A meta-analysis of "hospital in the home"

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Abstract

Objective: To assess the effect of "hospital in the home" (HITH) services that significantly substitute for inhospital time on mortality, readmission rates, patient and carer satisfaction, and costs.

Data sources: MEDLINE, Embase, Social Sciences Citation Index, CINAHL, EconLit, PsycINFO and the Cochrane Database of Systematic Reviews, from the earliest date in each database to 1 February 2012.

Study selection: Randomised controlled trials (RCTs) comparing HITH care with inhospital treatment for patients aged > 16 years.

Data extraction: Potentially relevant studies were reviewed independently by two assessors, and data were extracted using a collection template and checklist.

Data synthesis: 61 RCTs met the inclusion criteria. HITH care led to reduced mortality (odds ratio [OR], 0.81; 95% CI, 0.69 to 0.95; $P = 0.008$; 42 RCTs with 6992 patients), readmission rates (OR, 0.75; 95% CI, 0.59 to 0.95; $P = 0.02$; 41 RCTs with 5372 patients) and cost (mean difference, – 1567.11; 95% CI, – 2069.53 to – 1064.69; $P < 0.001$; 11 RCTs with 1215 patients). The number needed to treat at home to prevent one death was 50. No heterogeneity was observed for mortality data, but heterogeneity was observed for data relating to readmission rates and cost. Patient satisfaction was higher in HITH in 21 of 22 studies, and carer satisfaction was higher in and six of eight studies; carer burden was lower in eight of 11 studies, although not significantly (mean difference, 0.00; 95% CI, – 0.19 to 0.19).

Conclusion: HITH is associated with reductions in mortality, readmission rates and cost, and increases in patient and carer satisfaction, but no change in carer burden.

"Hospital in the home" (HITH) provides acute or subacute treatment in a patient's residence for a condition that would normally require admission to hospital.[1] It is also known as "hospital at home", "home hospitalisation" and "early supported discharge",[2-6] and it has been speculated that HITH improves outcomes. The key is substituting for inhospital care. HITH includes admission avoidance (ie, full substitution for hospitalisation) and early discharge followed by care at home (ie, shortened hospitalisation).[7,8]

Most HITH services are nurse based, but they may include doctors and allied health professionals.[9,10] Some focus on specialties (eg, surgical specialties,[11-20] medical specialties,[21-33] rehabilitation medicine,[34,35] geriatrics,[36,37] psychiatry,[38-42] infectious diseases,[43,44] respiratory diseases[45-55] or orthopaedics[56]), diagnostic groups (eg, hip fracture[57,58] or stroke[59-70]) or a mixture.[71] The literature is confusing because many studies on HITH do not use the term HITH (or any similar terms) and some studies use the term HITH but do not involve substitution for inhospital care.

HITH has increased in popularity because of concerns about safety, availability and cost of inhospital care. Although hospitalisation is associated with mortality, adverse events and deteriorating cognitive and physical function, one cannot assume that a change of location will alter such outcomes. However, hospital-based clinicians have expressed concern that HITH care is lower quality than inhospital care and reduces access to technologies and resources that deliver urgent, life-saving treatment.[72]

Disease-specific reviews have not shown consistent benefit.[5,6] Location of care at home may be crucial to different outcomes, rather than particular diseases, subspecialties or the amount of hospital care that is replaced by HITH care, as long as some clinically significant substitution occurs.[1]

Reviews that did not look at specific diseases have similarly concluded no benefit,[2,7,8] but these have been criticised for problems with inclusion and exclusion criteria and lack of an overall meta-analysis.[73] Difficulties relating to definitions of HITH (which did not stipulate significant substitution) may have reduced the effect attributable to substitution,[2,74] although some benefit (eg, reduced mortality at 6 months) was seen.[7]

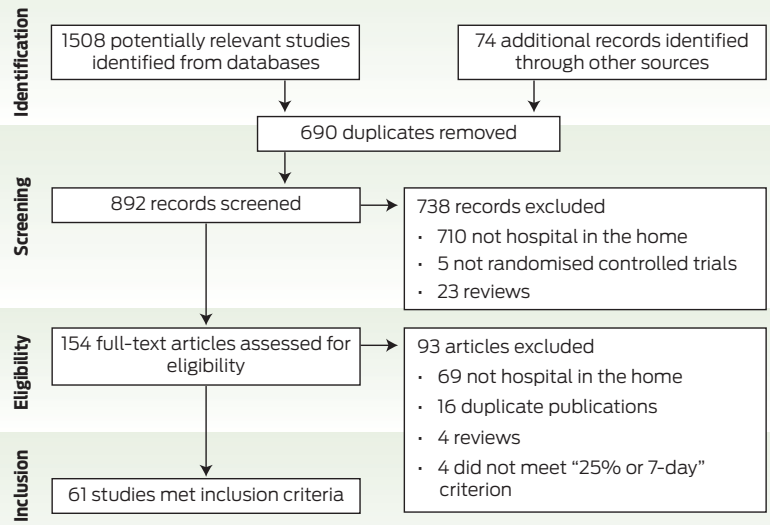
We conducted a review restricted to HITH services that significantly substitute for inhospital time, to determine (a) whether the hazards of hospitalisation are due to illness or time in hospital and (b) whether a change in location might reduce these. We hypothesised that replacing inhospital care with home-based care for ⩾ 7 days or for ⩾ 25% of the duration of the control hospital admissions would produce different clinical outcomes — relating to mortality, readmission rates, and patient and carer satisfaction — and result in different costs of care. We considered specialties and diagnostic groups to be of secondary importance, so all types of HITH service that substitute for inhospital care were included, and HITH services that do not substitute for inhospital care were excluded.

