Economic evaluation of an acute paediatric hospital at home clinical trial

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Aims: To compare the privately borne and NHS costs of hospital at home (HAH) and conventional inpatient care for children with selected acute conditions.

Methods: Prospective economic evaluation using cost minimisation analysis within a randomised controlled trial, in paediatric wards of a district general hospital, and private homes in the local catchment area in Wirral, Merseyside. Subjects were children who fulfilled the criteria for admission to HAH, suffering from breathing difficulties (n = 202), diarrhoea and vomiting (n = 125), or fever (n = 72).

Results: Direct costs borne by families are reduced by 41% for HAH patients (£23.31 v £13.76, p = 0.001). There is no evidence that HAH transfers the burden of care to parents, and there is no difference in absence rates from paid employment. Patients and their carers expressed a strong preference for HAH. Comparison of NHS costs is equivocal, depending on how HAH is implemented alongside the conventional hospital service.

Conclusion: Paediatric HAH schemes are unlikely to reduce NHS costs and do not increase privately borne costs. They will, however, significantly increase patient and carer satisfaction with care provision for sick children with appropriate conditions.

NHS care costs

The main health services resources used in the care of children were recorded: inpatient days per index admission, and subsequent readmissions for related conditions within 90 days, days of HAH care provided, home visits made, their duration, and distance travelled per visit.

The mean daily cost of inpatient care was obtained from the CIPFA database for 1999–2000. At the time that this study was being planned this database was the most comprehensive database of health service costs available. However, if we were to replicate the study we would almost certainly now make use of the more recently developed NHS reference costs database. The choice of costing database, however, is unlikely to significantly alter the comparative costs of the HAH and inpatient arms of the trial. As none of the children needed surgery, and all required only routine nursing care, no weighting for dependency was appropriate. The cost of home visits was based on allocating costed staff time and non-staff running costs pro rata to the number of home visits, and estimating travel costs for each patient visit at 40p per mile.

Statistical analysis

Statistical analysis was undertaken using Microsoft Excel 2000, and SPSS for Windows, release 10.0.7. Non-responders, modes of transport, and loss of working time frequencies were compared with Pearson’s χ² test, or Fisher’s exact test as appropriate.

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Abbreviations: HAH, Hospital at Home; HC, hospital care
appropriate. Costs, care activity times, and working time lost were compared by independent sample $t$ tests assuming equal/unequal variances as indicated by Levene's test.

**RESULTS**

**Parents’ and carers’ perspective**

Economic data were collected from 300 cases (75% of all patients). Respondents sometimes had difficulty recalling particular details of the episode. Parents of 127 children (32%) returned activity diaries. Comparison with non-responders showed no differences for either instrument in randomisation or its timing.

**Direct costs**

**Travel**

No differences in mode of transport to hospital were detected (mention of: ambulance, $p = 0.83$; car, $p = 0.29$; bus, $p = 0.76$; taxi, $p = 0.97$; foot, $p = 0.31$). Most reported journeys (79%) were made exclusively by car. Table 1 shows that families of HAH patients made fewer journeys ($p < 0.0001$), though mean distance travelled was similar. As the transporting of sick children is not a routine use for private cars, it is appropriate to cost variations in mileage travelled on a marginal cost basis (the additional cost solely related to the mileage travelled—largely the cost of petrol). The marginal cost of private car travel is therefore assumed to be £6.27 lower for HAH patients ($p = 0.007$).

**Food**

Extra food costs incurred by families outside the home were slightly lower ($p = 0.09$) for HAH patients (table 1).

**Telephone calls**

Minimal extra telephone use was recorded.

**Childcare**

Only six families in HC and one in the HAH arm paid for extra childcare. Though this difference is not significant, payments made by HC families were much larger, so the mean cost per patient differed considerably (€2.24 vs €0.12, $p = 0.047$).

**Other direct costs**

Only 15 families incurred additional direct costs, including a family losing £130 from holiday cancellation. This was excluded from the analysis as unrelated to the mode of care. Remaining costs did not differ significantly ($p = 0.31$).

**Total direct cost**

HAH families suffered lower overall direct costs ($−41$, £23.31 vs £13.76, $p = 0.001$; see table 1).

**Indirect costs**

**Working time lost**

A total of 121 families (30%) provided information on whether any family member was absent from work as a result of the child’s illness. Reported absence rates were similar for HAH and HC (76% vs 73%, $p = 0.84$). The mean number of days lost per family was also similar (2.4 vs 2.5, $p = 0.85$). The timing of randomisation had no impact on HC families, but had important effects on HAH cases: early randomisation led to absences in fewer cases (43% vs 90%, $p < 0.001$), and tended to involve less aggregate time off work (0.98 vs 2.32 days, $p = 0.09$).

The method employed in costing the economic impact of days off work depends on the perspective from which the analysis is being undertaken. The majority of parents were manual workers where the wage received was directly related to their presence at work. In such circumstances a real financial loss was imposed on the family as a consequence of work absence related to childhood illness. A further question that should be addressed relates to the extent to which such absence also led to a loss of output/welfare to society as a whole. However, as there was no difference in mean work days lost (both 1.84 days per patient), this potential theoretical minefield may be disregarded.

