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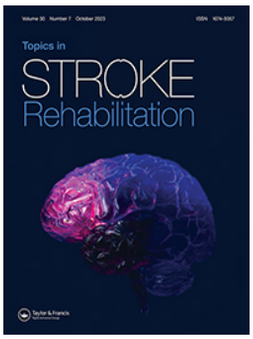

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Economic evaluation of the Very Early Rehabilitation in SpEech (VERSE) intervention

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ABSTRACT

Introduction: There is limited evidence on the costs and outcomes of patients with aphasia after stroke. The aim of this study was to estimate costs in patients with aphasia after stroke according to the aphasia therapies provided.

Methods: A three-arm, prospective, randomized, parallel group, open-label, blinded endpoint assessment trial conducted in Australia and New Zealand. Usual ward-based care (Usual Care) was compared to additional usual ward-based therapy (Usual Care Plus) and a prescribed and structured aphasia therapy program in addition to Usual Care (the VERSE intervention). Information about healthcare utilization and productivity were collected to estimate costs in Australian dollars for 2017–18. Multivariable regression models with bootstrapping were used to estimate differences in costs and outcomes (clinically meaningful change in aphasia severity measured by the WAB-R-AQ).

Results: Overall, 202/246 (82%) participants completed follow-up at 26 weeks. Median costs per person were $23,322 (Q1 5,367, Q3 52,669, $n = 63$) for Usual Care, $26,923 (Q1 7,303, Q3 76,174, $n = 70$) for Usual Care Plus and $31,143 (Q1 7,001. Q3 62,390, $n = 69$) for VERSE. No differences in costs and outcomes were detected between groups. Usual Care Plus was inferior (i.e. more costly and less effective) in 64% of iterations, and in 18% was less costly and less effective compared to Usual Care. VERSE was inferior in 65% of samples and less costly and less effective in 12% compared to Usual Care.

Conclusion: There was limited evidence that additional intensively delivered aphasia therapy within the context of usual acute care provided was worthwhile in terms of costs for the outcomes gained.

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aphasia; economic evaluation; speech therapy; cost-effectiveness; therapy dose

Introduction

Aphasia after stroke is a common disability influencing the ability to communicate, affecting 20–41% of patients with a new stroke.[1] Greater costs have been reported for people with this condition over and above usual treatment for stroke in people without aphasia. The additional costs to the health system for patients with aphasia after stroke relative to those without aphasia using Medicare data from the United States (US) in 2004 was estimated to be US $1703 over one year.[2] In Australia, costs of acute hospitalization were $2882 greater on average for patients with aphasia compared with patients without aphasia, with large differences seen in medical, nursing, and allied health services costs.[3]

There is evidence that speech and language therapy improves communication outcomes of patients with aphasia after stroke.[4,5] It is anticipated that improving outcomes for aphasia will reduce the likelihood of long-term costs, or that the additional treatment costs will be justified given the improvements in health outcomes achieved. However, few studies have been conducted on speech and language therapy provided in the initial weeks after stroke. Therefore, the optimal timing, intensity and type of aphasia therapy remains unclear within this period, as well as the potential cost-effectiveness of the options.

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The Very Early Rehabilitation in SpEech (VERSE) trial was a three-arm, prospective, randomized, parallel group, open-label, blinded endpoint assessment trial conducted in Australia and New Zealand in 246 people with aphasia recruited after an acute stroke.[6] There was no evidence that additional aphasia therapy improved the primary outcome of communication measured by the Western Aphasia Battery-Revised Aphasia Quotient (WAB-R-AQ) compared to usual care at 26 weeks after randomization.[7] There were also no differences between groups in other outcomes such as discourse measures, the Bosting Naming Test, Stroke and Aphasia Quality of Life Scale-39 and the Aphasia Depression Rating Scale.

Secondary outcomes for the VERSE trial included the cost-effectiveness of the VERSE intervention compared to usual ward-based aphasia therapy at 26 weeks post stroke. However, since there were no differences in the primary outcome observed in the trial, we aimed to estimate the costs in this trial cohort by treatment group, and also aimed to estimate the differences in costs and outcomes within subgroups of patients based on their baseline aphasia severity and the amount of aphasia therapy provided since these factors may influence recovery.