Methods

We report this meta-analysis according to the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[75] and the recommendations of the Cochrane Effective Practice and Organisation of Care (EPOC) Group.[76]

We searched MEDLINE, Embase, Social Sciences Citation Index, CINAHL, EconLit, PsycINFO and the Cochrane Database of Systematic Reviews, from the earliest date in each database to 1 February 2012. We used the search strategy reported in the initial Cochrane protocol,[2] which combined acute and subacute studies (Appendix 1, online at mja.com.au). Additional records were identified through other sources (backward searching through references of published articles, forward searching through citations, and articles known to us).

1 Flow of information



We included randomised controlled trials (RCTs) that compared HITH care with inhospital care for patients aged > 16 years. Significant substitution for inhospital care was defined as the intervention group spending significantly less time in hospital — the duration of out-of-hospital care being either ⩾ 7 days or ⩾ 25% of the average length of stay (ALOS) for control hospital admissions.

We included studies from the community,[21-24] emergency departments (EDs),[28-33,36-42,44-48,55,59,70] hospitalisations in departments other than EDs,[11-20,25-27,34,35,43,48-54,56-58,60-69,71] and hospital-based outreach teams and community-based teams.[11,13-15,21,44,48,69] We excluded long-term care, outpatient care without any care provided at home, elaborate home care services in which patients in the control group were also at home, paediatric care and obstetric care.

Study selection

The initial search for potentially relevant studies was performed by a research assistant. Two of us (G A C and N S S) independently read the abstracts of potentially relevant studies (excluding articles that clearly did not meet the inclusion criteria and selecting articles for detailed analysis), independently read the remaining studies in full to assess them for eligibility, and extracted data using a collection template and checklist (which were developed by the Cochrane Collaboration and modified for this review). Disagreements were resolved by discussion or referral to external assessors. Quality of eligible studies was assessed by Cochrane criteria. Four of us (D A M, N A R, A D W and L B) checked the selected studies to ensure that they met the inclusion criteria.

Outcomes of interest were mortality, readmission rates, patient and carer satisfaction, and cost. We collected data on these outcomes at longest available follow-up. We assessed each study for bias using EPOC criteria. This included concealment of allocation, blinded assessment of outcomes, measurement of baseline data, use of reliable outcome measures (objective measures or measures known to be reliable and valid) and protection against contamination. One criterion, follow-up by professionals, was not applicable and was therefore excluded.

We analysed mortality data using fixed-effects Peto odds ratios (ORs) with 95% confidence intervals, and readmissions and cost data using random-effects Peto ORs with 95% confidence intervals. Continuous data (such as data on cost and carer burden) were also analysed by calculation of differences in means. Categorical data (patient and carer satisfaction, and subsidiary information about cost and carer burden) were reported as counts. Statistical heterogeneity was measured by χ^2 and I^2 tests.

We analysed intention-to-treat data wherever available. A 2-sided P value of 0.05 or lower was considered significant. Meta-analyses were conducted using RevMan 5.1.6 (Nordic Cochrane Centre). Studies were also analysed by specialty, age of participants, and date of publication.

In cases where different validated instruments were used for the same outcomes, attempts were made to collapse scores into dichotomous outcomes. If this was not rational, the results of the different outcomes were counted. A direct cost comparison was attempted, taking into account inflation, by using proportional differences in costs, rather than absolute values.

Publication bias was assessed using a funnel plot, and reporting bias was assessed by comparing the number of studies included in our study with the numbers included in other meta-analyses.

Sensitivity analyses were conducted on data relating to mortality, readmission rates and cost to determine how many studies could be omitted without affecting the results, starting with the strongest results.

