Improving acute stroke care in regional hospitals: clinical evaluation of the Victorian Stroke Telemedicine program

Chris F Bladin[1,2], Joosup Kim[1,3], Kathleen L Bagot[1,3], Michelle Vu[4], Natasha Moloczij[5], Sonia Denisenko[6], Chris Price[7], Nancy Pompeani[1], Lauren Arthurson[8], Casey Hair[9], Justin Rabl[10], Mick O'Shea[11], Patrick Groot[12], Leslie Bolitho[13], Bruce CV Campbell[14,15], Helen M Dewey[16], Geoffrey A Donnan[15], Dominique A Cadilhac[1,3]

The known: Telemedicine support has improved access to acute stroke therapies in regional hospitals overseas, but has not been provided on a large scale in Australia.

The new: The Victorian Stroke Telemedicine (VST) program in 16 hospitals in regional Victoria was associated with improved delivery of acute stroke therapies, including providing thrombolysis more quickly and safely.

The implications: The VST program has improved access to stroke specialists in regional Victoria and the quality of care for people with acute stroke. The program is now fully funded by the Victorian government.

Abstract

Objectives: To evaluate the impact of the Victorian Stroke Telemedicine (VST) program during its first 12 months on the quality of care provided to patients presenting with suspected stroke to hospitals in regional Victoria.

Design: Historical controlled cohort study comparing outcomes during a 12-month control period with those for the initial 12 months of full implementation of the VST program at each hospital.

Setting: 16 hospitals in regional Victoria that participated in the VST program between 1 January 2010 and 30 January 2016.

Participants: Adult patients with suspected stroke presenting to the emergency departments of the participating hospitals.

Main outcome measures: Indicators for key processes of care, including symptom onset-to-arrival, door-to-first medical review, and door-to-CT times; provision and timeliness of provision of thrombolysis to patients with ischaemic stroke.

Results: 2887 patients with suspected stroke presented to participating emergency departments during the control period, 3178 during the intervention period; the patient characteristics were similar for both periods. A slightly larger proportion of patients with ischaemic stroke who arrived within 4.5 hours of symptom onset received thrombolysis during the intervention than during the control period (37% *v* 30%). Door-to-CT scan time (median, 25 min [IQR, 13–49 min] *v* 34 min [IQR, 18–76 min]) and door-to-needle time for stroke thrombolysis (73 min [IQR, 56–96 min] *v* 102 min [IQR, 77–128 min]) were shorter during the intervention. The proportions of patients who received thrombolysis and had a symptomatic intracerebral haemorrhage (4% *v* 16%) or died in hospital (6% *v* 20%) were smaller during the intervention period.

Conclusions: Telemedicine has provided Victorian regional hospitals access to expert care for emergency department patients with suspected acute stroke. Eligible patients with ischaemic stroke are now receiving stroke thrombolysis more quickly and safely.

Stroke is a major cause of death and disability in Australia; about 65 000 people were hospitalised with stroke during 2016–17.[1,2] Hospitals that admit fewer than 200 patients with stroke per year provide intravenous thrombolysis within 4.5 hours of an ischaemic stroke less frequently than the larger capacity hospitals typical of metropolitan areas.[3] One of the major reasons for this difference is the lack of stroke expertise outside metropolitan areas, underscoring the need for acute stroke telemedicine services. Overseas, telemedicine has improved access to thrombolysis and other acute stroke therapies in non-metropolitan hospitals.[4] The risks of complications and mortality after thrombolysis delivered by clinicians without specialty expertise in stroke are lower when telemedicine clinical support is provided.[5] Despite the positive overseas experience, large scale telemedicine programs for people with stroke have not been introduced in Australia.

The Victorian Stroke Telemedicine (VST) program was introduced as a new model of clinical care for supporting the treatment of patients with acute stroke in Victorian regional hospitals. Using advanced audio-visual technology, clinicians at the 16 participating hospitals can discuss the diagnosis and treatment of patients with stroke specialists. Prior to the VST program, only five of the 16 hospitals routinely provided stroke thrombolysis for patients, and stroke care was provided by general physicians, apart from one hospital with a limited on-site neurology service.