Methods

The VERSE trial was registered prospectively with the Australian New Zealand Clinical Trials Registry (number: 12613000776707) and approved by ethics committees at 15 recruiting hospitals in Australia and 2 recruiting hospitals in New Zealand. Written informed consent was obtained from participants prior to the baseline assessment and randomization. The Usual Care Plus and VERSE therapies were commenced within 15 days of stroke and were completed within 5 weeks of randomization. These intervention arms received a total of 20 additional sessions (45–60 minutes, provided daily) of aphasia therapy, with *one arm receiving* additional usual ward-based therapy (Usual Care Plus) and the other arm receiving a prescribed and structured aphasia therapy program (the VERSE intervention). All data required for an economic evaluation of the intervention were obtained at assessments conducted at 12 weeks and 26 weeks after randomization. Further details of the intervention, trial design, methods of data collection, and the effectiveness results for the primary outcome have been published elsewhere.[6,7]

Details of this economic evaluation were reported according to the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) checklist.[8] An economic analysis plan was not previously published. A societal perspective with a focus on the health sector was used for this economic evaluation. Costs involved in the provision of aphasia treatments during the hospital stay, costs of healthcare resources used and other costs thought to be influenced by the type of aphasia treatment received that are incurred beyond the health sector (such as time cost associated with informal care provided by family members and productivity gains/losses and out-of-pocket costs) were considered.

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Data collection on resource use and costs to participants

The interventions relied primarily on increased hours of rehabilitation treatment with speech pathologists. These clinicians, who were from the recruiting hospitals, tracked each interaction with participants in the trial (regardless of provision of the intervention) and documented the time spent providing therapy to the patients. Documented direct therapy time (one-on-one impairment-based training, group impairment-based therapy, conversation group therapy, and augmentative and alternative communication training) was considered in this analysis. The costs of training and education that were needed to build capacity in the workforce to implement the intervention/s were not included as part of the intervention costs since this would reflect the intervention in a "steady-state" or "business as usual" application. To categorize patients according to the amount of aphasia therapy received, participants were categorized into three groups based on tertiles of therapy hours provided.

Data on health resources used following randomization and productivity losses (i.e. lost/reduced income) were obtained from participants at the 26-week follow-up assessment using a standardized

questionnaire (see Online Supplement). Participants were asked about their discharge destination from acute care or inpatient rehabilitation, changes to living arrangements following the stroke, emergency department attendances, hospital admissions, other rehabilitation services accessed after randomization, outpatient clinic visits, use of community services, visits to the general practitioner, other speech and language-related communication aids, respite care, employment status, informal care and out-of-pocket expenses for health services and speech/communication aids.

To minimize recall bias at the outcome assessments, participants were encouraged to complete a diary about healthcare services attended for the duration of the study. Assistance from their primary caregiver or communication partner was encouraged.

Estimation and valuation of costs

Costs to patients, the health system and productivity costs were estimated per patient in Australian dollars for the reference year 2017. Costs were estimated by applying unit prices to the resources utilized. Unit prices were obtained primarily from published Australian sources (Table 1). Where prices in $AU 2017 were unavailable, adjustments to the 2017–18 price were made using the total health price index (purchasing power parity conversion to 2017 $US: 1.478).[11,12] Discounting was not applied since both costs and outcomes occurred within a 6-month period.

Health outcomes

The primary outcome for the economic evaluation was the clinically meaningful improvement in the WAB-R-AQ (5.03 point improvement from baseline to 26 weeks follow-up).[13] Aphasia severity was categorized according to WAB-R-AQ scores at baseline (mild 93.6–62.6, moderate 62.5–31.3, and severe 0–31.2). The WAB-R-AQ is considered an appropriate outcome to assess overall language ability (comprehension and expression).[14] The absolute change, percentage change, and the percent change of the

Table 1. Unit prices applied to resources utilized (Australian dollars).