Results

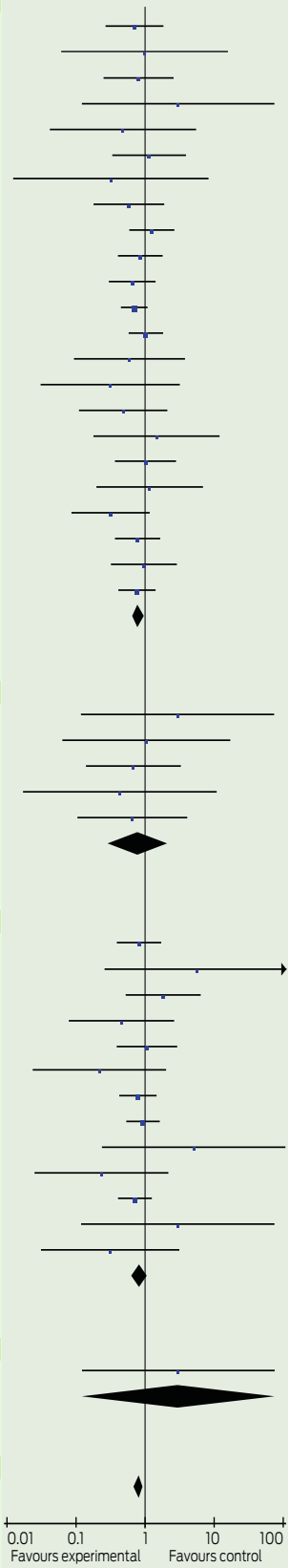
Of 1582 potentially relevant studies, 61 met the inclusion criteria (Box 1). For brevity, we only cite the principal publications. For eight studies,[19,31,37,44,55,56,68,70] additional information was obtained from authors. Almost all studies were not blinded. However, many studies used blinded initial assessments before randomisation. Some outcome assessment was blinded.

The effect sizes for data relating to mortality are shown in Box 2. There was a clinically significant reduction in mortality (OR, 0.81; 95% CI, 0.69 to 0.95; $P = 0.008$) in favour of HITH, giving a 19% relative reduction and 2.01% absolute reduction in mortality; the number needed to treat at home to prevent one death was 50. No significant heterogeneity was observed in the mortality data ($P > 0.99$), and there were similar reductions in mortality in medical (OR, 0.79; 95% CI, 0.65 to 0.97; $P = 0.02$), surgical (OR, 0.78; 95% CI, 0.29 to 2.10; $P = 0.62$) and rehabilitation studies (OR, 0.83; 95% CI, 0.63 to 1.08; $P = 0.17$), with no significant heterogeneity in these subgroups. Analysis by degree of substitution, age of patients and year of publication did not reveal marked shifts (Box 3), although there was a significant reduction in mortality in the middle age group (OR, 0.70; 95% CI, 0.51 to 0.95; $P = 0.02$).

The effect sizes for data relating to readmission rates are shown in Box 4. The reduction in readmission rates (OR, 0.75; 95% CI, 0.59 to 0.95; $P = 0.02$) in favour of HITH was associated with significant heterogeneity by one test ($\chi^2 =$