The aim of our study was to evaluate the impact of the VST program during its first 12 months on the quality of care provided to patients presenting with suspected stroke to participating hospitals in regional Victoria.

Methods

The background to the program has been described elsewhere.[6,7] Briefly, the VST program provides a telemedicine service for acute stroke to 16 hospitals in regional Victoria, 24 hours a day, 365 days a year (Box 1). The number of emergency department (ED) urgent cases seen per year (triage categories 1–4) at the participating hospitals during 2016–17 ranged from 5741 for Hamilton to 50 969 for Ballarat (data source: MyHospitals, https://www.aihw.gov.au/myhospitals).

Victorian Stroke Telemedicine program: clinical protocol and implementation

Patients with symptoms of suspected stroke were assessed by ED clinical staff according to the standard computed tomography (CT) imaging protocol (non-contrast CT brain, CT angiogram). A stroke specialist on the VST program roster was contacted at the discretion of ED clinicians on a dedicated toll-free telephone number. Audio-visual consultation between the VST stroke specialist, ED clinical staff, and patients (and their family and carers) was facilitated by a telemedicine

[1] Florey Institute of Neuroscience and Mental Health, Melbourne, VIC. [2] Ambulance Victoria, Melbourne, VIC. [3] Monash University, Melbourne, VIC. [4] Epworth HealthCare, Melbourne, VIC. [5] Victorian Comprehensive Cancer Centre, Melbourne, VIC. [6] Department of Health and Human Services, Melbourne, VIC. [7] Brotherhood of Saint Laurence, Melbourne, VIC. [8] Echuca Regional Health, Echuca, VIC. [9] Ballarat Health Services, Ballarat, VIC. [10] Goulburn Valley Health, Shepparton, VIC. [11] Albury Wodonga Health, Wodonga, NSW. [12] South West Healthcare, Warrnambool, VIC. [13] Northeast Health Wangaratta, Wangaratta, VIC. [14] Melbourne Health, Melbourne, VIC. [15] Melbourne Brain Centre at the Royal Melbourne Hospital, University of Melbourne, Melbourne, VIC. [16] Eastern Health, Melbourne, VIC. chris.bladin@unimelb.edu.au
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1 Victorian regional hospitals participating in the Victorian Stroke Telemedicine program, January 2019*

Source: Chris Bladin, Ambulance Victoria. Werribee commenced participation after the completion of the evaluation reported in this article. ◆

cart (mobile computer and camera) at the bedside of the patient. The stroke specialist connects to the telemedicine cart via embedded software that also provides rapid access to a picture archiving and communication system for reviewing brain images. A diagnosis is provided by the specialist and best practice treatments recommended for patients diagnosed with stroke, including thrombolysis or transfer for endovascular clot retrieval (from May 2016) when appropriate. On completion, the consultation is documented in a standardised form and sent to each hospital for filing with the patient's paper or electronic medical record.

After a successful pilot phase at Bendigo Health, the VST program formally commenced in 2013 and was incrementally expanded to a total of 16 hospitals by 2016.[8,9] The process for implementing the VST program has been described elsewhere.[8] Briefly, a governance committee and focused working groups (medical, information technology, research and evaluation, and communication and education) provided oversight or support for the iterative implementation of the program, and a VST coordinator was appointed for each hospital to integrate the VST protocol into routine ED workflows according to an implementation plan.[6,9] A multidisciplinary stroke education program was provided for all clinical staff involved. The implementation process, including discussions with information technology, radiology (for access to the picture archiving and communication system), Ambulance Victoria, hospital executive, and ED clinical staff was typically completed within 6 months.