Parameter	Unit price ($)	Units	Data source
Aphasia therapist cost	39	Per hour	From study investigators
Ambulance transfers			
Emergency road transport	1265	Per trip	Ambulance Victoria fee schedule, 2019/20
Fixed wing air transport	5,275	Per trip	Ambulance Victoria fee schedule, 2019/20
Hospital presentations			
Emergency department presentations	605	Per Visit	NHCDC, 2014/15
Hospital admissions	1901	Per day	NHCDC, 2014/15
Inpatient rehabilitation	985	Per day	NHCDC, 2014/15
Outpatient rehabilitation	272	Per service	NHCDC, 2014/15
General Practitioner	52	Per Visit	Medicare Benefits Schedule Book, 2020
Rehabilitation services provided at home	63.25	Per session	Medicare Benefits Schedule Book, 2020
Community speech and language services	90	Per session	Study investigator estimate
Community services			
Nursing services	56.09	Per visit	Farag et al, 2013[9]
Anticoagulation therapy	13.7	Per test	Medicare Benefits Schedule Book, 2020
Delivered meals	11.1	Per meal	Farag et al, 2013[9]
Personal care	36.4	Per hour	Farag et al, 2013[9]
Housework help	39.07	Per hour	Farag et al, 2013[9]
Gardening/home maintenance	52.26	Per visit	Farag et al, 2013[9]
Home respite	1168	Per day	Daughterly Care Sydney, 2020
Patient Transport	12.39	Per trip	Farag et al, 2013[9]
Podiatry	22.95	Per session	Farag et al, 2013[9]
Private speech and language therapy	90	Per session	Study investigator estimate
Respite care	56.7	Per day	Department of Health (Australian Government), 2020
Informal care hours	31.36	Per hour	Deloitte Access Economics[10]
Changes to living arrangements			
Nursing home	245	Per day	My Aged Care (Australian Government), 2020
Supported residential service	142	Per day	My Aged Care (Australian Government), 2020
Private hospital	568	Per day	State Insurance Regulatory Authority, 2019
Productivity	-	-	Based on productivity and wages reported by participants

Costs were adjusted to the 2017–18 equivalent based on the Total Health Price Index (published by the Australian Bureau of Statistics)
NHCDC: National Hospital Cost Data Collection.

maximal recovery of the WAB-R-AQ, and the Stroke and Aphasia Quality of Life Scale-39 (SAQoL-39)[15] were also compared by study arm and baseline aphasia severity (Online supplement).

Statistical analysis

Chi2 tests were used to assess differences in proportions and Kruskal Wallis tests were used to assess differences in continous data between groups. Median regression models were used to assess differences in costs between study arms. Logistic regression models were used to assess differences in the achievement of a clinically meaningful improvement in WAB-R-AQ outcomes between study arms. Regression models were adjusted for age and sex. Bootstrapping with 1,000 iterations was used to assess the robustness of the results. Analyses were conducted using Stata/SE 15.0.

Results

Detailed baseline clinical and demographic characteristics of patients in the study have been published elsewhere.[7] This analysis included 202 patients who completed follow-up at 26 weeks with data available on the WAB-R-AQ and resource use questionnaire; 63 participants receiving Usual Care, 70 receiving Usual Care Plus, and 69 receiving VERSE. Briefly, the mean age was 72 years, 49% were female and 94% had an ischemic stroke. Compared to the 43 patients who did not complete follow-up at 26 weeks, the 202 patients were similar in age and sex distribution, but more often had severe aphasia at baseline (63% vs 36%, $p = 0.002$). There were 75 participants requiring assistance to complete questionnaires at 26 weeks follow-up, with a spouse or partner providing this assistance for 41 participants (55%).

At study baseline (median 9 days after stroke onset), 36% had severe aphasia ($n = 23$ Usual Care, $n = 28$ Usual Care Plus, $n = 22$ VERSE), 31% had moderate aphasia ($n = 18$ Usual Care, $n = 20$ Usual Care Plus, $n = 24$ VERSE) and 33% had mild aphasia ($n = 22$ Usual Care, $n = 22$ Usual Care Plus, $n = 23$ VERSE), with no differences in proportions between study arms ($p = 0.856$). The majority of participants achieved a clinically meaningful improvement in aphasia (92% Usual Care, 87% Usual Care Plus, 88% VERSE), with no differences between study arms ($p = 0.644$).

