Journal of Physiotherapy 62 (2016) 124–129

Journal of PHYSIOTHERAPY

journal homepage: www.elsevier.com/locate/jphys

Research

Additional weekend therapy may reduce length of rehabilitation stay after stroke: a meta-analysis of individual patient data

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KEY WORDS

Physical therapy
Occupational therapy
Rehabilitation
Stroke
Weekend therapy

ABSTRACT

Questions: Among people receiving inpatient rehabilitation after stroke, does additional weekend physiotherapy and/or occupational therapy reduce the length of rehabilitation hospital stay compared to those who receive a weekday-only service, and does this change after controlling for individual factors? Does additional weekend therapy improve the ability to walk and perform activities of daily living, measured at discharge? Does additional weekend therapy improve health-related quality of life, measured 6 months after discharge from rehabilitation? Which individual, clinical and hospital characteristics are associated with shorter length of rehabilitation hospital stay? **Design:** This study pooled individual data from two randomised, controlled trials (n = 350) using an individual patient data meta-analysis and multivariate regression. **Participants:** People with stroke admitted to inpatient rehabilitation facilities. **Intervention:** Additional weekend therapy (physiotherapy and/or occupational therapy) compared to usual care (5 days/week therapy). **Outcome measures:** Length of rehabilitation hospital stay, independence in activities of daily living measured with the Functional Independence Measure, walking speed and health-related quality of life. **Results:** Participants who received weekend therapy had a shorter length of rehabilitation hospital stay. In the un-adjusted analysis, this was not statistically significant (MD –5.7 days, 95% CI –13.0 to 1.5). Controlling for hospital site, age, walking speed and Functional Independence Measure score on admission, receiving weekend therapy was significantly associated with a shorter length of rehabilitation hospital stay ($\beta = 7.5$, 95% CI 1.7 to 13.4, $p = 0.001$). There were no significant between-group differences in Functional Independence Measure scores (MD 1.9 points, 95% CI –2.8 to 6.6), walking speed (MD 0.06 m/second, 95% CI –0.15 to 0.04) or health-related quality of life (SMD –0.04, 95% CI –0.26 to 0.19) at discharge. **Discussion:** Modest evidence indicates that additional weekend therapy might reduce rehabilitation hospital length of stay. **Clinical Trial Registration:** ACTRN12610000096055, ACTRN12609000973213. **[English C, Shields N, Brusco NK, Taylor NF, Watts JJ, Peiris C, et al. (2016) Additional weekend therapy may reduce length of rehabilitation stay after stroke: a meta-analysis of individual patient data. *Journal of Physiotherapy* 62: 124–129]**

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Introduction

Rehabilitation for people who have had a stroke is expensive, costing an estimated AUD150 million per year in Australia.[1] One of the most powerful ways of reducing cost is reducing the number of days spent in hospital.[2] Providing therapy services on weekends has become a more common part of usual care for rehabilitation facilities in Australia,[3] although until recently there was little published evidence to support its clinical effectiveness or impact on length of rehabilitation hospital stay.

Two recent, large, randomised, controlled trials investigated the effectiveness of weekend therapy services for people during rehabilitation after stroke. One trial,[4] referred to here as the Saturday trial, investigated the effectiveness of additional physiotherapy and occupational therapy services provided on Saturdays, compared to usual care for people with a range of diagnoses, including stroke. The other trial,[5] referred to here as the CIRCIT trial, included only participants with stroke, and included three arms: weekend physiotherapy services provided on Saturdays and Sundays; group circuit class therapy provided 5 days per week; and usual care physiotherapy. In both trials, participants receiving weekend therapy had a shorter mean length of rehabilitation hospital stay (by 2 days[4] and 3 days[5]), compared to usual care consisting of therapy 5 days per week. However, in both trials, the

http://dx.doi.org/10.1016/j.jphys.2016.05.015
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between-group difference in length of rehabilitation hospital stay did not reach statistical significance.