Data collection

We employed a historical controlled cohort design[6] to evaluate the VST program. At each participating hospital, data for the 12 months preceding implementation (the control period) were retrospectively collated (Bendigo Health: 1 January 2010 – 31 December 2010; all other hospitals: during 1 January 2013 – 30 June 2016). After implementation of the telemedicine consultation service was completed at a site, data were collected prospectively for 12 months (intervention period) during 8 January 2014 – 31 December 2017.

During both the control and intervention study periods, data were collected in a similar manner on standardised forms. Basic clinical information was extracted from medical records for all patients over 18 years of age with suspected stroke when they arrived in the ED. Eligible patients were identified using International Classification of Diseases, Australian modification, version 10 (ICD-10-AM) codes (for ED patients: G45.9, I61.9, I62.1, I62.9, I63.9, I64, R41.0, R47.0, R47.1, S06.00, S06.01; for patients admitted to hospital: G45.0, G45.1, G45.2, G45.3, G45.8, G45.9, I61, I62.9, I63, I64, I67.8, I67.9). A screening log was used to determine whether each patient had a final diagnosis of ischaemic stroke and had arrived within 4.5 hours of symptom onset. For patients satisfying these criteria or who had received a VST consultation (irrespective of the final diagnosis and time of symptom onset), a purpose-designed, standardised audit tool was used to collect further data on their hospital presentation, including details of any telemedicine consultation, management and treatment while in hospital, and outcomes at discharge from hospital. The final diagnosis was confirmed in medical records for the ED presentation and any subsequent inpatient admission.

Part-time site coordinators were employed to educate staff about the VST clinical protocol and trained to collect data; they could therefore prospectively verify patient details only during the intervention period. Data for patients who had an in-hospital stroke or had not had a stroke but received a telemedicine consultation were collected but not included in our analysis of the stroke telemedicine intervention. Data quality checks were routinely undertaken and errors flagged for correction by the hospital site coordinators.

The major outcome measures were statistics for key processes of care, including symptom onset-to-arrival, door-to-first medical review, and door-to-CT times; and provision and timeliness of provision of thrombolysis to patients with ischaemic stroke.

Statistical analyses

As the data were not normally distributed, differences between groups were assessed in χ^2 tests for categorical variables and Kruskal–Wallis tests for continuous variables. The use of telemedicine and its association with patient treatment and outcomes were assessed by logistic regression; the use of telemedicine and its associations with time to diagnosis and treatment were assessed by median regression. All models were adjusted for age, sex, history of stroke, ability to walk on admission (as a marker of stroke severity), hospital size (annual number of admissions for stroke), and patient clustering by hospital. Regression analyses of stroke thrombolysis were limited to patients with ischaemic stroke.

Ethics approval

Data collection was approved by the twelve Human Research Ethics Committees overseeing research activities at the 16 hospitals (Supporting Information, table 1).

Results

A total of 2887 patients with a diagnosis of suspected stroke presented to participating EDs during the control period, and 3178 during the intervention period; the characteristics of the patients were similar for both periods (Box 2). During the intervention period, the median age of patients who arrived within 4.5 hours of symptom onset and had a final diagnosis of stroke was lower for those who had a VST consultation (75 years; interquartile range [IQR], 64–82 years) than for those who did not (78 years; IQR, 70–86 years); a greater proportion had received ED diagnoses of ischaemic stroke (90% *v* 57%) and a smaller proportion received ED diagnoses of transient ischaemic attack (2% *v* 14%). Ambulance pre-notification of the hospital of the delivery of patients was more frequent for those who had VST consultations (67% *v* 50%) (Box 3).