2 Effects of hospital in the home (HITH) on mortality

	HITH		Hospital			
	Events	Total	Events	Total	Weight	Odds ratio, Peto, fixed effect (95% CI)
Medical						
Aimonino Ricauda 2008[55]	9	52	12	52	2.7%	0.70 (0.27–1.83)
Aujesky 2011[32]	1	171	1	168	0.3%	0.98 (0.06–15.83)
Caplan 1999[36]	6	51	7	49	1.8%	0.80 (0.25–2.57)
Carratalà 2005[47]	1	102	0	101	0.2%	3.00 (0.12–74.52)
Cotton 2000[50]	1	41	2	40	0.4%	0.47 (0.04–5.46)
Davies 2000[45]	9	100	4	50	1.7%	1.14 (0.33–3.89)
Diaz Lobato 2005[54]	0	20	1	20	0.2%	0.32 (0.01–8.26)
Hernandez 2003[53]	5	121	7	101	1.8%	0.58 (0.18–1.88)
Hill 1978[22]	17	132	14	132	4.4%	1.25 (0.59–2.64)
Koopman 1996[26]	14	202	16	198	4.5%	0.85 (0.40–1.79)
Levine 1996[25]	11	247	17	253	4.1%	0.65 (0.3–1.41)
Mather 1976[21]	44	226	58	224	12.7%	0.69 (0.44–1.08)
Melin 1992[34]	40	150	26	99	7.6%	1.02 (0.57–1.82)
Mendoza 2009[29]	2	37	3	34	0.7%	0.59 (0.09–3.77)
Ojoo 2002[52]	1	30	3	30	0.5%	0.31 (0.03–3.17)
Otero 2010[31]	3	72	5	60	1.2%	0.48 (0.11–2.09)
Patel 2008[28]	2	13	2	18	0.6%	1.45 (0.18–11.94)
Richards 1998[27]	12	160	6	81	2.4%	1.01 (0.37–2.81)
Shepperd 1998[71]*	3	15	3	17	0.8%	1.17 (0.2–6.89)
Skwarska 2000[51]	4	122	6	62	1.5%	0.32 (0.09–1.17)
Tibaldi 2004[37]	24	56	26	53	4.4%	0.78 (0.37–1.66)
Tibaldi 2009[30]	7	48	8	53	2.1%	0.96 (0.32–2.88)
Wilson 1999[23]	26	101	30	96	6.5%	0.76 (0.41–1.42)
Total	242	2269	257	1991	63.1%	0.79 (0.65–0.97)
Test for heterogeneity: $\chi^2 = 8.54$; df = 22; $P > 0.99$; $I^2 = 0$						
Test for overall effect: Z = 2.28; $P = 0.02$						
Surgical						
Bonnema 1998[16]	1	61	0	59	0.2%	2.95 (0.12–73.88)
Bundred 1998[17]	1	49	1	51	0.3%	1.04 (0.06–17.13)
Crotty 2002[57]	3	34	4	32	1.0%	0.68 (0.14–3.29)
Shepperd 1998[71]*	0	37	1	49	0.2%	0.43 (0.02–10.89)
Wells 2004[19]	2	54	3	54	0.7%	0.65 (0.10–4.08)
Total	7	235	9	245	2.6%	0.78 (0.29–2.1)
Test for heterogeneity: $\chi^2 = 0.89$; df = 4; $P = 0.93$; $I^2 = 0$						
Test for overall effect: Z = 0.49; $P = 0.62$						
Rehabilitation						
Aimonino Ricauda 2004[70]	21	60	24	60	4.6%	0.81 (0.39–1.69)
Anderson 2000[63]	2	42	0	44	0.3%	5.49 (0.26–117.88)
Askim 2004[68]	8	31	5	31	1.6%	1.81 (0.52–6.31)
Bautz-Holter 2002[66]	2	42	4	40	0.8%	0.45 (0.08–2.61)
Caplan 2006[35]	15	70	7	34	2.5%	1.05 (0.38–2.88)
Donnelly 2004[69]	1	59	4	54	0.5%	0.22 (0.02–1.99)
Indredavik 2000[64]	21	160	26	160	6.5%	0.78 (0.42–1.45)
Kalra 2000[65]	21	144	47	301	8.1%	0.92 (0.53–1.61)
Mayo 2000[59]	2	58	0	56	0.3%	5.00 (0.23–106.5)
Rodgers 1997[61]	1	46	4	46	0.5%	0.23 (0.03–2.17)
Rudd 1997[60]	26	167	34	164	7.9%	0.71 (0.40–1.24)
Suwanwela 2002[67]	1	52	0	50	0.2%	2.94 (0.12–73.93)
Widén Holmqvist 1998[62]	1	41	3	40	0.5%	0.31 (0.03–3.10)
Total	122	972	158	1080	34.1%	0.83 (0.63–1.08)
Test for heterogeneity: $\chi^2 = 9.41$; df = 12; $P = 0.67$; $I^2 = 0$						
Test for overall effect: Z = 1.38; $P = 0.17$						
Psychiatric						
Zwerling 1964[38]	1	100	0	100	0.2%	3.03 (0.12–75.28)
Total	1	100	0	100	0.2%	3.03 (0.12–75.28)
Test for heterogeneity: not applicable						
Test for overall effect: Z = 0.68; $P = 0.50$						
All subgroups						
Total	372	3576	424	3416	100%	0.81 (0.69–0.95)
Test for heterogeneity: $\chi^2 = 19.56$; df = 41; $P > 0.99$; $I^2 = 0$						
Test for overall effect: Z = 2.66; $P = 0.008$						
Test for subgroup differences: $\chi^2 = 0.71$; df = 3; $P = 0.87$; $I^2 = 0$						



* The article by Shepperd[71] contains five subanalyses.

3 Effect sizes of hospital in the home (HITH) on mortality in different subgroups

	No. of studies	No. of patients treated in HITH	Odds ratio (95% CI)	*P*
Degree of admission substitution (*n* = 42)				
Full substitution	14	1249	0.81 (0.62–1.05)	0.11
> 50% substitution*	11	1055	0.72 (0.49–1.07)	0.11
< 50% substitution	17	1251	0.84 (0.67–1.06)	0.15
Average age of patients in HITH group (*n* = 42)				
Youngest group, average age < 70 years	15	1560	0.79 (0.59–1.05)	0.10
Middle group, average age 70–73 years	13	1012	0.70 (0.51–0.95)	0.02
Oldest group, average age ⩾ 74 years	14	983	0.89 (0.71–1.13)	0.35
Year of publication† (*n* = 42)				
First third, 1964–1998	12	1452	0.80 (0.63–1.01)	0.06
Middle third, 1998–2002	16	1212	0.82 (0.63–1.06)	0.13
Last third, 2003–2011	14	854	0.83 (0.57–1.21)	0.32

* This category excludes full substitution. † Eight studies were published in 1998; five are in the first third and three are in the middle third. ◆

73.27; $P = 0.001$) but not the other ($I^2 = 45\%$) owing to larger reductions in readmissions in psychiatric (OR, 0.29; 95% CI, 0.05 to 1.65; $P = 0.16$) compared with medical (OR, 0.76; 95% CI, 0.60 to 0.97; $P = 0.02$), surgical (OR, 0.66; 95% CI, 0.36 to 1.22; $P = 0.18$) and rehabilitation studies (OR, 0.96; 95% CI, 0.70 to 1.31; $P = 0.79$). The absolute reduction in readmissions was 2.09%.

