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The Community In-reach Rehabilitation and Care Transition (CIRACT) clinical and cost-effectiveness randomisation controlled trial in older people admitted to hospital as an acute medical emergency

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Abstract

Objective: to compare the clinical and cost-effectiveness of a Community In-reach Rehabilitation and Care Transition (CIRACT) service with the traditional hospital-based rehabilitation (THB-Rehab) service.

Design: pragmatic randomised controlled trial with an integral health economic study.

Settings: large UK teaching hospital, with community follow-up.

Subjects: frail older people aged 70 years and older admitted to hospital as an acute medical emergency.

Measurements: Primary outcome: hospital length of stay; secondary outcomes: readmission, day 91-super spell bed days, functional ability, co-morbidity and health-related quality of life; cost-effectiveness analysis.

Results: a total of 250 participants were randomised. There was no significant difference in length of stay between the CIRACT and THB-Rehab service (median 8 versus 9 days; geometric mean 7.8 versus 8.7 days, mean ratio 0.90, 95% confidence interval (CI) 0.74–1.10). Of the participants who were discharged from hospital, 17% and 13% were readmitted within 28 days from the CIRACT and THB-Rehab services, respectively (risk difference 3.8%, 95% CI –5.8% to 13.4%). There were no other significant differences in any of the other secondary outcomes between the two groups. The mean costs (including NHS and personal social service) of the CIRACT and THB-Rehab service were £3,744 and £3,603, respectively (mean cost difference £144; 95% CI –1,645 to 1,934).

Conclusion: the CIRACT service does not reduce major hospital length of stay nor reduce short-term readmission rates, compared to the standard THB-Rehab service; however, a modest (<2.3 days) effect cannot be excluded. Further studies are necessary powered with larger sample sizes and cluster randomisation.

Trial registration: ISRCTN 94393315, 25th April 2013

Keywords: older people, care transition, transition coach, community rehabilitation, in-reach, readmission, hospital length of stay, cost-effectiveness

Introduction

The number of people aged 75 years and older in the UK is expected to double by 2,025, compared to a 12% growth in the overall population (Office for National Statistics, 2010). The proportion of acute medical emergencies contributed to by this age group has seen a significant rise in the last 5 years from 9.5% to 14% and with ageing trends, this is expected to increase significantly over the next 10 years [1]. For older people, hospital length of stay is much longer, the risk of hospital acquired complications much higher, discharge planning more complex and 28-day readmission rates much greater, compared to younger patients admitted to hospital [2]. Although, some hospitals in the UK have seen a significant reductions in hospital length of stay, 28-day readmission rate has increased. Nationally over the last 6 years, 28-day readmission rate has increased from 11% to 14% (DH, Emergency Admission Rates, 2008). The reasons for these readmissions are multifactorial, but an important component is the availability of appropriate resources in the community, which are able to respond to the needs of these patients in a responsive manner. Patient safety is often compromised during this vulnerable period, with high rates of medication errors [3–6], incomplete or inaccurate information on transfer [7] and lack of appropriate follow-up of care [8]. Collectively, this leads to fragmented discharge planning and increased rates of recidivism to high-intensity care settings.

In England and Wales, to address the problem of rising readmission rates, the Department of Health has allocated £300 million, as part of the ‘funding for reablement linked to the hospital discharge’ funding stream (Department of Health, 2012). This money was to be spent on developing local plans in conjunction with the Local Authority, Foundation Trusts/NHS Trusts and Community Health services, to facilitate seamless care for patients on discharge from hospital and prevent avoidable hospital readmissions. Some Clinical Commissioning Groups (CCGs) have invested in ‘early supported discharge at home’ schemes, some into ‘community-based rehabilitation’ schemes and some very little investment at all. Reviews of the literature (see Appendix 1 in the Supplementary Data, available at *Age and Ageing* online) suggest that it is currently unclear which are the most effective and efficient structures and organisation of community/intermediate care services in relation to their purpose [1, 9].

The aims of this study were therefore to examine the clinical effectiveness and cost-effectiveness of such a service, the Community In-Reach and Care Transition (CIRACT) service, compared to standard current UK practice, the traditional hospital-based rehabilitation (THB-Rehab) service.

