Economic evaluation of hospital at home versus hospital care: cost minimisation analysis of data from randomised controlled trial

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Abstract

Objectives To compare the costs of admission to a hospital at home scheme with those of acute hospital admission.

Design Cost minimisation analysis within a pragmatic randomised controlled trial.

Setting Hospital at home scheme in Leicester and the city's three acute hospitals.

Participants 199 consecutive patients assessed as being suitable for admission to hospital at home for acute care during the 18 month trial period (median age 84 years).

Intervention Hospital at home or hospital inpatient care.

Main outcome measures Costs to NHS, social services, patients, and families during the initial episode of treatment and the three months after admission.

Results Mean (median) costs per episode (including any transfer from hospital at home to hospital) were similar when analysed by intention to treat—hospital at home £2569 (£1655), hospital ward £2881 (£2031), bootstrap mean difference − 305 (95% confidence interval − 1112 to 448). When analysis was restricted to those who accepted their allocated place of care, hospital at home was significantly cheaper—hospital at home £2557 (£1710), hospital ward £3660 (£2903), bootstrap mean difference − 1071 (− 1843 to − 246). At three months the cost differences were sustained. Costs with all cases included were hospital at home £3671 (£2491), hospital ward £3877 (£3405), bootstrap mean difference − 210 (− 1025 to 635). When only those accepting allocated care were included the costs were hospital at home £3698 (£2493), hospital ward £4761 (£3940), bootstrap mean difference − 1063 (− 2044 to − 163); P = 0.009. About 25% of the costs for episodes of hospital at home were incurred through transfer to hospital. Costs per day of care were higher in the hospital at home arm (mean £207 *v* £134 in the hospital arm, excluding refusers, P < 0.001).

Conclusions Hospital at home can deliver care at similar or lower cost than an equivalent admission to an acute hospital.

Introduction

Managing the demand for hospital services by shifting activity elsewhere requires alternatives that can be justified on both clinical and economic grounds. Hospital at home is one such alternative, with a contested evidence base.[1] In acute care, hospital at home can provide an alternative to inpatient care in two ways—early discharge of patients from hospital or avoidance of admission. The comparator adopted in most evaluations is the acute hospital, although this

may not always be appropriate,[2] and the use of average costs for inpatients has been challenged.[3]

Evaluations of early discharge of surgical patients to hospital at home care have suggested that it can save costs by reducing length of stay,[4–6] although these savings may not always be achieved. More recent economic evaluations, conducted alongside randomised controlled trials,[7 8] failed to clarify the uncertainty, with one concluding that hospital at home provided care at lower cost than hospital[9] whereas the other did not.[10]

No randomised controlled trials of hospital at home schemes to avoid acute admission have been published, despite demands for such evidence.[11] Although the Kettering study included a small number of cases in which admission was avoided, these were not analysed separately.[7]

Methods

The processes of recruitment to the study, randomisation, and patient outcomes have been described elsewhere.[12] The approach we adopted for the economic analysis was to calculate costs for the original episode and at three months from admission, following the convention regarding the intention to treat. Patients were costed as randomised, regardless of whether they accepted allocated care or were subsequently transferred to hospital. When patients transferred directly to nursing or residential care from hospital at home or inpatient care, this was included. We collected data using routine patient data for hospital at home and inputs from the community trust, additional encounter sheets (for inputs from general practitioners), and patients' questionnaires.

Hospital at home

We identified five main items in the use of resources for costing the stay of patients receiving hospital at home care. These were staff inputs, consumables, equipment (provided by the Red Cross on contract to the community trust), overhead costs (local scheme management and administration, car leasing and travel costs, the management and finance functions of the community trust), and capital costs associated with the scheme's health centre base.

Nurses' work study—We extracted hours of nursing and contact with therapists from patients' hospital at home notes and adjusted these in the analysis for staff time spent not in contact with patients, using information from a work study completed by nurses working on the scheme.