The effect sizes for data relating to cost are shown in Box 5. There was strong evidence for reduced cost (mean difference, – 1567.11; 95% CI, – 2069.53 to – 1064.69; $P < 0.001$) albeit with heterogeneity ($\chi^2 = 237.45$; $P < 0.001$; $I^2 = 96\%$), although all 11 studies favoured HITH. The heterogeneity was due to inflation, different currencies and different cost structures for brief surgical stays compared with much longer rehabilitation stays, causing a nearly 20-fold difference in raw numbers. Reduced costs were seen in all subgroups.

Of the 34 studies in which any cost data were presented, 32 concluded that HITH care was cheaper.[12-16,23,24,27-29,33-36,40-43,46,48,49,51,53,55,59-64,69,70] The other two studies concluded that hospital care was cheaper.[40,71] Overall, the cost for HITH care was 73.5% of the average for the control groups.

It was not possible to perform a meta-analysis on patient or carer satisfaction data because the studies that met our inclusion criteria used different validated and non-validated measurements. Data from 21 of 22 studies favoured HITH for patient satisfaction,[14,15,19,23,27,35,36,41,42,44,47,48,51,52,55,57,60,62,63,66,69] and data from the other showed equal patient satisfaction for hospital- and home-based care.[46]

Carer satisfaction in HITH was higher in six of eight studies,[15,35,36,57,63,66] one study showed no difference,[60] and one showed higher carer satisfaction in the control group.[27] Similarly, eight of 11 studies showed lower carer burden in HITH,[19,27,39,57,59,64,69,71] one found no difference,[63] and two favoured the control groups.[60,68] For carer burden, a meta-analysis of seven studies yielded no difference (mean difference, 0.00; 95% CI, – 0.19 to 0.19).

A funnel plot for mortality (Appendix 2, online at mja.com.au) was generally symmetrical, indicating that publication bias was unlikely. Compared with similar meta-analyses, the larger number of trials that we found indicates a low risk of reporting biases.

The sensitivity analyses for mortality, readmission rates and cost showed that after removing nine, five and nine studies, respectively, the meta-analyses became non-significant. Also, a meta-analysis of mortality data that included four additional studies (which had been excluded because they did not meet the 25% or 7-day criterion) did not produce markedly different results (OR, 0.84; 95% CI, 0.72 to 0.99; $P = 0.03$; no heterogeneity). In addition, a meta-analysis of 14 admission-substitution studies showed a similar, although not statistically significant, effect on mortality (OR, 0.81; 95% CI, 0.62 to 1.05; $P = 0.11$).

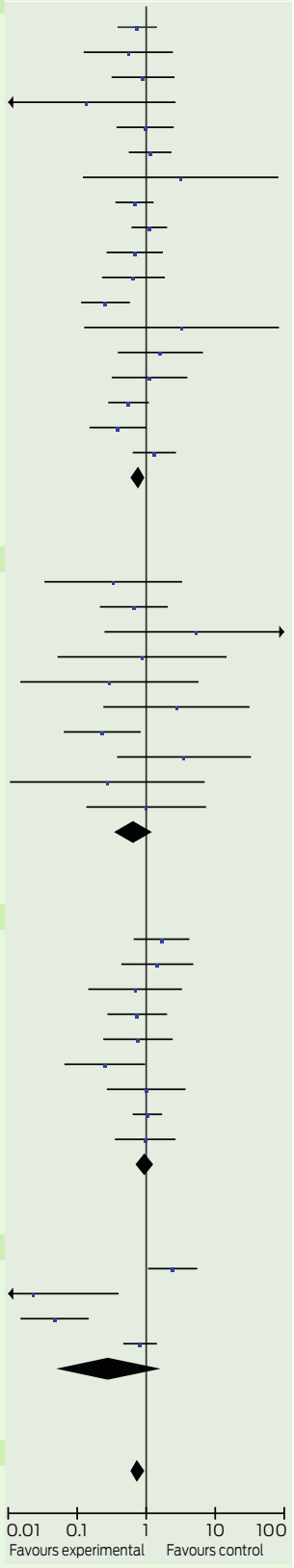
Discussion

Our study shows that HITH reduces mortality, readmission rates and cost compared with inhospital care, in a statistically and clinically significant way. Similar reductions in mortality were found for all age groups. The results also suggest that HITH increases patient and carer satisfaction but does not affect carer burden. These outcomes are likely to be generalisable as our study covered a broad range of clinical conditions and 61 RCTs from five continents.