Key processes of care

A slightly larger proportion of patients with ischaemic stroke who arrived within 4.5 hours of symptom onset received intravenous thrombolysis during the intervention period than during the control period (control, 107 of 351 [30%]; intervention, 185 of 503 [37%]). During the intervention period, two hospitals provided thrombolysis to patients with stroke for the first time. Median times to diagnosis and treatment were lower during the intervention, including door-to-first medical review (control, 8 min [IQR, 3–20 min]; intervention, 3 min [IQR, 0–9 min]), door-to-CT (control, 34 min [IQR, 18–76 min]; intervention, 25 min [IQR, 13–49 min]), and door-to-needle time for stroke thrombolysis (control, 102 min [IQR, 77–128 min]; intervention, 73 min [IQR, 56–96 min]). For patients who received thrombolysis, the proportion treated within 60 minutes of arrival increased from 13% (14 of 102) during the control period to 32% (58 of 158) during the intervention period (Box 4). During the entire study period (control and intervention), 271 of the 292 patients who received thrombolysis (92%) did so within 4.5 hours of symptom onset.

During the intervention period, 165 of the 185 patients who received thrombolysis (89%) also had a telemedicine consultation. Among patients who received thrombolysis, the proportions who had a symptomatic intracerebral haemorrhage (control, 17 of 107 [16%]; intervention, eight of 185 [4%]) or died in hospital (control, 21 of 107 [21%]; intervention, 12 of 185 [6%]) were smaller during the intervention than during the control period (Box 4).

Compared with the control period, the odds of receiving thrombolysis were higher for patients who had a VST consultation (adjusted odds ratio [aOR], 2.11; 95% confidence interval [CI], 1.39–3.21), as was delivery of thrombolysis within 60 minutes of arriving at the hospital (aOR, 3.14; 95% CI, 1.21–8.15) (Box 5). In the multivariable median regression analysis, the VST program was associated with a reduction in median door-to-needle time for thrombolysis delivery of greater than 25 minutes, regardless of whether the patient had a VST consultation (Box 6). Time to thrombolysis and the odds of symptomatic intracerebral haemorrhage after thrombolysis were each lower during the intervention period (Supporting Information, tables 2 and 3).

2 Characteristics of patients with suspected stroke who presented to 16 participating emergency departments in regional Victoria during the 12 months preceding the local introduction of the Victorian Stroke Telemedicine (VST) program (control) and during the first 12 months of its full operation (intervention)

	Control	Intervention
Number of patients	2887	3178
Age (years), median (IQR)	74 (63–83)	74 (63–83)
Age (years)		
Under 65	799 (28%)	891 (28%)
65–74	666 (23%)	735 (23%)
75–84	825 (29%)	918 (29%)
85 or more	597 (21%)	634 (20%)
Sex (men)	1521 (53%)	1709 (54%)
Emergency department diagnosis		
Ischaemic stroke	1217 (42%)	1462 (46%)
Intracerebral haemorrhage	216 (8%)	262 (8%)
Transient ischaemic attack	1248 (43%)	1181 (37%)
Not stroke	195 (7%)	269 (9%)
Missing data	11	4
Symptom onset time known	1473 (51%)	1897 (60%)
Emergency department separation		
Ward (admission)	2100 (73%)	2243 (71%)
Other acute hospital	112 (4%)	194 (6%)
Home	494 (17%)	502 (16%)
Residential care	51 (2%)	41 (1%)
Other	130 (5%)	198 (6%)
VST consultations	NA	803 of 3178 (25%)
Patients with final diagnosis: not stroke	NA	315 of 803 (39%)
Patients with final diagnosis of stroke and arrived within 4.5 hours of symptom onset	423 of 2887 (15%)	601 of 3178 (19%)
Patients with final diagnosis of stroke and arrived within 4.5 hours of symptom onset: ischaemic stroke	351 of 423 (83%)	503 of 601 (84%)

IQR = interquartile range; NA = not applicable. ◆

Discussion

We report the first statewide telemedicine program for stroke care in regional hospitals in Australia. The VST program was associated with more timely assessment and treatment and improved outcomes for patients with suspected stroke. A larger proportion of patients who arrived at the ED within 4.5 hours of symptom onset received thrombolysis within 60 minutes, with more rapid processes of care and fewer adverse events. More than 95% of people living in regional Victoria are now within an hour's drive of a hospital with access to expert stroke care facilitated by the VST program, and some regional hospitals can now deliver stroke thrombolysis for the first time.[10]