No differences were observed in the utilization of resources and costs at 26 weeks between treatment arms (Table 2). A small proportion of participants had presented to hospital and most participants attended inpatient or outpatient rehabilitation. Community speech and language services and private speech and language therapy were accessed by less than 20% of the participants during the follow-up period. In the usual care group, 9 participants (14%) reported receiving private speech therapy. Fewer than 20% of patients obtained speech and language communication aids. Overall, there were no detectable differences in age, sex, diagnosis, and aphasia severity between those that reported receiving private speech and language therapy and those that did not, with similar findings in the Usual Care arm.

Due to greater therapist input as a result of the intervention, there were differences in costs of acute aphasia therapy between groups. The median cost of acute aphasia therapy per person in comparison to the Usual Care group ($715), was approximately $400 higher for Usual Care Plus ($1,108) and VERSE ($1,180) groups. No differences were observed in median costs in other cost categories (Table 3). The majority of the total costs were attributed to health services (hospital presentations, rehabilitation, general practitioner care, speech and language therapy and respite care). Median costs of changes in living arrangements and loss of productivity were over $25,000 for those incurring these costs. Overall, there were no differences in the overall median total costs between the treatment arms ($23,322 for Usual Care; $26,923 for Usual Care Plus; and $31,143 for VERSE; $p = 0.469$).

After adjustment, there were no differences in the odds of achieving a clinically meaningful improvement in aphasia with VERSE compared to Usual Care (odds ratio 0.62, 95% confidence interval 0.19 to 1.97) or with Usual Care Plus compared to Usual Care (odds ratio 0.69, 95% confidence interval 0.21 to 2.25). After adjustment, costs favored Usual Care but there were no statistically significant differences with other

Table 2. Resource utilization at 26 weeks follow-up by treatment arm.

	Usual Care	Usual Care Plus	VERSE	p-value
	N = 63	N = 70	N = 69	
Ambulance services, n(%)	12 (19)	17 (24)	15 (22)	.766
Total number of trips	20	55	32	.645
Emergency department presentations, n(%)	5 (8)	3 (4)	6 (9)	.551
Total number of presentations	5	3	7	.875
Hospital admissions, n(%)	9 (14)	14 (20)	16 (23)	.426
Total number of admissions*	4	18	12	.525
Total length of admissions (days)	20	161	57	.989
Inpatient rehabilitation admissions, n(%)	29 (46)	29 (41)	28 (41)	.795
Total number of admissions*	33	34	35	.867
Total length of admissions (days)	1011	1155	1441	.537
Outpatient rehabilitation, n (%)	33 (52)	35 (50)	35 (51)	.962
Total number of days attended	596	451	557	.252
General practitioner visits, n (%)	51 (84)	60 (86)	53 (77)	.364
Total number of visits	373	374	298	.945
Rehabilitation at home, n (%)	24 (38)	29 (41)	21 (30)	.388
Total number of sessions	503	563	517	.399
Community speech and language services, n (%)	3 (5)	6 (9)	4 (6)	.647
Total number of sessions	7	52	38	.715
Private speech and language therapy, n (%)	9 (14)	3 (4)	5 (7)	.106
Total number of sessions	41	62	42	.131
Respite care, n (%)	1 (2)	1 (4)	2 (3)	.795
Total number of days provided	49	21	89	.861
Community services (total number of services provided)				
Nursing services	139	39	184	.673
Anticoagulation therapy	1	25	0	.221
Delivered meals	272	200	344	.705
Personal care	93	430	384	.532
Housework help	285	345	528	.644
Gardening/home maintenance	23	50	70	.382
Home respite	1	6	20	.368
Transport	57	26	57	.806
Speech aids, n (%)	11 (17)	9 (13)	11 (16)	.752
Tablet	8	2	8	.062
Tablet applications	4	6	4	.172
Other speech aids	2	2	3	.841
Informal carer, n (%)	30 (48)	39 (56)	40 (58)	.460
Total number of hours	396.17	759.25	649.67	.563
Changes to living arrangements (total number of days)				
Nursing home	815	1243	1302	.744
Supported residential service	165	311	585	.485
Private hospital**	0	111	0	-
Reduced productivity, n (%)	17 (27)	19 (27)	13 (19)	.433