Methods

Trial design

Single-centre pragmatic randomised controlled trial (1:1 allocation ratio) with an integral health economic study.

Participants

Frail older people (aged 70 years and older) admitted to the elderly care medical wards as an acute medical emergency.

Eligibility criteria

Eligible if all of the inclusion and none of the exclusion criteria were met.

Inclusion criteria

- Aged 70 years and older;
- General Practitioner (GP) registered within the Nottingham City CCG catchment area only (catchment population 300,000).

Exclusion criteria

- Bed bound prior to admission or moribund on admission;
- Receiving palliative care;
- Previously included in the trial on an earlier admission;
- Unable to be screened and recruited by the research team within 36 hours of admission to the study ward. A 36-hour deadline ensured there was not a delay to the participant receiving therapy and enabled the recruitment of a large proportion of patients admitted over a weekend when the research team were not available;
- Nursing home residents.

Study setting

General medical elderly care wards at the Queen’s Medical Centre (1,800-bed hospital, serving a population of 680,000), with community follow-up, Nottingham, UK.

Study intervention

The trial had two arms: (i) the CIRACT service (intervention arm) and (ii) the THB-Rehab service (standard care arm). Further details are described in Appendix 2 (Supplementary data available in *Age and Ageing* online).

In either group if a participant became medically unwell at any point to the extent they were no longer able to undertake rehabilitation activities, the treating team withheld further rehabilitation until being instructed by the ward doctor that it was safe to recommence rehabilitation activities. The nursing and medical care provided by the ward staff did not differ between the two groups.

Primary outcome measure

Hospital length of stay from randomisation to discharge from hospital.

Secondary outcome measures

- Unplanned readmission rate at day 28 and day 91;
- Super spell bed days (total time in NHS care including hospital care and intermediate care) from randomisation to 91 days follow-up;

- Functional ability at 91 days post-discharge as assessed by the Barthel Activities of Daily Living (ADL) index [25]. This 10-item index is scored out of 20 where people scoring 20 can get up and down stairs unaided and in and out of the bath or shower independently;
- Health-related quality of life as measured by the EQ-5D-3L [26] at 91 days post-discharge. The EQ-5D-3L is a standardised measure of quality of life including five domains: mobility, self-care, usual activities, pain/discomfort and anxiety/depression, each with three levels;
- Co-morbidity as measured by the Charlson index [27] at 91 days post-discharge. The Charlson index codes a total of 22 co-morbid conditions into a single score;
- Cost-effectiveness of the CIRACT and THB-Rehab services were estimated from a NHS and personal social service (PSS) perspective, using data collected from a modified Client Service Receipt Inventory (CSRI) questionnaire, with quality-adjusted life years (QALYs) at 91 days post-discharge.

Data collection

The research team collected demographic data and outcome measures via face-to-face interviews (at baseline) and follow-up data from (i) established hospital and community databases and (ii) participants directly (telephone interviews and face to face if necessary (majority with the participant directly rather than proxy)).

Sample size calculation

The primary statistical analysis was to compare length of stay for those allocated to receive the CIRACT service versus the THB-Rehab service. Pilot data showed the log-transformed length of stay to be normally distributed with a standard deviation of 0.9. Therefore, 111 patients per arm were recruited for the analysis in order to detect a clinically important effect size of 3 days (equivalent to a geometric mean ratio of 0.7) with a 5% two-sided alpha and 80% power. Allowing for a 5% non-collection of primary outcome data, 250 patients in total were recruited over a 13-month recruitment period.

Health economic study

An integral health economic study was designed to evaluate the cost-effectiveness of the CIRACT service, compared to the THB-Rehab service. A cost-effectiveness analysis was undertaken in line with the NICE reference case (NICE, 2013) and carried out to compare NHS and PSS costs with QALYs, using established methods. The EQ-5D-3L scores were converted into QALYs using linear interpolation and area under the curve methods for the trial period. These were adjusted for baseline differences between the groups. The results are presented using the Incremental Cost-Effectiveness Ratio (ICER). The costs and benefits were not discounted.

Further details available at <http://www.trialsjournal.com/content/16/1/41>.