Individual patient data meta-analyses provide the opportunity to pool data from trials at a participant level, resulting in greater statistical power to test secondary hypotheses more conclusively and to conduct further exploratory analyses.[6] The aim of the present study was to conduct an individual patient data meta-analysis, combining data from the CIRCIT and Saturday trials, to investigate the effectiveness of providing additional weekend therapy services to people with stroke, compared to usual care in the Australian context.

Therefore, the primary research question for this study was:

1. Among people receiving inpatient rehabilitation after stroke, does additional weekend physiotherapy and/or occupational therapy reduce length of rehabilitation hospital stay compared to those who receive a weekday-only service, and does this change after controlling for individual factors?

The secondary research questions were:

1. Does additional weekend therapy improve the ability to walk and to perform activities of daily living, measured at discharge?
2. Does additional weekend therapy improve health-related quality of life, measured 6 months after discharge from rehabilitation?
3. Which individual, clinical and hospital characteristics are associated with shorter length of rehabilitation hospital stay?

Method

Design

Both trials were Phase-III multicentre, randomised, controlled trials with concealed allocation and blinded assessment of outcomes. The full trial protocols have been published elsewhere.[7,8] Randomisation in both trials, across seven hospital sites, occurred within 1 week of admission to rehabilitation.

Participants

Briefly, the inclusion criteria for people with stroke in the CIRCIT trial were: diagnosed stroke of moderate severity, defined as a Functional Independence Measure (FIM) total score between 40 and 80 points or a motor subscale score between 38 and 62 points; and ability to mobilise independently prior to their stroke. There were no stroke-specific inclusion criteria for the Saturday trial.

Interventions

In the CIRCIT trial, participants allocated to the 7-day arm received additional physiotherapy services on Saturday and Sunday. In the Saturday trial, participants in the intervention arm received additional physiotherapy and occupational therapy on Saturdays only. In both trials, usual care participants received physiotherapy and occupational therapy Monday to Friday only. The treating therapists recorded the amount of therapy time received by participants in both trials. In the CIRCIT trial, therapists recorded the time that participants spent in physiotherapy sessions on trial-specific data sheets, up to the first 4 weeks of their rehabilitation stay. In the Saturday trial, therapy time was recorded as part of routine hospital data collection procedures for the entire length of stay.

Outcome measures

Length of rehabilitation hospital stay was defined as the number of days between admission to, and discharge from, the rehabilitation facility. Measures of walking speed and independence in activities of daily living (FIM scores) and health-related quality of life were made 4 weeks after randomisation (CIRCIT trial), at discharge from rehabilitation (Saturday trial), and at approximately 6 months after discharge (in both trials). Health-related quality of life was measured with the Australian Quality of Life tool in the CIRCIT trial and the EQ5D-3L tool in the Saturday trial. The average time post-randomisation for the discharge assessment point in the Saturday trial for people with stroke was 34 days (SD 23); therefore, these data were pooled with the 4-week data from the CIRCIT trial.

Data analyses

Data were pooled from the CIRCIT trial (all participants from the usual care group and the group that received therapy 7 days per week) and the Saturday trial (participants with a diagnosis of stroke from the usual care group and from the group that received additional therapy on Saturdays). Univariate analyses (Chi-squared or Fisher's exact test for categorical variables, *t*-tests or Mann-Whitney U for continuous variables) were used to compare participant characteristics at baseline between the two trials, and outcomes between intervention and control groups in the pooled dataset. Descriptive statistics were used to summarise the average weekly (Monday to Friday) therapy time provided to the usual care groups in the two trials, and the amount of additional weekend therapy provided. As length-of-stay data were not normally distributed, the between-group difference was first examined using a Mann-Whitney U test. Independent *t*-tests were also conducted to determine the mean differences and 95% confidence intervals (CI) to allow interpretation of the size of effect. Multivariate regression was used to explore the independent effect of providing weekend therapy services on rehabilitation length of hospital stay. A theoretically based model, which included factors known to influence length of hospital stay, was developed. As it was a secondary analysis of existing data, the choice of variables was constrained by the data available. Therefore, these participant factors were included: age, gender, co-morbidities, and baseline walking speed and FIM score. As length of rehabilitation hospital stay differed both between trials (CIRCIT versus Saturday trial), and across hospital site within the trials, both of these factors were also included in the model, and collinearity between variables within the model was assessed. Between-group differences in self-selected walking speed and independence in activities of daily living (FIM scores) were examined using Mann-Whitney U tests (as data were not normally distributed), and independent *t*-tests (to allow for interpretation of the size of the effect). Analyses were conducted using commercial software[a] with significance set at $\alpha = 0.05$. As health-related quality of life data were collected using two different tools, group data (means and standard deviations) were pooled in meta-analysis software[b] using a fixed-effect model and reported as a standardised mean difference. A fixed-effect model was chosen because heterogeneity between the trials was assumed to be low. This assumption was verified by checking heterogeneity using the I^2 statistic.