*Data point not used for economic evaluation.
**One participant changed residence to care in private hospital.

groups (Table S1). In 1,000 bootstrapped iterations, Usual Care Plus was inferior (i.e. more costly and less effective) for 64% of samples and was dominant (i.e. less costly and more effective) in 6% of samples compared to Usual Care. In 12% of samples, Usual Care Plus was more costly and more effective, and in 18% was less costly and less effective, compared to Usual Care (Figure 1). VERSE was inferior in 65% of samples, was dominant in 3%, was more costly and more effective in 19%, and was less costly and less effective in 12% of samples, compared to Usual Care (Figure 2).

Median costs were greater for those with severe aphasia at baseline ($45,634, interquartile range: $15,101 to $83,469) than patients with moderate aphasia at baseline ($12,917, interquartile range: $3,731 to $52,325, $p = 0.001$) and patients with mild aphasia at baseline ($20,612, interquartile range: $6,696 to $38,532, $p < 0.001$). There were no significant differences in costs between patients with mild aphasia and those with moderate aphasia at baseline ($p = 0.759$).

There were no significant differences in costs observed between different treatment arms by baseline aphasia severity (Table 4). Amongst those with severe aphasia at baseline, median costs were: $61,565 for patients in the Usual Care Plus group; $57,906 for patients in the VERSE group; and $32,357 in the Usual Care group. Amongst those with mild aphasia at baseline, median costs were: $24,277 for patients in the

Table 3. Costs by treatment arm (Australian dollars).

	Usual Care	Usual Care Plus	VERSE	p-value
	N=63	N=70	N=69	
Aphasia therapy cost				
Total for the group	$48,219	$88,506	$91,457	
Median per person*	$715	$1,108	$1,180	<.001
(Q1-Q3)	(351–1,165)	(865–1,576)	(871–1,498)	
Health services cost				
Total for the group	$1,282,842	$1,709,665	$1,786,139	
Median per person*	$7,393	$10,120	$16,443	.775
(Q1-Q3)	(3,017–38,198)	(2,150 –36,293)	(2,085–44,013)	
Community services cost				
Total for the group	$29,315	$44,687	$77,004	
Median per person*	$1,065	$1,420	$1,577	.742
(Q1-Q3)	(526–2,798)	(405–3,014)	(640–6,857)	
Speech aids cost				
Total for the group	$2,334	$1,074	$1,681	
Median per person*	$475	$86	$150	.976
(Q1-Q3)	(89–600)	(55–88)	(121–500)	
Change in living arrangements cost				
Total for the group	$216,578	$397,716	$389,031	
Median per person*	$35,079	$25,295	$28,397	.719
(Q1-Q3)	(22,094–41,044)	(17,943 –41,760)	(18,852–36,988)	
Informal care cost				
Total for the group	$12,424	$23,810	$20,374	
Median per person*	$329	$580	$470	.563
(Q1-Q3)	(94–690)	(125–1,035)	(157–862)	
Productivity losses				
Total for the group	$486,833	$672,546	$472,426	
Median per person*	$27,000	$25,176	$45,000	.414
(Q1-Q3)	(7,500–33,750)	(11,992 –45,000)	(7,500–45,000)	
Overall cost				
Total for the group	$2,078,544	$2,938,003	$2,838,112	
Median per person*	$23,322	$26,923	$31,143	.469
(Q1-Q3)	(5,367–52,669)	(7,303 –76,174)	(7,001–62,390)	

*Amongst people incurring the cost.