The role of the stroke telemedicine doctor is, in collaboration with the local clinical team, to assess patients with suspected stroke, to review the relevant investigations (including brain imaging), and to establish the diagnosis (stroke, transient

3 Characteristics of 601 patients with a final diagnosis of stroke who arrived at an emergency department within 4.5 hours of symptom onset (intervention period only)

	Victorian Stroke Telemedicine program consultation	
	Not provided	Provided
Number of patients	244	357
Age (years), median (IQR)	78 (70–86)	75 (64–82)
Age (years)		
Under 65	38 (16%)	90 (25%)
65–74	58 (24%)	88 (25%)
75–84	75 (31%)	129 (36%)
85 or more	73 (30%)	50 (14%)
Sex (men)	138 (56%)	213 (60%)
Emergency department diagnosis		
Ischaemic stroke	140 (57%)	321 (90%)
Intracerebral haemorrhage	58 (24%)	21 (6%)
Transient ischaemic attack	33 (14%)	8 (2%)
Not stroke	13 (5%)	7 (2%)
Final diagnosis		
Ischaemic stroke	171 (70%)	332 (93%)
Intracerebral haemorrhage	73 (30%)	25 (7%)
History of stroke	64 (26%)	81 (23%)
Ability to walk on admission*	65 (27%)	93 (26%)
Arrived after hours	61 (25%)	100 (28%)
Transfer from another hospital	11 (5%)	23 (6%)
Arrival by ambulance	207 (85%)	308 (86%)
Emergency department pre-notified of patient arrival	102 (50%)	206 (67%)

IQR = interquartile range. * Proxy for stroke severity. ◆

4 Indicators of processes of care for patients with a final diagnosis of stroke who had arrived at a participating emergency department in regional Victoria within 4.5 hours of symptom onset

	Control	Intervention	*P*
Time taken for diagnostic procedures			
Number of patients	423	601	
Symptom onset-to-arrival (min), median (IQR)	100 (64–152)	93 (59–140)	0.07
Door-to-first medical review (min), median (IQR)	8 (3–20)	3 (0–9)	< 0.001
Door-to-CT (min), median (IQR)	34 (18–76)	25 (13–49)	< 0.001
Door-to-telemedicine consultation (min), median (IQR)	NA	43 (27–65)	-
Discharge destination†			< 0.001
Acute metropolitan hospital	46 (11%)	109 (18%)	
Acute regional hospital	10 (2%)	45 (7%)	
Home	135 (32%)	187 (31%)	
Residential aged care	17 (4%)	29 (5%)	
Rehabilitation	132 (31%)	136 (23%)	
Palliative care	4 (1%)	4 (1%)	
Died in hospital	72 (17%)	69 (11%)	
Other	7 (2%)	22 (4%)	
Patients with ischaemic stroke who arrived within 4.5 hours of symptom onset	351 (83%)	503 (84%)	
Stroke thrombolysis received	107 [30%]	185 [37%]	0.06
Symptomatic intracerebral haemorrhage*	17 (16%)	8 (4%)	0.001
Door-to-needle (min), median (IQR)*	102 (77–128)	73 (56–96)	< 0.001
Door-to-needle time less than 60 min*	14 (13%)	58 (32%)	< 0.001
Symptom onset-to-needle (min), median (IQR)*	211 (170–245)	169 (134–210)	< 0.001
Died in hospital*	21 (20%)	12 (6%)	0.001

CT = computed tomography imaging; IQR = interquartile range. * For patients who received thrombolysis. † Includes discharge destination from emergency department and after admission. ◆

ischaemic attack, or non-stroke). Treatment options, including reperfusion therapies, can then be planned.[4,11] Diagnostic accuracy with telemedicine is comparable with that achieved with face-to-face specialist assessment.[4] This is particularly important because stroke telemedicine consultations often involve non-stroke cases and patients presenting with stroke mimics;[12] in large hospital stroke centres, as many as 30% of patients with sudden onset neurological deficits have stroke mimics.[4,13–16] Most incorrect diagnoses in the ED involve patients with possible transient ischaemic attacks or patients presenting with non-specific clinical features.[17] This may explain the increased ED diagnosis of ischaemic stroke and reduction in the diagnosis of transient ischaemic attack during the VST period. Conversely, most cases of intracerebral haemorrhage can be detected with CT, which may explain why ED clinicians initiated a VST consultation less frequently for patients with this condition (25 of 98 patients [26%] *v* 332 of 503 patients with a final diagnosis of ischaemic stroke [66%]).