Results

Flow of participants through the study

All participants that were randomised to therapy 7 days a week (n = 96) or usual care (n = 94) in the CIRCIT trial, and all participants in the Saturday trial with a diagnosis of stroke (usual care n = 79, weekend therapy n = 81) were included in the pooled analysis. Figure 1 presents the flow of participants through the trials. Table 1 compares baseline characteristics of all included participants. Table 2 compares baseline differences between usual care and weekend therapy participants for the pooled dataset.

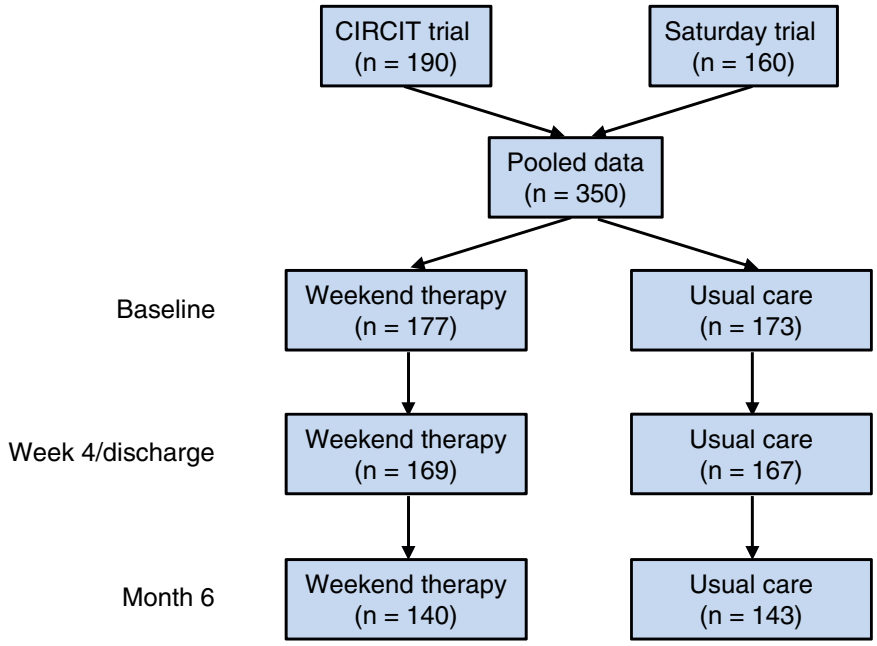


Figure 1. Flow of participants through the included studies. Reasons for loss to follow-up are reported in the main results papers of the included trials.[4,5]

Table 1
Baseline characteristics of participants, amount of therapy received and length of stay, by trial.