Our study adds to the findings of four Cochrane reviews of HITH. The first of these reviews combined early discharge of older medical patients (acute and subacute), early discharge of elective surgical patients, admission avoidance for a mix of medical conditions, and care of terminally ill patients (which did not directly involve substitution for inhospital care).[2] A second iteration of this review was divided into three reviews, covering admission substitution,[7] early discharge (acute and subacute)[8] and palliative care.[76] A strength of our study is the quantified definition of HITH. The 25% or 7-day criterion was appropriate because ALOS is 4–5 days in many countries, so a 25% decrease represents ⩾1 day out of hospital. In addition, in countries with an ALOS of several weeks, a 7-day reduction is still clinically significant. This meant that our study included HITH models regardless of temporal-, team- and disease-specific frameworks. Our HITH definition increased the number of included studies compared with recent Cochrane reviews, and provided findings that were similar in direction but with more statistical power

4 Effects of hospital in the home (HITH) on readmission rates

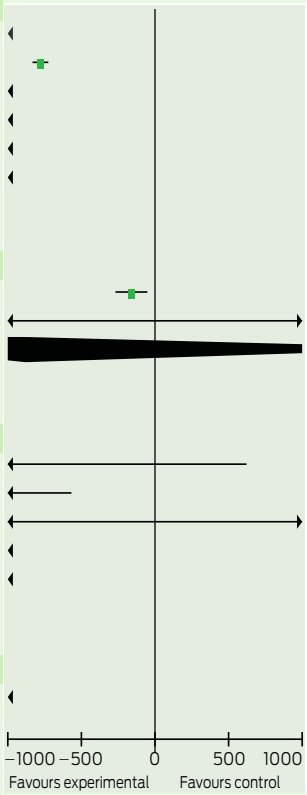
	HITH		Hospital			
	Events	Total	Events	Total	Weight	Odds ratio, Peto, random effect (95% CI)
Medical						
Aujesky 2011[32]	18	171	23	168	4.2%	0.74 (0.38–1.43)
Caplan 1999[36]	3	51	5	49	1.8%	0.55 (0.12–2.44)
Carratalà 2005[47]	7	110	8	114	2.8%	0.90 (0.32–2.57)
Corwin 2005[44]	0	98	3	96	0.6%	0.14 (0.01–2.66)
Cotton 2000[50]	12	41	12	40	3.1%	0.97 (0.37–2.51)
Davies 2000[45]	37	100	17	50	4.0%	1.14 (0.56–2.32)
Diaz Lobato 2005[54]	1	20	0	20	0.5%	3.15 (0.12–82.16)
Hernandez 2003[53]	23	121	26	101	4.3%	0.68 (0.36–1.28)
Melin 1992[34]	51	110	32	73	4.5%	1.11 (0.61–2.01)
Mendoza 2009[29]	15	37	17	34	3.1%	0.68 (0.27–1.74)
Ojoo 2002[52]	10	30	13	30	2.8%	0.65 (0.23–1.86)
Ricauda 2008[55]	17	52	34	52	3.6%	0.26 (0.11–0.58)
Richards 2005[27]	1	24	0	25	0.5%	3.26 (0.13–83.9)
Shepperd 1998[71]*	7	15	6	17	1.9%	1.60 (0.39–6.64)
Shepperd 1998[71]*	6	50	5	46	2.2%	1.12 (0.32–3.95)
Skwarska 2000[51]	27	122	21	62	4.1%	0.55 (0.28–1.09)
Tibaldi 2009[30]	8	48	18	53	3.1%	0.39 (0.15–1.00)
Wilson 1999[23]	21	101	16	96	4.0%	1.31 (0.64–2.70)
Total	264	1301	256	1126	51.0%	0.76 (0.60–0.97)
Test for heterogeneity: Tau^2 = 0.03; χ^2 = 19.54; df = 17; P = 0.30; I^2 = 13%						
Test for overall effect: Z = 2.25; P = 0.02						
Surgical						
Bundred 1998[17]	1	49	3	51	0.9%	0.33 (0.03–3.32)
Crotty 2002[57]	7	34	9	32	2.5%	0.66 (0.21–2.06)
Horgan 2000[18]	2	50	0	51	0.5%	5.31 (0.25–113.41)
Palmer Hill 2000[56]	1	32	1	28	0.6%	0.87 (0.05–14.60)
Ruckley 1978[15]	0	117	3	243	0.6%	0.29 (0.01–5.71)
Shepperd 1998[71]*	2	37	1	49	0.8%	2.74 (0.24–31.46)
Shepperd 1998[71]*	3	114	13	124	2.2%	0.23 (0.06–0.83)
Shepperd 1998[71]*	4	47	1	39	0.9%	3.53 (0.38–33.02)
Siggeirsdottir 2005[20]	0	27	1	23	0.5%	0.27 (0.01–7.02)
Wells 2004[19]	2	54	2	54	1.1%	1.00 (0.14–7.37)
Total	22	561	34	694	10.9%	0.66 (0.36–1.22)
Test for heterogeneity: Tau^2 = 0.00; χ^2 = 8.95; df = 9; P = 0.44; I^2 = 0						
Test for overall effect: Z = 1.33; P = 0.18						
Rehabilitation						
Anderson 2000[63]	15	42	11	44	3.2%	1.67 (0.66–4.22)
Askim 2004[68]	8	31	6	31	2.4%	1.45 (0.44–4.81)
Bautz–Holter 2002[66]	3	42	4	40	1.6%	0.69 (0.14–3.31)
Caplan 2006[35]	13	70	8	34	2.9%	0.74 (0.27–2.01)
Donnelly 2004[69]	6	59	7	54	2.5%	0.76 (0.24–2.42)
Mayo 2000[59]	3	58	10	56	2.0%	0.25 (0.07–0.97)
Rodgers 1997[61]	5	46	5	46	2.1%	1.00 (0.27–3.72)
Rudd 1997[60]	44	167	42	164	5.0%	1.04 (0.64–1.70)
Widén Holmqvist 1998[62]	10	41	10	40	2.9%	0.97 (0.35–2.66)
Total	107	556	103	509	24.6%	0.96 (0.70–1.31)
Test for heterogeneity: Tau^2 = 0.00; χ^2 = 6.30; df = 8; P = 0.61; I^2 = 0						
Test for overall effect: Z = 0.27; P = 0.79						
Psychiatric						
Muijen 1992[42]	20	92	10	97	3.6%	2.42 (1.06–5.49)
Stein 1975[39]	0	60	14	54	0.6%	0.02 (0.00–0.40)
Stein 1980[40]	4	64	34	58	2.5%	0.05 (0.02–0.15)
Zwerling 1964[38]	40	100	45	100	4.6%	0.81 (0.46–1.43)
Total	64	316	103	309	11.3%	0.29 (0.05–1.65)
Test for heterogeneity: Tau^2 = 2.67; χ^2 = 36.11; df = 3; P < 0.001; I^2 = 92%						
Test for overall effect: Z = 1.40; P = 0.16						
All subgroups						
Total	457	2734	496	2638	100%	0.75 (0.59–0.95)
Test for heterogeneity: Tau^2 = 0.22; χ^2 = 73.27; df = 40; P = 0.001; I^2 = 45%						
Test for overall effect: Z =2.36; P = 0.02						
Test for subgroup differences: χ^2 = 3.13; df = 3; P = 0.37; I^2 = 4.1%						