Acute hospital

We based costing of patients' stay in hospital on the length of stay and the costs of specialty or ward. For

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Table 1 Mean (SD) resource use during admisson per patient in each arm of the trial

	Hospital at home	Hospital ward
Length of admission (days):		
HAH stay	6.9 (4.51)	—
Hospital stay	5.1 (13.53)	18.5 (18.51)
Community hospital	—	1.2 (5.97)
Nursing/residential care	4.2 (17.56)	4.7 (15.27)
No of journeys by patient	0.3 (0.56)	1.4 (0.91)
HAH staff inputs (contact minutes per patient):		
G grade	176.9 (146.63)	—
E grade	545.2 (513.94)	—
D grade	691.9 (702.22)	—
B grade day	1277.9 (1178.78)	—
B grade night	931.6 (1550.89)	—
Physiotherapy	83.1 (146.73)	—
Occupational therapy	47.8 (72.02)	—
Total HAH contacts	3496.9 (3378.58)	—
No of visits by general practitioner	0.9 (1.62)	—

HAH=hospital at home.

patients allocated to hospital who declined admission, any admission that occurred within seven days of the original referral was counted as an initial treatment episode.

Costs borne by patients and costs falling on family and friends

Concern has been expressed that hospital at home is made to seem cheaper than hospital care by shifting costs to patients and their families. The scope of analysis during the trial was limited to collecting descriptive information on who provided care during patients' stay in hospital and whether patients perceived home care as a burden in terms of increased heating and lighting of their homes, laundering, and other domestic arrangements.

Valuation of the use of resources

We used a combination of local and national sources to calculate unit costs. For nurses and therapists we adopted the methods outlined by the Personal Social Services Research Unit.[13] We costed staff inputs at the midpoints of the appropriate salary scales, with employer costs of superannuation and national insurance added. Further additions were needed to take account of direct and indirect revenue costs. For hospital at home staff, we estimated the costs to cover the local management and administration of the scheme (for the manager and secretary, plus a divisional overhead) and the management and finance functions of the community trust. For physiotherapists

and occupational therapists we used estimates from *Unit Costs of Community Care.*[13]

The cost of storing and delivering the equipment provided to patients in hospital at home care is subsumed in the non-pay budget heading—the value of the contract between the community trust and Red Cross has been included in full. The cost of equipment provided to patients' homes during the study has been calculated at replacement cost divided by the length of equipment's expected life (years), using a 6% discount rate.

Analysis

We adopted the cost minimisation form of economic analysis as the clinical trial report showed no significant differences in outcome.[12] We report the mean (SD) use of resources and standard deviations for initial admissions and the mean and median costs per case in each arm of the trial for the initial episode and at three month follow up. Since cost data per patient (but not per day of care) are typically highly skewed, we used bootstrap estimation to derive a 95% confidence interval for average cost.[14 15] We also used estimation in addition to a standard *t* test on the mean difference in cost between hospital at home and acute hospital care.

Results

Altogether 199 patients were randomised, 102 to hospital at home and 97 to hospital. Median age was 84 years, and 71% were female. After randomisation six patients in the hospital at home arm and 23 in the hospital arm declined admission to their allocated place of care. These "refusers" were kept in the study, and any care they received in the three month follow up period was costed.

Use of resources

Table 1 shows the average use of resources in each arm of the trial. This includes days of care and number of journeys undertaken by patients in both arms and, for the group in hospital at home, a detailed breakdown of minutes of care by hospital at home staff and number of visits to the general practitioner. Length of stay, including any hospital transfer, was shorter in the hospital at home group.[12] The average number of visits by the general practitioner to patients in hospital at home was 0.9.

Nurses' work study

During the nurses' work study (September-October 1996) a total of 12 patients were admitted to or being cared for in hospital at home. These patients had a total length of stay in hospital at home of 66 days (during the work study) and received 690 hours of nursing care. The ratio of time not in contact with patients to contact time varied from 1.8:1 for B grade staff to 8.0:1 for G grade staff. This was used to derive a cost per hour of contact for each staff grade as shown in table 2, which also includes a sensitivity analysis showing the effect of different ratios of contact time to non-contact time.

Costs of episodes

Table 3 shows average costs for patients in each arm of the trial. These were calculated in two ways—firstly, for all randomised patients, including those who refused

Table 2 Nurse contact to non-contact multipliers (ratios of nurses' contact time with patients to non-contact) and cost of contact, derived from work study of hospital at home staff

| Nurse grade | Baseline analysis | | Sensitivity analysis | | |
	Multiplier	Cost per contact hour (£)	Multiplier	Cost per contact hour (£)	Cost per day (£)*
B	1.8	14.30	1.2	9.54	188.60
D	2.5	21.56	2.1	22.64	183.93
E	4.0	49.08	2.1	26.99	161.60
G	8.0	128.40	5.0	80.25	146.44

*These changes are sequential—this shows the impact of first changing the B grade value, then changing the D grade value (leaving B grade at new level) and so on.