Results

Flow of participants into the trial

Recruitment commenced on 23 June 2013 and ended on 31 July 2014, during which 1,584 patients from three acute medical elderly care wards were screened for eligibility, of whom 250 were randomised into the trial. The dominant reasons for exclusion were GP registered outside the Nottingham City CCG catchment area, lack of research staff capacity and unable to gain consent from participants (Figure S1). A total of 212 participants were followed up and included in the primary analysis.

Baseline characteristics of randomised participants

The baseline characteristics are shown in Table 1 below. The mean age at randomisation was 84.1 years (range 67–99 years), with a slight predominance of females (64%). The mean Mini Mental State Examination (MMSE) was 22/30 and mean Barthel ADL score 11/20. There was a high prevalence of co-morbidities among the participants, mean Charlson Score 7. The groups appeared well balanced at baseline. This also held true between participants who had primary outcome data and those who did not within each arm, except for the Barthel ADL score, which was higher among those who had primary outcome data than those who did not.

Follow-up

In total, 212 participants were discharged from the hospital alive (106 in each arm), of whom 174 were followed at 91 days post-discharge (91 from the THB-Rehab service and 83 from the CIRACT service). The main reason for not being followed up at 91 days post-discharge was death post-discharge. Twelve participants died in hospital prior to discharge and another 18 withdrew consent prior to discharge. There were eight participants who discontinued from the study prior to discharge for various post-randomisation eligibility breaches. These are categorised as ‘other withdrawals’—Figure S1 (see Appendix 3 in the Supplementary data, available at *Age and Ageing* online).

Primary outcome

There was no significant difference in length of stay between the CIRACT and THB-Rehab service (median 8 versus 9 days; geometric mean 7.8 versus 8.7 days; mean ratio 0.90, 95% confidence interval (CI) 0.74–1.10), which was supported by the sensitivity analyses (Table 2).

Secondary outcomes

There were no significant differences in any of the secondary outcomes between the two arms (Table 3). Median super spell bed days were 15 and 17 days for the CIRACT

Table 1. Summary of participant characteristics at baseline by intervention arm

Variable	Intervention arm		THB-Rehab		CIRACT		Total (<i>n</i> = 250)
			Primary outcome collected		Primary outcome collected		
	THB-Rehab (<i>n</i> = 125)	CIRACT (<i>n</i> = 125)	Yes (<i>n</i> = 106)	No (<i>n</i> = 19)	Yes (<i>n</i> = 106)	No (<i>n</i> = 19)	
Age at randomisation (years)							
Mean [SD]	84.5 [5.9]	83.6 [6.6]	84.3 [5.9]	85.8 [5.7]	83.8 [6.5]	82.8 [7.4]	84.1 [6.3]
Median [25th Q, 75th Q]	85 [81, 89]	84 [79, 89]	84 [81, 88]	86 [81, 90]	84 [79, 89]	85 [76, 88]	84.5 [80, 89]
Min, max	70, 98	67, 99	70, 98	73, 94	70, 99	67, 93	67, 99
<i>N</i>	125	125	106	19	106	19	250
Gender							
Male	46 (37%)	43 (34%)	38 (36%)	8 (42%)	33 (31%)	10 (53%)	89 (36%)
Female	79 (63%)	82 (66%)	68 (64%)	11 (58%)	73 (69%)	9 (47%)	161 (64%)
Barthel ADL score							
Mean [SD]	10.5 [5.4]	11.0 [6.1]	11.4 [4.7]	5.6 [6.5]	12.1 [5.4]	4.8 [6.1]	10.7 [5.8]
Median [25th Q, 75th Q]	10 [7, 15]	12 [6, 16]	11 [8, 15]	4 [0, 13]	13 [8, 16]	1 [0, 12]	11 [7, 16]
Min, max	0, 20	0, 20	1, 20	0, 17	0, 20	0, 16	0, 20
<i>N</i>	125	125	106	19	106	19	250
Charlson co-morbidity scale							
Mean [SD]	7.3 [1.9]	7.4 [2.2]	7.2 [1.9]	8.5 [1.8]	7.4 [2.2]	7.3 [2.1]	7.4 [2.1]
Median [25th Q, 75th Q]	7 [6, 9]	7 [6, 9]	7 [6, 9]	8.5 [8, 9]	7 [6, 9]	7 [6, 9]	7 [6, 9]
Min, max	4, 12	4, 13	4, 12	5, 12	4, 13	4, 11	4, 13
<i>N</i>	120	116	106	14	106	10	236
MMSE score							
Mean [SD]	22.0 [6.2]	21.4 [6.3]	22.9 [5.3]	16.2 [8.8]	21.5 [6.4]	20.2 [4.8]	21.7 [6.2]
Median [25th Q, 75th Q]	23 [19.5, 27]	22 [19, 26]	24 [20, 27]	18 [8, 21]	22.5 [19, 26]	21 [17, 23]	23 [19, 26]
Min, max	0, 30	1, 30	6, 30	0, 28	1, 30	14, 26	0, 30
<i>N</i>	80	87	70	10	82	5	167
EQ-5D health state score							
Mean [SD]	54.5 [19.6]	53.1 [22.7]	54.7 [20.2]	51.9 [6.5]	52.9 [23.1]	55.0 [15.5]	53.8 [21.1]
Median [25th Q, 75th Q]	50 [45, 70]	50 [40, 70]	50 [40, 70]	50 [50, 57.5]	50 [40, 70]	50 [50, 65]	50 [40, 70]
Min, max	10, 100	0, 100	10, 100	40, 60	0, 100	30, 80	0, 100
<i>N</i>	114	111	106	8	104	7	225