Characteristic	CIRCIT (n = 190)	Saturday trial (n = 160)	MD (95% CI)[a] or *p*-value for Chi^2 test
Age *(y)*, mean (SD) range	70 (13) 23 to 91	75 (12) 36 to 92	5 (2 to 7)
Gender, n male (%)	111 (58)	86 (54)	0.22
First stroke, n (%)	153 (81)	129 (81)[b]	0.11
Living prior to admission, n (%)			1.0
home	183 (96)	150 (94)	
residential aged care/other	6 (3)	5 (3)	
missing	1 (1)	5 (3)	
Charlson co-morbidity index score, n (%)			0.001
0	89 (47)	51 (32)	
1	53 (28)	38 (24)	
> 1	48 (25)	71 (44)	
FIM total *(18 to 126)*, mean (SD) range	66 (16) 40 to 112	72 (25) 19 to 123	5 (1 to 10)
FIM motor *(13 to 91)*, mean (SD) range	41 (3) 15 to 78	46 (21) 13 to 88	6 (2 to 9)
Participants unable to walk, n (%)	96 (51)	76 (48)	0.11
Gait speed of those able to walk *(m/s)*, mean (SD) range	0.43 (0.24) 0.05 to 1.20	0.63 (0.34) 0.09 to 1.92	0.20 (0.11 to 0.29)
Weekday therapy time *(min/wk)*, mean (SD) range	134 (75) 19 to 483	267 (115) 28 to 595	133 (113 to 154)
Extra weekend therapy time *(min/wk)*, mean (SD) range[c]	36 (23) 0 to 140	76 (32) 0 to 168	41 (33 to 49)
Length of stay *(d)*[d]	58.6 (37.6) 14 to 240	34.1 (23.2) 4 to 119	−24.4 (−17.6 to −31.2)

[a] MD is calculated as Saturday trial minus CIRCIT.
[b] Participants with previous hemiplegia as recorded by the Charlson co-morbidity index.
[c] For the CIRCIT trial this is physiotherapy time provided Saturday and Sunday. For the Saturday trial this refers to physiotherapy and occupational therapy time provided on Saturdays.
[d] 12 participants had missing data for length of stay in the CIRCIT trial.
FIM = Functional Independence Measure.

CIRCIT versus Saturday trial

Participants in the Saturday trial had higher FIM scores on admission to rehabilitation, suggesting that they were less disabled than those in the CIRCIT trial. A similar proportion of participants in both trials were able to walk at admission to rehabilitation, and of those able to walk, the average walking speed was faster in the Saturday trial participants. Significantly more people in the Saturday trial had at least one co-morbidity.

Participants in the CIRCIT trial received an average of 134 minutes/week (SD 75) of physiotherapy during weekdays. This was significantly less than the 267 minutes/week (SD 115) of physiotherapy provided during weekdays in the Saturday trial (mean difference 133 minutes/week, 95% CI 113 to 154). The CIRCIT trial participants in the intervention arm received an average of 36 minutes/week (SD 23) of additional weekend physiotherapy. Again, this was significantly less than the average additional therapy (physiotherapy and occupational therapy) provided to intervention participants in the Saturday trial, which was 76 minutes/week (SD 32). The mean difference was 41 minutes/week (95% CI 33 to 50).

Additional weekend therapy compared to usual care

Pooling the individual data, participants receiving weekend therapy had, on average, 5.7 days shorter length of rehabilitation hospital stay, although in the unadjusted model this difference did not reach statistical significance (MD −5.7 days, 95% CI −13.0 to 1.5, 90% CI −11.8 to 0.3), as shown in Table 3. The multivariate regression model showed that age, baseline FIM score, baseline walking speed, hospital site and treatment group (weekend therapy versus usual care) all contributed significantly to length of rehabilitation hospital stay (Table 4). As there was co-linearity between trial and hospital site, the model was first tested with trial only, then with hospital sites only. Including hospital sites explained more of the variance (adjusted r^2 0.386 versus 0.356); therefore, the final model included dummy variables for hospital sites. Controlling for all these variables, randomisation to the

Table 2
Baseline characteristics of participants by group.

Characteristic	Con (n = 173)	Exp (n = 177)
Age *(y)*, mean (SD) range	72 (13) 23 to 92	73 (12) 36 to 91
Gender, n male (%)	93 (54)	104 (59)
Living at home prior to admission, n (%)	164 (95)	169 (97)
No important co-morbidities, n (%)[a]	72 (42)	68 (38)
FIM total *(18 to 126)*, mean (SD) range	70 (21) 21 to 123	67 (21) 19 to 118
FIM motor *(13 to 91)*, mean (SD) range	45 (18) 13 to 88	42 (17) 13 to 88
Gait speed of those able to walk *(m/s)*, mean (SD) range	0.55 (0.31) 0.10 to 1.90	0.51 (0.31) 0.05 to 1.61

[a] Charlson co-morbidity index = 0.
Con = control group (usual care only), Exp = experimental group (extra weekend therapy), FIM = Functional Independence Measure.