Table 3 Average costs per patient (in £), including and excluding patients who refused their allocated place of care

	Hospital ward	Hospital at home	Mean difference (t test)	Bootstrap mean difference (95% CI)
Including refusers	(n=97)	(n=102)		
Cost of initial episode:				
Mean (95% CI*)	2880.65 (2316.05 to 3547.77)	2568.97 (2089.25 to 2972.04)	−311.68 (0.80, P=0.427)	−304.72 (−1112.35 to 447.89)
Median (interquartile difference)	2031.39 (3140.29)	1654.57 (2252.40)		
Mean cost per day (95% CI)	104.95 (91.53 to 118.37)	204.65 (181.07 to 228.22)	99.71 (7.29, P<0.001)	
Cost at 3 months:				
Mean (95% CI*)	3876.86 (3224.51 to 4559.63)	3671.28 (3140.46 to 4231.28)	−205.68 (0.46, P=0.647)	−210.90 (−1025.14 to 635.47)
Median (interquartile difference)	3405.40 (5119.61)	2491.40 (3716.54)		
Excluding refusers	(n=73)	(n=101)		
Cost of initial episode				
Mean (95% CI*)	3659.20 (3140.46 to 4231.28)	2594.40 (2170.36 to 3143.50)	−1064.79 (2.56, P=0.011)	−1070.53 (−1843.20 to −245.73)
Median (interquartile difference)	2938.45 (3037.90)	1709.83 (2294.30)		
Mean cost per day (95% CI)	133.70 (124.57 to 142.82)	206.68 (183.21 to 230.14)	72.98 (5.75, P<0.001)	
Cost at 3 months:				
Mean (95% CI*)	4761.29 (4105.60 to 5476.66)	3697.50 (3136.13 to 4330.66)	−1063.79 (2.26, P=0.025)	−1063.45 (−2043.84 to −162.69)
Median (interquartile difference)	3939.59 (4657.90)	2493.49 (3718.30)		

*Derived using bootstrap method with 1000 subsamples.

their allocated place of care, and, secondly, with these refusers excluded. Hospital at home provided an episode of care more cheaply than an acute hospital, although this difference was marginal when patients who refused their allocated place of care were included.

Cost per day for hospital at home was significantly higher than for acute hospital care, reflecting a greater intensity of nursing input and a lack of the economies of scale attainable on a hospital ward. Estimated cost per day for hospital at home includes hospital costs of those patients who refused hospital at home care and those who transferred directly to hospital. Hence it reflects the pattern of care provided to patients randomised to hospital at home and does not give an estimate of the cost per day purely of hospital at home.

Costs at three month follow up

Table 3 also shows costs at three months after randomisation. Patients allocated to and accepting hospital at home continued to have lower costs than those allocated to and accepting hospital treatment. Costs for the two arms were similar when refusers (all but three of whom received some care during the three months of follow up) were included in the analysis.

Contribution of different services to total costs

Table 4 shows the distribution of costs across services at the end of the initial episode of care and at three months' follow up. As expected, the nursing costs dominated the costs of hospital at home; the other main components were admissions to hospital and, to a lesser extent, nursing and residential care. Hospital costs dominated the costs of the initial episode of care for patients randomised to inpatient care, and costs of residential or nursing care constituted a similar proportion of total costs in this arm, as for hospital at home. Community inputs for physiotherapy and occupational therapy constituted a comparatively small component of total cost, but they were more apparent in hospital at home than hospital care.

Sensitivity analyses

The costs reported here are sensitive to assumptions incorporated into the analysis. Several analyses tested

the robustness of the study results to changes in certain important variables.

In the nurses' work study the comparatively high ratios of time not in contact with patients to contact time (table 2) show that the scheme was running under capacity during the trial. Changing the balance of work within the scheme in favour of more direct nursing care reduced the mean cost to £2029.53 (£1130.59) and gave a cost per day for the initial episode of hospital at home that was similar to that for the hospital care when refusers were excluded (table 3). Repeating this analysis for costs at three months gave a mean cost of £3028.89 (£2023.28).