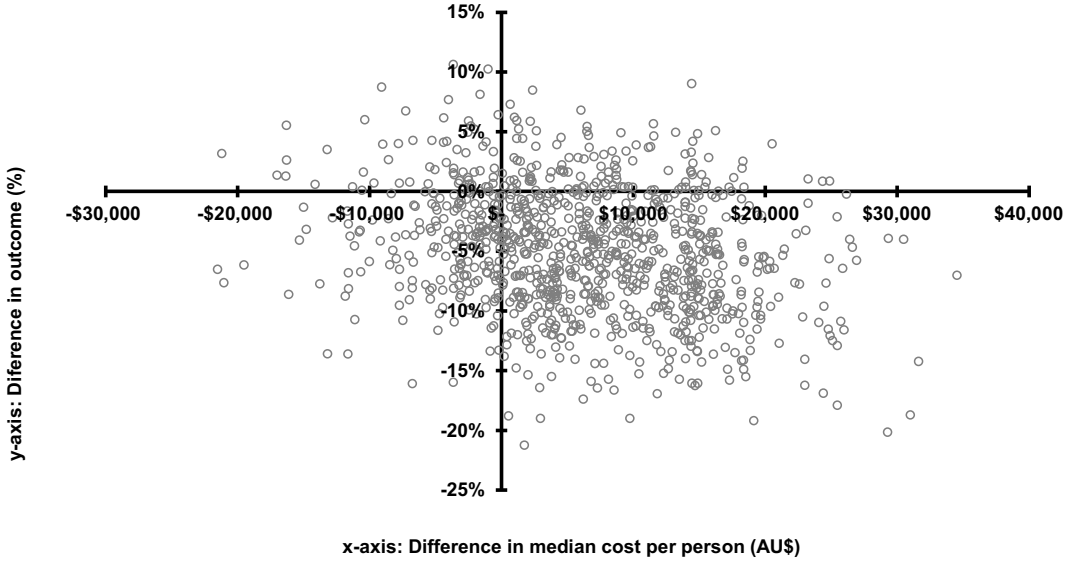

Figure 1. Differences in costs and outcomes between Usual Care Plus and Usual Care groups in 1000 iterations of bootstrapping. Positive values in the x-axis (difference in median cost per person) indicate iterations where Usual Care Plus was more expensive than Usual Care. Costs were adjusted for age and sex. Positive values in the y-axis (difference in outcome) indicate iterations where patients in the Usual Care Plus group had better outcomes than those in Usual Care. The outcome (a clinically meaningful improvement in the Western Aphasia Battery Revised Aphasia Quotient) was not adjusted.

