Conference 2022, New Orleans, Los Angeles and Virtual, 8 February 2022

2. Cadilhac DA. Using clinical registries to improve care. Session: Future directions – case studies from elsewhere. PREDICT Implementation research virtual workshop, Murdoch Children's Research Institute, Melbourne, 31 March 2022

3. Cadilhac DA. Patient reported outcomes for guiding clinical practice, comparing service performance, and clinical data interpretation. ICNE 2022 Virtual Conference, 31 March 2022

4. Cadilhac DA, Kilkenny MF. National Stroke Data Linkage Program: 10 years of progress. PHRN Linkage Luminaries Webinar Series, 31 March 2022

5. Cadilhac DA, Kilkenny MF, Alexander, T. Aphasia CRE early career researcher peer capacity building group. ASCR and AROC, Melbourne, 25 May 2022

6. Cadilhac DA. Stroke - statistics, gaps and inequities. ACvA Stroke Clinical Theme Virtual Workshop, 30 May 2022

7. Cadilhac DA. Health Economic Aspects of Stroke. Stroke 2022, 31st Annual Scientific Meeting of the Stroke Society of Australasia, Christchurch, 1 September 2022

8. Cadilhac DA. Progress with the registry program and future directions: National and WSO Angels Awards, SMS and A-LISTS Project. 10th Annual National Stroke Quality Improvement Workshop, Parkville, 21 October 2022

9. Cadilhac DA. Using AuSCR data for publications and how to get involved in writing committees.10th Annual National Stroke Quality Improvement Workshop, Parkville, 21 October 2022

10. Cadilhac DA. Long-Term Mortality after Admission for Stroke between 2010-2020: Observational data from the Australian Stroke Clinical Registry [Oral selected from Abstract]. 14th World Stroke Congress, Singapore, 26 October 2022

11. Cadilhac DA. Australian Stroke Clinical Registry: Automation of data entry. Australian Registry Annual Scientific Meeting, ACTA, Adelaide, 7 November 2022

12. Cadilhac DA. Clinical Quality Registry Interoperability Workshop: Australian Stroke Clinical Registry. Commonwealth Government, Adelaide, 8 November 2022

13. Carter H. Interpreting AuSCR Data: Live reports, exports and hospital performance reports. 10th Annual National Stroke Quality Improvement Workshop, Parkville, 21 October 2022

14. Dale S, Coughlan K. Quality in Acute Stroke Care (QASC) Australia Project and Fever Sugar Swallow (FeSS) Adherence Project. 10th Annual National Stroke Quality Improvement Workshop, Parkville, 21 October 2022

15. Frost T. Improving door-in-door-out times. 10th Annual National Stroke Quality Improvement Workshop, Parkville, 21 October 2022

16. Hair C. Driving improvement through AuSCR data. 10th Annual National Stroke Quality Improvement Workshop, Parkville, 21 October 2022

17. May J. Improving door to CT times and in-patient stroke code development. 10th Annual National Stroke Quality Improvement Workshop, Parkville, 21 October 2022

18. Morrison J. Lessons from the 2021 Annual report and 2022 progress. 10th Annual National Stroke Quality Improvement Workshop, Parkville, 21 October 2022

19. Stirling M. After the data: an innovation for implementation. 10th Annual National Stroke Quality Improvement Workshop, Parkville, 21 October 2022

APPENDIX M: EMERGENCY DEPARTMENT DATA

Table I: Baseline and clinical characteristics

	N=363 adult patients
	n (%)
Age in years, mean (standard deviation)	68 (14)
Age in years, median (25th–75th percentile)	70 (61–78)
Female	158 (44)
	N=367 adult episodes
Clinical diagnosis	
Ischaemic	299 (81)
Intracerebral haemorrhage	54 (15)
Transient ischaemic attack	4 (1)
Undetermined	10 (3)
Able to walk on admission*	34 (11)
National Institutes of Health Stroke Scale	
No stroke symptoms (0)	15 (4)
Minor stroke (1–4)	58 (16)
Moderate stroke (5–15)	149 (41)
Moderate to severe stroke (16–20)	55 (15)
Severe stroke (21–42)	37 (10)
Missing	53 (14)
Modified Rankin Scale prior to stroke	
0 – No symptoms at all	256 (70)
1 – No significant disability despite symptoms	51 (14)
2 – Slight disability	25 (7)
3 – Moderate disability	18 (5)
4 – Moderately severe disability	7 (2)
5 – Severe disability	5 (1)
Missing	5 (1)
Triage category	
1	26 (7)
2	250 (68)
3	16 (4)
4	<5 (<1)
5	<5 (<1)
Missing	74 (20)

Excludes missing responses (12%).