* The article by Shepperd[71] contains five subanalyses.

5 Effects of hospital in the home (HITH) on cost

	HITH			Hospital				
	Mean	SD	Total	Mean	SD	Total	Weight	Mean difference, inverse variance, random effect (95% CI)
Medical								
Caplan 1999[36]	1 764	1 253	51	3 775	2 496	49	13.2%	− 2 011.00 (− 2 789.89 to − 1 232.11)
Hernandez 2003[53]	1 255.12	138.3	121	2 033.51	244.23	101	19.4%	− 778.39 (− 832.02 to − 724.76)
Mendoza 2009[29]	2 541	1 334	37	4 502	2 153	34	12.6%	− 1961.00 (− 2 802.72 to − 1 119.28)
Nicholson 2001[46]	745	75	13	2 543	388.5	12	18.7%	− 1 798.00 (− 2 021.56 to − 1 574.44)
Talcott 2011[33]	10 977	5 686	35	16 341	7 652	57	2.9%	− 5 364.00 (− 8 101.63 to − 2 626.37)
Total			257			253	66.8%	− 1 821.69 (− 2 591.89 to − 1 051.49)
Test for heterogeneity: Tau^2 = 579 049.20; χ^2 = 101.56; df = 4; P < 0.001; I^2 = 96%								
Test for overall effect: Z = 4.64; P < 0.001								
Surgical								
Shepperd 1998[71]	487.43	350.2	114	647.77	496.27	124	19.3%	− 160.34 (− 268.79 to − 51.89)
Siggeirsdottir 2005[20]	8 550	2 409	27	11 952	11 407	23	1.1%	− 3 402.00 (− 8 151.55 to 1 347.55)
Total			141			147	20.3%	− 875.89 (− 3 510.96 to 1 759.19)
Test for heterogeneity: Tau^2 = 2 316 492.61; χ^2 = 1.79; df = 1; P = 0.18; I^2 = 44%								
Test for overall effect: Z = 0.65; P = 0.21								
Rehabilitation								
Anderson 2000[63]	8 040	4 439	42	10 054	7 676	44	3.1%	− 2 014.00 (− 4 649.60 to 621.60)
Caplan 2006[35]	7 680	4 154	70	10 598	6 365	34	3.7%	− 2 918.00 (− 5 268.38 to − 567.62)
Donnelly 2004[69]	9 680	7 381	59	11 734	10 340	54	2.0%	− 2 054.00 (− 5 393.59 to 1 285.59)
Mayo 2000[59]	7 784.25	3 858.36	58	11 065.20	7 504.19	56	4.1%	− 3 280.95 (− 5 482.97 to − 1 078.93)
Total			229			188	12.9%	− 2 704.18 (− 3 973.29 to − 1 435.07)
Test for heterogeneity: Tau^2 = 0; χ^2 = 0.70; df = 3; P = 0.87; I^2 = 0								
Test for overall effect: Z = 4.18; P < 0.001								
All subgroups								
Total			627			588	100%	− 1 567.11 (− 2 069.53 to − 1 064.69)
Test for heterogeneity: Tau^2 = 338 166.33; χ^2 = 237.45; df = 10; P < 0.001; I^2 = 96%								
Test for overall effect: Z = 6.11; P < 0.001								
Test for subgroup differences: χ^2 = 2.09; df = 2; P = 0.35; I^2 = 4.2								