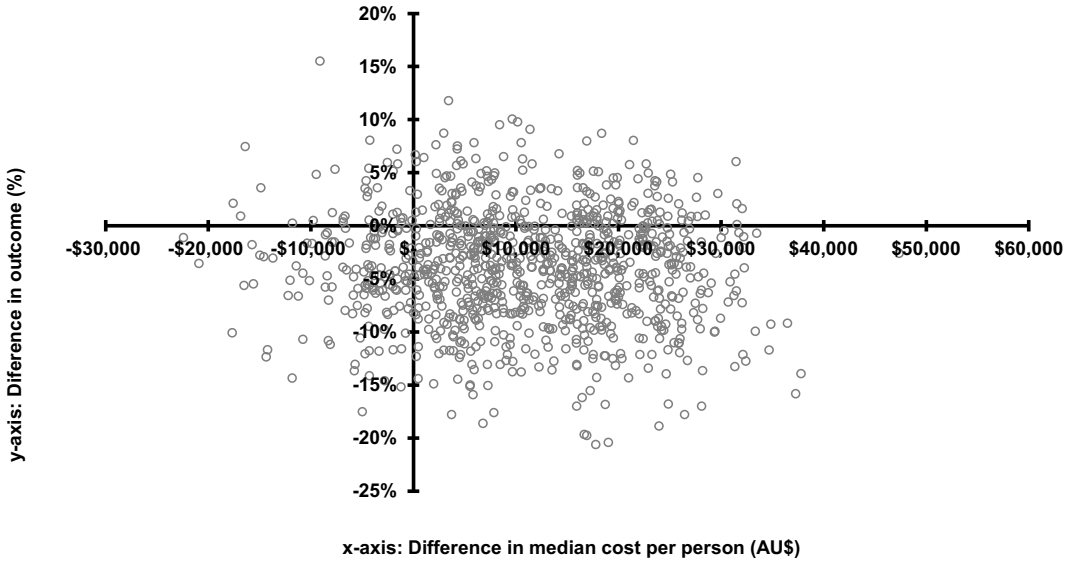

Figure 2. Differences in costs and outcomes between VERSE and Usual Care groups in 1000 iterations of bootstrapping. Positive values in the x-axis (difference in median cost per person) indicate iterations where VERSE was more expensive than Usual Care. Costs were adjusted for age and sex. Positive values in the y-axis (difference in outcome) indicate iterations where patients in the VERSE group had better outcomes than those in Usual Care. The outcome (a clinically meaningful improvement in the Western Aphasia Battery Revised Aphasia Quotient) was not adjusted.

Table 4. Clinical outcomes and costs by treatment arm and by baseline aphasia severity and amount of aphasia therapy.

	Usual Care	Usual Care Plus	VERSE	p-value
	N=63	N=70	N=69	
Overall cost (AUD), median (Q1-Q3)				
Baseline aphasia severity				
Mild aphasia	$17,257 (5,652–30,536)	$24,277 (8,156 –38,532)	$20,297 (6,975–43,216)	.589
Moderate aphasia	$30,456 (5,936–55,351)	$10,806 (2,939 –26,880)	$13,110 (3,276–56,944)	.377
Severe aphasia	$32,357 (4,584–62,061)	$61,565 (20,569 –88,055)	$57,906 (36,013–89,406)	.051
Amount of aphasia therapy provided*				
0–35 hours of therapy	$23322 (5936–47602)	$35669 (22633 –70,857)	$7591 (4277–31143)	.200
36–52 hours of therapy	$25500 (5173–55351)	$20538 (5224 –46,685)	$25334 (7001–71645)	.855
53–147 hours of therapy	$29815 (5291–57365)	$26864 (9087 –78,071)	$53072 (22892–85165)	.335
Clinically meaningful improvement in the WAB-R-AQ†, n/N (%)				
Baseline aphasia severity				
Mild aphasia	19/22 (86)	19/22 (86)	19/23 (83)	.920
Moderate aphasia	18/18 (100)	19/20 (95)	23/24 (96)	.647
Severe aphasia	21/23 (91)	23/28 (82)	19/22 (86)	.639
Amount of aphasia therapy				
Quantile 1 (0–35 hours)	35/37 (95)	10/14 (71)	13/17 (76)	.056
Quantile 2 (36–52 hours)	14/14 (100)	24/26 (92)	25/27 (93)	.570
Quantile 3 (53–147 hours)	11/12 (92)	29/30 (97)	24/25 (96)	.770

WAB-R-AQ: Western Aphasia Battery Revised Aphasia Quotient, AUD: Australian dollars.
Changes and improvement from baseline to 26 weeks follow-up.
* Groups were split according to tertiles.
†5.03 point improvement at 26 weeks follow-up from baseline.

Usual Care Plus group; $20,297 for patients in the VERSE group; and $17,257 in the Usual Care group. There were no significant differences between groups in costs or outcomes according to the amount of aphasia therapy. Overall, there was an increase of $466 in total cost per additional hour of aphasia therapy provided (p = 0.001, Online Supplement Figure S1).

Discussion

We provide novel data on costs incurred by people with aphasia after acute stroke based on a multisite, randomized controlled trial from Australia and New Zealand. There has been limited research conducted on this patient group, particularly research related to resources used and costs. Despite the unfavorable

results related to the aphasia therapies in this economic evaluation, there is value in the description of the different types of costs incurred. These data may also be used as a basis to investigate where service provision may be improved and inform the design of future economic evaluations.