All data are *N* (%) unless specified.

Table 2. Summary of analyses for primary outcome

	Treatment arm		Analysis type	Ratio	95% CI	P value
	THB-Rehab (<i>n</i> = 106)	CIRACT (<i>n</i> = 106)				
Length of stay						
Geometric mean (95% CI)	8.7 (7.5, 10.1)	7.8 (6.9, 8.9)	(i) Primary analysis	0.90	0.74–1.10	0.303
Median [25th Q, 75th Q]	9 [5, 15]	8 [5, 13]				
Min, max	2, 55	1, 41				
<i>N</i>	106	106				
Length of stay						
Geometric mean (95% CI)	8.9 (7.7, 10.2)	8.0 (7.0, 9.2)	(ii) As (i) with deaths in hospital	0.90	0.75–1.10	0.316
Median [25th Q, 75th Q]	9 [5, 15.5]	8 [5, 14]				
Min, max	2, 55	1, 62				
<i>N</i>	112	112				
Length of stay						
Geometric mean (95% CI)	9.1 [7.9, 10.5]	8.3 [7.2, 9.5]	(iii) As (i) with missing data imputation	0.91	0.75–1.09	0.307
Median [25th Q, 75th Q]	9 [5, 16]	8 [5, 14]				
<i>N</i>	125	125				

Multiple imputation model included all baseline variables that might be associated with missing outcome. In this case, we included the Charlson co-morbidity scale index, age, gender and Barthel score.

service and THB-Rehab service, respectively (geometric mean ratio 0.96, 95% CI 0.76–1.21). Of participants discharged from hospital, 17% and 13% were readmitted within 28 days post-discharge from the CIRACT service

and THB-Rehab service, respectively (risk difference 3.8%, 95% CI –5.8% to 13.4%), and 42% versus 37% were readmitted by 91 days post-discharge (risk difference 5.7%, 95% CI –7.5% to 18.8%).

Table 3. Summary of analyses for secondary outcomes

	Intervention arm		Effectiveness parameter	95% CI	P value
	THB-Rehab	CIRACT			
Super spell bed days					
Geometric mean (95% CI)	15.6 (13.2–18.6)	14.9 (12.4–17.9)	0.96 ^a	0.76 to 1.21	0.713
Median [25th Q, 75th Q]	17 [9, 31]	15 [7, 32]			
Min, max	2, 112	2, 120			
N	112	112			
Readmitted to hospital at 28 days post-discharge	14 (13%)	18 (17%)	3.8% ^b	−5.8% to 13.4%	0.442
N	106	106			
Readmitted to hospital at 91 days post-discharge	39 (37%)	45 (42%)	5.7% ^b	−7.5%, 18.8%	0.399
N	106	106			
Barthel ADL score					
Mean [SD]	12.6 [5.7]	14.3 [5.5]	1.02 ^c	−0.41 to 2.44	0.161
Median [25th Q, 75th Q]	14 [8, 17]	16 [10, 18]			
Min, max	0, 20	0, 20			
N	90	83			
Co-morbidity score					
Mean [SD]	7.5 [2.1]	7.6 [2.1]	−0.06 ^c	−0.31 to 0.20	0.663
Median [25th Q, 75th Q]	7 [6, 9]	7 [6, 9]			
Min, max	4, 13	4, 13			
N	92	85			

^aRatio of geometric means.^bRisk difference.^cDifference in means, adjusted by baseline score.