Table 3
Mean (SD) range of continuous outcomes by group, and mean difference (95% CI) between groups.

Outcome	Con (n = 173)	Exp (n = 177)	MD (95% CI)[a] Exp minus con
Length of stay *(d)*	49.9 (36.7) 6 to 240	44.1 (30.7) 4 to 199	−5.7 (−13.0 to 1.5)
Gait speed of those able to walk at 4 wk/discharge[b] *(m/s)*	0.71 (0.45) 0.07 to 2.27	0.65 (0.40) 0.07 to 2.08	−0.06 (−0.16 to 0.04)
FIM total at 4 wk/discharge[b] *(18 to 126)*	95 (22) 18 to 125	97 (22) 26 to 126	2 (−3 to 7)
FIM total at 6 months *(13 to 91)*	102 (22) 33 to 126	102 (23) 22 to 126	0 (−5 to 5)

[a] All comparisons were non-significant on Mann-Whitney U tests.
[b] At discharge in the Saturday trial and at 4 weeks in CIRCIT.
Con = control group (usual care only), Exp = experimental group (extra weekend therapy), FIM = Functional Independence Measure.

Table 4
Multivariate regression analysis of factors associated with length of hospital stay.

Independent variable	Unstandardised ß (SE)	95% CI for ß	Standardised ß	*p*-value
Group	7.5 (3.0)	1.7 to 13.3	0.111	0.011
FIM total at baseline	−0.4 (0.1)	−0.6 to −0.2	−0.263	< 0.001
Walking speed at baseline *(m/s)*	−23.1 (5.7)	−34.3 to −11.9	−0.226	< 0.001
Age *(y)*	−0.3 (0.1)	−0.6 to −0.1	−0.125	0.006
Female	−4.9 (3.1)	−10.9 to 1.1	−0.710	0.112
CCI = 1	−3.5 (3.7)	−10.8 to 3.9	−0.045	0.354
CCI > 1	−2.9 (3.6)	−10.0 to 4.1	−0.041	0.412
Hospital site 1	3.1 (4.5)	−5.8 to 11.9	0.035	0.490
Hospital site 3	18.8 (4.0)	11.0 to 26.6	0.252	< 0.001
Hospital site 4	66.2 (11.6)	43.4 to 89.1	0.259	< 0.001
Hospital site 5	20.0 (5.5)	9.2 to 30.8	0.176	< 0.001
Hospital site 6	11.5 (6.4)	−1.3 to 24.2	0.082	0.077
Hospital site 7	11.9 (8.0)	−3.8 to 27.6	0.068	0.136

CCI = Charlson co-morbidity index, where the referent is Charlson co-morbidity index = 0, a CCI of 1 means one co-morbidity, and CCI > 1 means 2 or more co-morbidities; FIM = Functional Independence Measure.
Hospital sites were entered as dummy variables; the referent is Hospital 2. The variables of trial (CIRCIT vs Saturday trial) and hospital site had high collinearity, therefore the variable of trial was removed from the model.

weekend therapy group was found to be an independent predictor of shorter rehabilitation hospital length of stay (MD 7.5 days, 95% CI 1.7 to 13.4), accounting for 39% of the variance in length of rehabilitation hospital stay.