In 2017, the Stroke Foundation reported that only 30% of patients with ischaemic stroke in Australia received thrombolysis within 60 minutes of hospital arrival, compared with 59% in the United States and 62% in the United Kingdom.[18] People living in regional Australia are 19% more likely than those in metropolitan areas to have a stroke, but only 53% of regional hospitals offer thrombolysis for patients with stroke (compared with 83% of metropolitan hospitals).[18] Further, the Stroke Foundation has also reported that only 32% of patients arriving at the hospital within 4.5 hours of an ischaemic stroke receive this critical treatment in regional areas, compared with more than 40% in metropolitan hospitals.[18] With the VST program, 37% of patients who arrived within 4.5 hours of the onset of an ischaemic stroke received thrombolysis, of whom 32% were treated within 60 minutes of arrival, comparable with processes of care in metropolitan hospitals with specialist stroke teams. With the support of stroke telemedicine, all key regional hospitals in Victoria can now provide stroke thrombolysis.

5 Factors associated with receiving thrombolysis: multivariable logistic regression with clustering by hospital

	Odds ratio (95% confidence interval)		
	Thrombolysis	Door-to-needle within 60 minutes*	Intracerebral haemorrhage after thrombolysis
Number of patients with outcome	854	291	292
Data collection phase			
Control period (reference)	1	1	1
VST period: no consultation	0.30 (0.13–0.76)	2.07 (0.72–5.92)	0.50 (0.14–1.76)
VST period: with consultation	2.11 (1.39–3.21)	3.14 (1.21–8.15)	0.18 (0.04–0.84)
Age (years), per year	0.97 (0.96–0.99)	1.00 (0.98–1.02)	1.04 (1.01–1.07)
Sex (men)	0.87 (0.63–1.19)	1.31 (0.77–2.24)	1.08 (0.38–3.08)
First ever stroke	1.71 (1.08–2.73)	2.16 (1.07–4.35)	2.19 (0.71–6.72)
Unable to walk on admission†	3.22 (1.92–5.39)	1.60 (0.69–3.66)	0.81 (0.25–2.61)
Hospital size (stroke admissions per year)			
Less than 75 (reference)	1	1	1
75–199	1.56 (0.73–3.34)	2.93 (0.75–11.46)	1.10 (0.13–8.97)
200 or more	1.32 (0.61–2.87)	1.41 (0.39–5.05)	0.58 (0.06–5.87)

VST = Victorian Stroke Telemedicine program. * One person with missing time to thrombolysis. † Proxy for stroke severity. ◆