Table II: Care provision in the Emergency Department

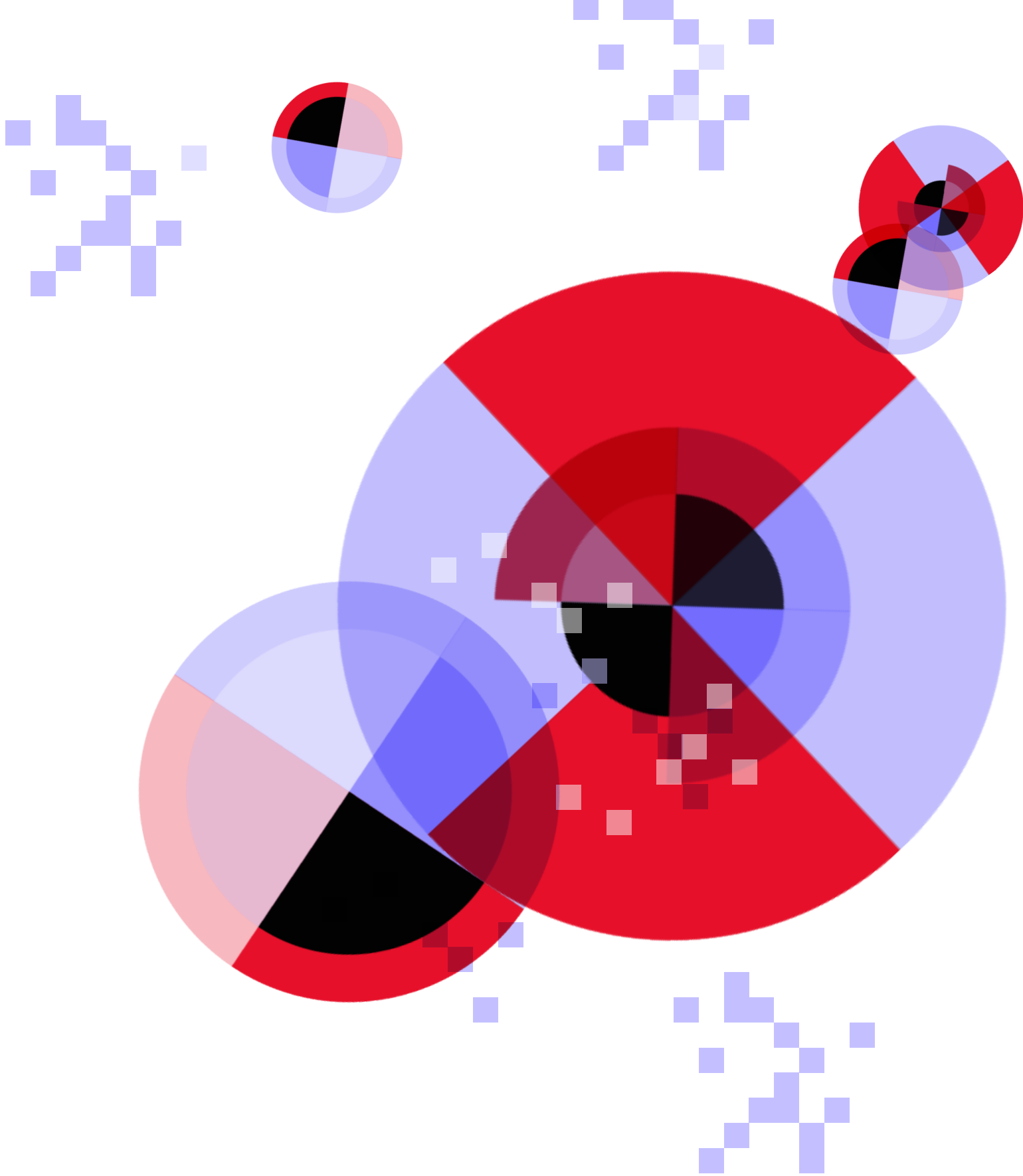|	N=367 adult episodes
	n (%)
Arrival by ambulance	322 (88)
Arrival within 4.5 hours of symptom onset	218 (59)
Pre-hospital notification by paramedics	188 (51)
Brain scan after stroke	300 (100)
Advanced Imaging Performed*	
CT angiography	330 (90)
CT perfusion	273 (75)
Diffusion weighted imaging	0 (0)
MR angiography	0 (0)
Perfusion weighted imaging	<5 (<1)
None	16 (4)
Median time to brain scan, minutes (25th–75th percentile) †	24 (14–47)
Provision of thrombolysis if ischaemic stroke	147 (49)
Serious adverse event related to thrombolysis occurred	5 (3)
Telemedicine consultation	157 (84)
Swallow screen conducted	70 (20)
Swallow screen prior to oral intake	114 (38)
Reason for transfer to another hospital *	
Need for intravenous thrombolysis	13 (4)
Need for stroke unit care	75 (20)
Need for specialist medical assessments	105 (29)
Need for surgical interventions	62 (17)
Need for diagnostic tests	48 (13)
Need for endovascular therapy	251 (68)
Unknown	31 (8)
Other	21 (6)

CT: computed tomography; MR: magnetic resonance.
* Responses are not mutually exclusive (i.e., >1 option may be selected).
† Excludes 11% missing or invalid responses (i.e., negative time or after 4.5 hours from arrival).

APPENDIX N:
ABBREVIATIONS

ABC™	Achievable benchmarks of care
ACT	Australian Capital Territory
APF	Adjusted performance fraction
ANZSO	Australian and New Zealand Stroke Organisation
ASC	Australian Stroke Coalition
ASGS	Australian Statistical Geography Standard
AuSCR	Australian Stroke Clinical Registry
AuSDaT	Australian Stroke Data Tool
ECR	Endovascular clot retrieval
ED	Emergency Department
EQ-5D-3L™	European Quality of Life - five dimension, three level instrument
FeSS	Fever Sugar Swallow
ICD-10	International Classification of Diseases (Version 10)
ICH	Intracerebral haemorrhage
mRS	Modified Rankin Scale
NDI	National Death Index
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
SD	Standard deviation
SSA	Stroke Society of Australasia
SMS	Short Message Service
TAS	Tasmania
TIA	Transient ischaemic attack
tPA	Tissue plasminogen activator
VAS	Visual Analogue Scale
VIC	Victoria
WA	Western Australia

AuSCR
Australian Stroke Clinical Registry