The FIM scores at discharge/4 weeks were not different between usual care and weekend therapy participants (MD 1.9 points, 95% CI −2.8 to 6.6). At the same time point, walking speed was also not significantly different between the groups (MD −0.06 m/second, 95% CI −0.15 to 0.04); see Table 3. Similarly, there was no significant between-group difference in FIM scores at

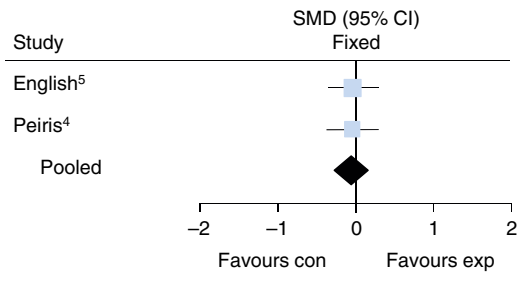


Figure 2. Standardised mean difference (95% CI) of the pooled effect of adding extra weekend therapy on health-related quality of life at discharge/4 weeks.
Con = control group = usual care; Exp = experimental group = extra weekend therapy.

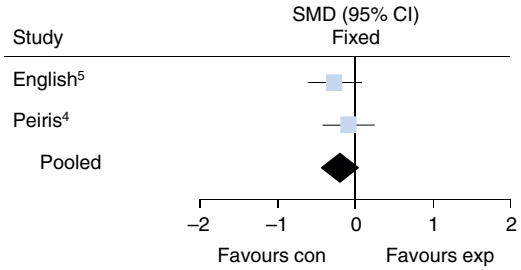


Figure 4. Standardised mean difference (95% CI) of the pooled effect of adding extra weekend therapy on health-related quality of life at 6 months.
Con = control group = usual care; Exp = experimental group = extra weekend therapy.

6 months (MD 0 points, 95% CI −5 to 5). There was no significant difference between usual care and weekend therapy participants in health-related quality of life at discharge/4 weeks (SMD −0.04, 95% CI −0.26 to 0.19, $I^2 = 0\%$), as shown in Figure 2. For a more detailed forest plot, see Figure 3 on the eAddenda. At 6 months, there was a trend toward participants who received usual care therapy to report a higher quality of life compared to participants who received weekend therapy (standardised mean difference −0.17, 95% CI −0.41 to 0.06, $I^2 = 0\%$), as shown in Figure 4. For a more detailed forest plot, see Figure 5 on the eAddenda.

Discussion

Pooling data from two Australian rehabilitation trials in an individual patient data meta-analysis identified that participants who received additional therapy services on the weekend had an average shorter length of rehabilitation hospital stay of 5.7 days. Despite the increased sample size, this difference was still not statistically significant in an unadjusted analysis. When analysis was adjusted to control for person-related factors known to influence recovery trajectories (severity of disability, age, co-morbidities) and health service-related factors (hospital site), a significant and independent association was found between weekend therapy provision and shorter length of rehabilitation hospital stay. The difference in the outcome for the adjusted and unadjusted analysis highlights that there is not a simple causal pathway between increased weekend therapy service provision and rehabilitation hospital length of stay. This is not surprising. It is known that there are many complex, interrelated factors that influence when someone is discharged from a rehabilitation hospital. The present model was not perfect, in that it explained only 38% of the variance in length of stay. This is because it was limited by the data collected in the original two randomised, controlled trials. There were other factors that were likely to have influenced rehabilitation hospital length of stay, including: additional person-related factors (cognition, depression, fatigue), social factors (availability of a carer, home environment, financial issues) and hospital system-related factors (accessibility of outpatient services, discharge planning practices).

The present results confirm that there is considerable variability in length of rehabilitation hospital stay for people with stroke. It was found that participants with slower walking speeds and those requiring more assistance with activities of daily living on admission to rehabilitation had a longer length of rehabilitation hospital stay. This was not surprising and was consistent with other research findings.[9,10] In the present analysis, it was found that the hospital in which people with stroke received their rehabilitation care contributed significantly to the variance in length of rehabilitation hospital stay. The key factors that drive variation in length of stay are unknown, but may include: hospital and health service policies and practices; the level of demand for access to rehabilitation centres; the time taken for approval and completion of essential home modifications; access to funding for carer and domiciliary support; and access to ongoing therapy services. Identifying the key factors driving variation in length of stay is likely to be a complex task, but is one that is vital to understanding how to improve the cost effectiveness of care for people with stroke. Without a thorough understanding of what the key service-related factors are, and how to control them, the impact of changes in clinical care provision on length of rehabilitation hospital stay will not be accurately determined.