Protocol deviations and adverse events

There were 15 protocol deviations in the CIRACT group and 8 in the THB-Rehab group. There were 7 non-severe falls recorded from 7 participants (4 CIRACT service and 3 from the THB-Rehab service). No safety concerns were raised by the TSC (Trial Steering Committee).

Cost-effectiveness analysis

There was very little evidence of difference in resource use between participants in the CIRACT and THB-Rehab service. Table S1 (see Appendix 4 in the Supplementary data, available at *Age and Ageing* online) shows the mean (unadjusted and adjusted) costs and QALYs for the two groups. Using a nonparametric bootstrap with replacement method and 1,000 replications, the mean incremental cost-effectiveness ratio for CIRACT versus THB-rehab service was £2,022 per QALY (145/0.04). The net monetary benefit per patient per year (willingness to pay threshold at £30,000 per QALY) was £1,932 (95% CI –2,134 to 5,863) and the probability that the intervention is cost-effective was 0.91. This shows that CIRACT may be a cost-effective intervention for patients, although this has to be interpreted with caution given the small differences and wide CIs.

There were no significant differences in the EQ-5D scores at baseline and day 91 between the two groups (day 91, 0.42 CIRACT service compared to 0.40 THB-Rehab service).

Discussion

The CIRACT service comprising a senior occupational therapist ‘transition coach’, senior physiotherapist and assistant practitioner, linked directly to a social worker,

working across multiple boundaries with patients and their carers, did not reduce hospital length of stay or short-term readmission rates compared to the THB-Rehab service (current standard rehabilitation care across most hospitals in the UK). Our findings are in contrast to the systematic review by Shepperd *et al.* [10] which reported that a structured discharge plan tailored to the individual patient showed a small but significant reduction in hospital length of stay and readmission rate for older people admitted to hospital with a medical condition (mean difference –0.91 days, 95% CI –1.55 to –0.27). However our findings were similar to the review by Bachmann *et al.* [11] which showed no significant difference in length of hospital stay in inpatient rehabilitation specifically designed for geriatric patients.

An important factor in the interpretation of the systematic review and meta-analysis above is the definition of the intervention, where it is delivered and the subsequent understanding of the relative contribution of each member within the makeup of the team. It was acknowledged in the review by Sheppard *et al.* that while the authors of all of the trials provided some description of their interventions, it was not possible to assess how some components of the process or working makeup of the team members compared between trials. In the review by Bachmann, half of the studies included patients in community hospitals in contrast to our study-acute hospital care. The context in which an intervention such as discharge planning is delivered may also play a role, not only in the way the intervention is delivered, but in the way services are configured, which may also explain some of these differences. In the systematic review by Sheppard *et al.*, ten of the trials were based in the USA, five in the UK, three in Canada, one in Australia,

one in Denmark and one in France. In the systematic review by Bachmann, of the 8 general geriatric rehabilitation studies, only 2 were UK studies, both of which were undertaken in community hospitals. In every country the orientation of primary care services differs, which may affect both the delivery and communication between services. Different perceptions of care by professionals of alternative care settings, and country specific funding arrangements, will also influence timely discharge. Of the five UK studies highlighted above, three were studies of psychiatric in-patients, one stroke patients, and only one, general medical in-patients [10].