Payment for night work for hospital at home includes a weighting for unsociable hours. This was not included in the original analysis. The effect on cost of including this weighting was slight: it increased mean cost for the initial hospital at home episode to £2693.13 and median to £1654.57.

A reduction of 25% across the board in hospital costs reduced average costs for both arms, since some hospital at home patients transferred in. Hospital costs remained higher than for hospital at home when refusers were excluded.

Table 4 Total cost of hospital at home and hospital care at end of initial episode of care and at three months' follow up, and contribution to services of these costs. Values are £ (% of total)

	End of episode of care		At 3 months	
	Hospital at home	Hospital ward	Hospital at home	Hospital ward
Total costs*	262 035	270 781	374 471	368 302
Hospital at home nursing	157 921 (60.3)		157 921 (42.2)	
Physiotherapy	3 818 (1.5)		5 255 (1.4)	283 (0.1)
Occupational therapy	2 583 (1.0)		4 688 (1.3)	77 (0.0)
General practitioner	3 733 (1.4)		7 261 (1.9)	5 059 (1.4)
District nursing			11 712 (3.1)	15 612 (4.2)
Hospital	68 937 (26.3)	232 530 (86.2)	137 897 (36.8)	295 552 (80.2)
Nursing or residential care	20 087 (7.4)	20 648 (7.6)	20 087 (5.4)	20 648 (5.6)
Patient transport	4 228 (1.6)	16 603 (6.1)	8 901 (2.4)	20 044 (5.4)
Social work			546 (0.1)	624 (0.2)
Domiciliary care			19 475 (5.2)	10 402 (2.8)

*Including cost of equipment.

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What is already known on this topic

Economic evaluations of schemes for hospital at home care after early discharge have produced conflicting results. The cost of schemes to avoid admission compared with costs of hospital admission has not previously been assessed in a randomised trial

What this paper adds

Patients allocated to hospital at home and hospital care incurred similar costs. Restricting analysis to patients accepting their allocated care showed that an episode in hospital at home was cheaper than hospital, and this cost difference was sustained over three months

Hospital at home has the potential to provide care more cheaply than admission to hospital

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Cost shifting

Hospital at home had little input to the domestic care of patients—with the exception of washing the patient. This may point to hospital at home adopting a role oriented towards patients' personal care, in addition to their nursing needs, leaving domestic support to the usual carer, to patients themselves, or to their relatives.

Patients' perceptions of other costs associated with hospital at home varied: 44% reported using more lighting, 30% more laundry, 27% more heating, and 17% more hot water. In general the patients ascribed the use of extra utilities to the actions of night nurses, with patients themselves having little choice in the matter.

Discussion

The economic analyses suggest that care can be provided in patients' homes using the model of hospital at home, to avoid hospital admission, at the same or lower cost than an equivalent admission to hospital. The sensitivity analyses on hospital at home nurses' contact time with patients compared with their non-contact time suggest that the level of recruitment to the trial had an impact on the estimated cost per case for hospital at home. Adopting a balance of nursing work that might be more plausible for an established hospital at home service reduced the estimated cost per day for hospital at home to a level similar to that estimated for hospital care.

An examination of the contribution of different services to the costs of care of patients in the trial indicated an important role for acute hospital care in the management of patients in hospital at home. Costs for acute hospital care represented 26% of the costs for the initial episode in patients randomised to hospital at home and 37% of costs at three months.

This study shows that hospital at home may provide a viable alternative to acute hospital when viewed in the long term. Currently the service runs as a complement to hospital care, but it may have a role in managing demand for hospital admission and can provide an acceptable form of care for patients who do not want admission to hospital.

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Endpiece
Getting at the truth

It is editorial policy of the *BMJ* to avoid double negatives—"it is not unknown that." Here is the circumlocutory way in which Professor Bradley (1965) described Henry Mayhew's (1812-87) married life: "Inadvisable though it may be to draw conclusions from limited evidence, it is perhaps not uncharitable to assume that the marriage pursued a course somewhat less than equable." It was not a happy marriage.

Henry Mayhew. Selections from *London Labour and the London Poor*. Chosen with an introduction by John L Bradley. London: Oxford University Press,1965: xxi.

Submitted by Alan Pollock, retired consultant surgeon, Scarborough

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