This was an exploratory secondary analysis of clinical trial data and should be considered hypothesis-generating rather than definitive evidence of cause and effect. While a full cost-effectiveness analysis was not conducted, the results lend weight to the economic argument for implementing weekend therapy. Average rehabilitation bed-day costs vary between and within countries. Based on 2013 estimates of bed-day costs in the two main states of Australia in which the CIRCIT and Saturday trials were conducted,[11] a reduction of between 5 and 7 days represents a cost-saving of between AUD4855 and AUD6797 in South Australia and between AUD3770 and AUD5278 in Victoria. These savings would need to be offset against the cost of providing weekend therapy. These findings are in line with the published cost-effectiveness evaluation of the Saturday trial.[12]

Health-related quality of life is an important outcome to be included in rehabilitation trials, and both the CIRCIT and Saturday trials measured this construct. Because different instruments were used in the two trials, however, data could not be pooled at an individual level. When data were pooled in a traditional meta-analysis utilising standardised mean differences to account for differences between the outcome measures used, there was no significant between-group difference in health-related quality of life at discharge from hospital, and a trend toward better quality of life for participants who received usual care therapy at 6 months. Given the large amount of missing data at 6 months, this result should be interpreted with caution.

The present study has shown the value of using individual patient meta-analyses, and the complexities and challenges with such an approach. Despite having very similar a priori hypotheses, there were only three common outcome measures across the two trials (length of rehabilitation hospital stay, FIM and walking speed). Lack of commonality in outcome measures is a real issue for rehabilitation trials. An exploration of the Virtual International Stroke Trial Archives (VISTA) database in 2012 found that there were 69 different outcome measures used across 38 rehabilitation trials.[13] Twenty-five (36%) of these measures were used in only one trial. Reaching consensus in outcome measures is a fraught issue, but one that must be tackled to enable future pooling of trial data. The first Stroke Recovery and Rehabilitation Roundtable is currently working on consensus statements regarding measurement in clinical trials.[14]

Controlling for person-related and hospital system-related factors, some evidence of benefit for providing weekend therapy services on length of rehabilitation hospital stay was found, with a resultant possibility of cost savings to the healthcare system. This work highlighted what could be achieved with collaboration between trialists.

What is already known on this topic: Provision of weekend therapy for people in inpatient rehabilitation after stroke varies nationally and internationally. Trials of additional weekend physiotherapy are promising but inconclusive about the effect on length of stay.

What this study adds: Unadjusted pooling of individual patient data from existing trials does not identify a significant improvement in length of stay. When the analyses were adjusted for important patient-related factors and hospital site, there was significantly shorter average length of stay in the rehabilitation hospital for people receiving additional weekend therapy.

Footnotes: [a] SPSS Statistics Version 21, IBM Corp, Armonk, USA. [b] Review Manager Version 5.3, The Cochrane Collaboration, Copenhagen, Denmark.

eAddenda: Figures 3 and 5 can found at doi:10.1016/j.jphys.2016.05.015.

Ethics approval: Ethical approval for the CIRCIT trial was granted by the University of South Australia Human Research Ethics Committee, Southern Adelaide Health Service/Flinders University Clinical Research Ethics Committee, Sir Charles Gardiner Group Human Research Ethics Committee, Royal Adelaide Hospital Research Ethics Committee, Central Northern Adelaide Health Service Ethics of Human Research Committee and the St Vincent's Hospital Human Research Ethics Committee. Ethics approval for the Saturday trial was granted from the Eastern Health Research and Ethics Committee and La Trobe University Human Research Ethics Committee. All participants (or their proxy) in both trials provided informed written consent prior to data collection.

Competing interest: Nil.

Source of support: The CIRCIT trial was funded by National Health and Medical Research Council Grant 631905. The Saturday trial was supported by National Health and Medical Research Council Partnership Grant 541958.

Acknowledgement: Nil.

Provenance: Not invited. Peer reviewed.

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