Readmission rates were a secondary, but also recognised as an important outcome. Our findings are in contrast to recent published studies which have evaluated similar transition care models. The systematic review by Shepperd *et al.* [10] reported a 15% reduction in the 30-day readmission rate. The BOOST toolkit which included a number of similar components as our CIRACT service: risk assessment, medication review, discharge checklist and a multidisciplinary team-based approach to the discharge process showed modest reductions (2–6%) in the 30-day readmission rate [12]. The Transitional Care Model (TCM), which incorporated a multidisciplinary approach to patient care, led by a transitional care nurse ‘transition coach’ (TCN), who followed patients from the hospital to home, facilitated communication with outpatient providers and performed a series of home visits and telephone follow-up calls in the post-discharge period, similarly showed a reduction in the 90-day readmission rate between 13% and 48% [18, 19].

There are several possible explanations why the CIRACT service did not shorten hospital length of stay or reduce short-term readmission rates, compared to THB-Rehab service. The timing of delivery of an intervention such as discharge planning, which depends on organising other services, will have some bearing on how quickly these services can begin providing care. Although the CIRACT service was different to the THB-Rehab service, both services fed into similar community configured services; therefore, bottlenecks in providing community personal care services (for example community care support provided by social services) may have led to delays in both groups and potentially masked any significant benefits of the CIRACT intervention. Other service models that have been successful, but of which key interventions were not included as part of our CIRACT service have incorporated a more focused review on medicine management and the development of a portable personal health record. Project Reengineered Discharge (RED) focused on a multidisciplinary approach to patient care, coordinated by a nurse discharge advocate (DA) [14]. The DA engaged patients during their admission to hospital, provided clinical information and an individualised, illustrated plan post-discharge. However, following discharge, a pharmacist performed a telephone follow-up including a medication review with direct communication to the primary outpatient provider. There was a non-significant 6% reduction in the 30-day readmission rate and significant 8% reduction in 30-day visits to the Accident and Emergency post-discharge. In the Care Transitions Intervention, an advanced practice nurse ‘transition coach’

performed the post-discharge home visits and telephone calls emphasising patient engagement and self-management in the care of chronic diseases. This program reduced 30-day readmissions by 4–6% [15, 16] and 90-day readmission rate by 6–22% [17, 18]. Some of these elements were not present in our service. Another feature of many of the successful studies is the management of patients with specific chronic diseases, such as congestive cardiac failure, chronic obstructive airways disease and stroke disease rather than patients as in this study, who had a high prevalence of multiple co-morbidities: mean age 84 years, mean MMSE 22/30 (significant cognitive impairment), mean Barthel 11/20 (significant disability) and mean co-morbidity score 7.4 (no co-morbidities equal to 0). In disease-specific states, medication management may have a greater role in patient outcomes and interventions which address this, possibly by incorporating the patient’s GP or a community geriatrician may be more effective.

A number of limitations are recognised in this study. Patients were recruited from a single catchment area with a high number of patients excluded who were not living in the study catchment area, but admitted to the medical wards where participants were being actively rehabilitated. Thus, there were situations where the case workload of the THB-Rehab staff on some occasions was almost twice that on the CIRACT team, although there were no significant differences in any of the outcomes. Secondly and perhaps more important was the power of the study. The study was powered to show a large difference of 3 days, between the two groups, based on our early pilot work. The lower CI would have been unable to exclude any significant differences of less than 2.3 days, which clearly are important.

Conclusion

In conclusion, the CIRACT service as a complex intervention did not reduce major hospital length of stay nor short-term readmission rates compared to the THB-Rehab service; however, a modest (<2.3 days) but worthwhile effect cannot be excluded. The estimated ICER appears cost-effective, although it is subject to much uncertainty that spans all four quadrants of the cost-effectiveness plane such that caution should be used in interpreting this result. Further studies are necessary powered with larger sample sizes, cluster randomisation (to reduce bias), but more importantly including a more integrated community medical model as part of the CIRACT team.

Key points

- The proportion of acute medical emergencies contributed by older people has seen a significant rise in the last 5 years from 9.5% to 14% and is expected to increase significantly over the next 10 years.
- Optimal models of integrated service delivery to reduce length of stay and readmissions remains unclear.
- A community in reach and care transition team consisting of a senior occupational therapist (transition coach),

senior physiotherapist and assistant practitioner, linked directly to a social services practitioner, working across multiple boundaries with patients and their carers does not reduce major length of stay or readmissions.

Supplementary data

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

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See Appendix 5 in the Supplementary data, available at *Age and Ageing* online.

Conflicts of interest

None declared.

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