due to the larger dataset. We clarified the definition of HITH used in the Cochrane reviews by including replacement of both acute and subacute hospitalisation. Studies of HITH replacing subacute hospitalisation[35,56,57,60-64, 66-69] have actually been included in the Cochrane reviews, although the reviews state that they only included replacement of acute hospitalisation.[2,8]

We omitted two studies that were included in the first and last of the four Cochrane reviews of HITH.[2,77] These did not meet our HITH definition because they compared different intensities of home-based care.[78,79] The Cochrane reviews excluded studies of surgical early discharge followed up by specialist hospital outreach[16,17] but included studies of community-based follow-up.[14,15]

We included 14 admission-substitution studies, and their OR for mortality was 0.81. The Cochrane review on admission substitution included five studies and showed that mortality decreased by 38% with HITH; it also showed improved functional outcomes, greater patient satisfaction, lower costs and less chance of ending up in institutional care, but concluded that both groups had "similar outcomes".[7] This review included studies of patients with stroke, patients with acute exacerbations of chronic obstructive pulmonary disease (COPD), and older patients with a mix of conditions; however, to reduce heterogeneity, it excluded studies of patients with pneumonia, patients with cellulitis, and frail elderly people with dementia.[80]

The Cochrane review on early discharge included 26 trials, but the largest meta-analysis calculation included only six trials, despite eight being included in a earlier single-diagnosis early-discharge meta-analysis.[5,8] None of these Cochrane reviews included a meta-analysis calculation on all studies that met the inclusion criteria.

The results of two meta-analyses of HITH care for patients with stroke differed — one showed no benefit, but the second showed reduced death or dependency.[5,81] A systematic review of HITH for patients with COPD showed no differences.[6] In practice, patients move between diagnostic groups, older people have comorbidities, and HITH services treat many diagnostic groups across subspecialties.

The mechanisms by which changing location of care reduces mortality are likely to be multifactorial. A recent review demonstrated that HITH reduces delirium,[1] but it may also reduce iatrogenic infections, falls and adverse events.[10,30,82]

The reduction in cost shown in our study may be an underestimate of the true savings that result from HITH. Because HITH costings done during trials usually represent the period during which HITH is introduced, they are generally based on services that are not at full capacity, and are therefore operating at reduced efficiency. Also, the savings associated with reduced readmission rates were not taken into account in our study.

Our study also raises concern regarding inhospital care, particularly where HITH care is an option, and supports further investigation of differences between the two care models so that the quality of inpatient care can be improved.

A limitation of our study is that the wide range of HITH services included makes it difficult to determine which elements of care affected the outcomes. The HITH services varied from full multidisciplinary team care[23,24,34-37,39-42,46,60,61,63-65,68,70,71] and care by partial teams[13,15,20,27,38,47,48,52,54,55,57-59,62,66,69] to services with a single health worker, most often a nurse with doctor supervision.[11,12,14,16-18,19,21,22,25,26,43-45,49-53,67] Some services included outpatient care[12,18,38,46] and some involved parenteral self-administration of medications (such as antibiotics[49] or heparin[25,26,31,32]), but all involved health practitioners visiting the home and the control group being in hospital.

The central criterion that we used — for HITH care to significantly replace inhospital time — resulted in four studies being excluded, but including them made no difference to the outcome of mortality. This criterion is not likely to introduce a bias favouring positive findings, as admission to hospital is expected to reduce mortality, and early discharge is associated with higher readmission rates. Therefore any bias due to the central criterion should be negative.

Our data support greater use of HITH to improve patient outcomes, as measured by mortality, readmission rates and patient and carer satisfaction. Where suitable care can be provided at home as an alternative to hospitalisation, we believe that it should be recommended.

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