The costs over the first 26 weeks following randomization were approximately $23,000 per person provided in Usual Care. In terms of the potential cost-effectiveness of intensive aphasia therapy for patients with aphasia after acute stroke over and above Usual Care, we found that more therapy was not cost-effective based on the outcomes assessed. In comparison to Usual Care, the Usual Care Plus and VERSE interventions were costlier and less effective in the majority of the 1,000 bootstrapped samples. There also appeared to be no evidence that costs differed between groups amongst subgroups of baseline aphasia severity, and amongst subgroups based on the amount of hours of aphasia therapy provided.

The development of outcome measures for patients with aphasia after stroke that are sensitive to improvement in outcome from treatment are required. Clinically significant improvement in the WAB-R-AQ (5.03 points) that was used in this study was based on the meta-analysis conducted by Gilmore et al.[13] Most of the studies included in the within-group analysis in their meta-analysis were in the chronic phase of recovery (>6 months post-stroke). On the other hand, VERSE was an acute-phase study and participants commenced treatment within 15 days of stroke. Improvement in outcome reported in this study would be at least partially attributable to spontaneous recovery after stroke.

The only major difference in resources used between the study arms observed was in the provision of the intensive aphasia therapy provided as part of this study. There was evidence that a small number of participants in all groups had supplemented the therapy received in the acute phase, with several participants reporting the use of rehabilitation at home, community speech, and language therapy, private speech, and language therapy and the purchase of speech and language communication aids and equipment. This was observed in a minority of participants in both study arms, so it did not appear to substitute for or supplement any therapy received in the acute setting. Currently, there is limited evidence about the utilization of speech services and aids in the community after stroke.

There are few published studies on the cost-effectiveness of aphasia therapy after stroke so it is difficult to compare our findings with other studies. Two other studies with a similar or larger sample size have information about cost-effectiveness of aphasia therapies. In a study where lifetime costs related to government funded services were estimated in a Markov model, it was found that additional computerized word finding therapy was provided at a small additional cost, but with marginal improvements in quality adjusted life years, the intervention cost an additional £42686 per quality adjusted life year gained.[16] In another study, it was unclear that enhanced early communication speech and language therapy was cost-effective over 6 months when compared to attention control in patients with aphasia or dysarthria after stroke.[17] Costs for this latter study were based on data collected during inpatient admissions and data on community and primary care services were collected from carers at follow-up. Inevitably, in future research there will be efforts to have more strategic selection of patients, and optimize the timing and duration of therapy to optimize clinical outcomes and reduce intervention costs.

A strength of this study was the clinical trial design with good follow-up completion and the use of standardized questionnaires to ascertain costs and outcomes of patients. Costs were estimated based on resources used and other societal impacts beyond those directly related to the provision of healthcare, such as informal care and productivity. However, a limitation is that this information was obtained from self-report and was unable to be verified with other sources. Particularly for the healthcare resources used, there may be recall bias with these data. Another limitation is that while the sample size was relatively large within the context of aphasia research, this study was not powered to detect cost differences. Further investigation of differences in costs

may be warranted with a focus on identification of patient subgroups that may benefit from intensive aphasia therapy. Indeed, there were some iterations in bootstrapping where the intensive aphasia interventions were estimated to result in benefits to patient outcomes.

In future studies, longer-term economic outcomes should be investigated if communication outcomes are improved from aphasia therapies since improvement in communication may potentially affect employment and participation in other activities. Quality-of-life data should also be collected using a multi-attribute utility instrument such as the Euroqol-5 Dimension questionnaire in order to enable estimation of quality adjusted life years gained and facilitate comparison of cost-effectiveness with other interventions.

Conclusion

We provided novel evidence about resource use and productivity in patients with aphasia after stroke. There was no evidence that intensive aphasia therapy was cost-effective when provided within the first 5 weeks after stroke, with no evidence that this was affected by aphasia severity or the amount of therapy provided. Speech therapy continues to be provided within the acute and sub-acute hospital setting as part of standard rehabilitation services, but there remains limited evidence about the best type, timing, and intensity of therapy for patients with aphasia. Efforts to identify subgroups of patients that may benefit from intensive aphasia therapy and optimize the provision of aphasia therapy at an acceptable additional cost should be continued.

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