6 Factors associated with time to diagnosis and treatment: multivariable median regression with clustering by hospital

	Processes of care: β (95% confidence interval)*			
	Onset-to-arrival	Door-to-review	Door-to-scan	Door-to-needle
Number of patients	1024	830	991	291
Data collection phase				
Control period (reference)	1	1	1	
VST period: no consultation	−3.99 (−16.3 to 8.30)	−2.40 (−4.73 to −0.06)	3.71 (−4.71 to 12.1)	−25.4 (−47.2 to −3.66)
VST period: with consultation	−13.6 (−23.8 to −3.37)	−5.88 (−7.31 to −4.45)	−17.0 (−21.7 to −12.3)	−26.5 (−40.6 to −12.4)
Age (years), per year	0.47 (0.15 to 0.80)	0.05 (0.00 to 0.09)	0.19 (0.04 to 0.34)	0.15 (−0.31 to 0.60)
Sex (men)	2.40 (−6.59 to 11.4)	0.17 (−0.95 to 1.29)	0.96 (−2.87 to 4.80)	2.12 (−7.89 to 12.1)
First ever stroke	3.26 (−7.60 to 14.1)	−0.18 (−1.39 to 1.04)	0.89 (−4.95 to 6.73)	−14.18 (−30.9 to −2.50)
Unable to walk on admission†	−1.73 (−12.9 to 9.42)	−2.45 (−3.97 to −0.94)	−6.33 (−11.2 to −1.46)	−12.9 (−28.7 to 3.01)
Hospital size (stroke admissions per year)				
Less than 75 (reference)	1	1	1	1
75–199	8.48 (−5.68 to 28.3)	−1.83 (−3.99 to 0.32)	−17.8 (−31.9 to −3.76)	−2.13 (−19.8 to 15.5)
200 or more	14.6 (−5.68 to 35.0)	1.85 (−0.65 to 4.34)	−6.84 (−21.2 to 7.53)	7.94 (−11.6 to 27.5)

* β coefficient: median difference in time (in minutes) between groups. † Proxy for stroke severity. ◆

Stroke telemedicine programs in Europe and North America have reported similar success since the early 2000s. The TEMPiS network in Bavaria, Germany (operational since 2002) provides more than 5000 consultations each year; 80% of patients who underwent thrombolysis were treated within 60 minutes of presenting to hospital (median door-to-needle time, 40 min) and the in-hospital mortality rate is 6.3%.[19] Functional outcomes were similar whether the patient was treated in a stroke telemedicine hospital (spoke) or in a stroke centre hospital (hub).[20] Similar findings have been reported in the US and Canada.[21–23] In a meta-analysis of 26 studies (6605 patients receiving thrombolysis), no significant differences were found between stroke telemedicine and control groups in terms of in-hospital mortality, 90-day mortality, symptomatic intracranial haemorrhage, and clinical outcome at discharge or at 90-day follow-up.[24]

Capacity building and integration with other medical systems were major unplanned benefits of the VST program.[25] Most of the 16 hospitals now have salaried stroke coordinators; quality of care is being monitored through participation of the hospitals in the Australian Stroke Clinical Registry.[26] The VST program has also facilitated access to new evidence-based treatments, including the transfer of patients for endovascular clot retrieval

since May 2015. In 2018, the VST program was integrated into the Victorian health system under the governance of Ambulance Victoria.

Limitations

We have systematically assessed the early impact of telemedicine on emergency stroke care in regional hospitals of varying sizes. Data quality monitoring and analysis were undertaken by researchers not involved in the delivery of stroke telemedicine. A limitation of this pragmatic study, however, was the retrospective data collection for the control period. Time of symptom onset was less frequently recorded in medical records for patients with suspected stroke during the control period than during the intervention. This difference could partly account for the 31% increase in the proportion of patients with ischaemic stroke who arrived at hospital within 4.5 hours of symptom onset during the intervention period. Had symptom onset time been better documented during the control period, the number of patients categorised as arriving within 4.5 hours of symptom onset would have been higher and the proportion of eligible patients receiving thrombolysis consequently lower. In the course of implementing the VST, stroke care processes were established at some hospitals for the first time or received more attention, including routine documentation of stroke-specific assessments and treatment; important measures of stroke severity and contraindications for thrombolysis were inconsistently documented prior to the VST program. Practical adjustments to data collection were made; for example, ability to walk was collected as a proxy measure of stroke severity.[27] Information on outcomes was limited, as patient data were collected only until discharge from hospital.

Conclusion

The VST program has delivered acute stroke care to regional hospitals, with outcomes equivalent to, if not better than those achieved in metropolitan hospitals in Australia. Further data monitoring and analysis will focus on longer term outcomes, and a comprehensive health economic evaluation will be undertaken.

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Supporting Information

Additional Supporting Information is included with the online version of this article.