**Burden of care**

Care diaries were completed for 125 cases, evenly split between trial arms ($p = 0.59$, Fisher’s exact test). Despite disappointing response rate, some noteworthy patterns are evident in the data (table 2). Time spent on physical care was 27% greater in the HAH arm (215 minutes vs 169 minutes), while social care was similar. However, a correction is required for the longer care period for HAH responders (2.37 days v 1.37 days). Use of time per day figures reverse these trends: parental input may be reduced for HAH, particularly in playing time (~65%, $p = 0.004$). Diary data suggest that HAH may slightly reduce the time spent carrying out physical care tasks for sick children (for example, bathing ~47%, $p = 0.02$), and avoids extra social intervention from parents to distract children through play in hospital. There is no evidence that HAH transfers the burden of care to parents.

**Patient/carer satisfaction**

Results of the satisfaction survey are reported in full elsewhere. Of 40 families participating, 90% expressed clear preference for HAH in circumstances where their child’s disease could be managed at home with appropriate support. HAH was felt to empower parents to remain in control and in contact with their child, and hence avoided detrimental psychological effects associated with separation of parent and child. Most parents actively welcomed the opportunity for greater participation in their child’s care.

Disruption to family life was much reduced in HAH cases (5% vs 55% noted moderate disruption or worse). All families receiving HAH care reported high parental involvement compared to only 80% of HC families. Few families (5%) in either arm felt that parents bore too much responsibility. Most families felt that HAH represented a continuation of normal

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**Table 1**

<table>
<thead>
<tr>
<th></th>
<th>Hospital care</th>
<th>Hospital at Home</th>
<th>$p$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number of journeys to hospital</td>
<td>5.30</td>
<td>3.05</td>
<td>$&lt;0.0001^*$</td>
</tr>
<tr>
<td>Mean journey distance (miles)</td>
<td>4.5</td>
<td>5.2</td>
<td>0.11†</td>
</tr>
<tr>
<td>Mean fares paid (users of taxis and buses only)</td>
<td>£10.04</td>
<td>£8.25</td>
<td>0.99†</td>
</tr>
<tr>
<td>Mean total travel cost</td>
<td>£21.42</td>
<td>£15.15</td>
<td>0.007‡</td>
</tr>
<tr>
<td>Mean food cost</td>
<td>£9.23</td>
<td>£6.34</td>
<td>0.09†</td>
</tr>
<tr>
<td>Mean cost of phone calls</td>
<td>£0.87</td>
<td>£0.69</td>
<td>0.62†</td>
</tr>
<tr>
<td>Childcare costs</td>
<td>£2.24</td>
<td>£0.12</td>
<td>0.047*</td>
</tr>
<tr>
<td>Other costs</td>
<td>£1.17</td>
<td>£0.55</td>
<td>0.31†‡</td>
</tr>
<tr>
<td>Total direct costs</td>
<td>£23.31</td>
<td>£13.76</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

* Excluding £130 for holiday cancellation fee for one family.
† Test of means with unequal variance.
‡ Excluding £130 for holiday cancellation fee for one family.

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1 Excluding £130 for holiday cancellation fee for one family.
parenting, but in more familiar and less stressful surroundings than was possible in hospital.

**NHS perspective**

Economic analysis from an NHS perspective is complicated because during the trial, both the paediatric ward and the HAH service were operating well below full capacity. Paediatric services are frequently characterised by an apparent over-capacity for significant periods of time. Perhaps more than any other speciality, they need to have sufficient capacity to cover peaks of demand which require levels of resource that are likely to lead to over-capacity during periods of lower demand. Equally, the ability to shift nursing resources in and out of paediatric wards in response to such demand fluctuations is strictly limited by the need for specific paediatric nursing qualifications. Given such service overcapacity, the results of the NHS cost analysis should be interpreted as being indicative rather than definitive. The long term cost implications to the NHS of utilising paediatric HAH as an additional service will largely depend on how efficiently the new service is operationalised alongside a traditional paediatric hospital service (for example, rationalisation of bed capacity).

**Hospital costs**

A proportion of patients in both arms of the trial were not randomised immediately, but were admitted to hospital and randomised on the first subsequent medical assessment (for example, if admitted during the night). For a fair comparison between trial arms, all prerandomisation inpatient stays are included in NHS direct costs. Mean inpatient stays were 2.01 days for the hospital arm and 0.40 days for HAH, costing £741 and £147 respectively, implying a net reduction of £594 per patient for HAH patients. As eligible patients constitute only a small proportion of paediatric workload (about 10%), the home care incurs greater loss of working time, or that the HAH service were operating below full capacity. As the HAH service were operating below full capacity, it is likely to experience significant “economies of scale” (largely related to closer grouping of clients) which may provide it with a cost advantage for a restricted group of clients in terms of direct costs to the NHS over claims are suitably modest. There appears currently to be no significant difference in cost between HAH and traditional inpatient care with both services operating below full capacity. As the HAH service grows it is likely to experience significant “economies of scale” (largely related to closer grouping of clients) which may provide it with a cost advantage for a restricted group of clients in

**HAH care costs**

COSTING OF HAH CARE IS MORE PROBLEMATIC. THE HAH TEAM HAD AN ESTABLISHMENT OF 6.14 WTE NURSES TO ENSURE ADEQUATE COVER TO PATIENTS. HOWEVER, BECAUSE OF SLOW INITIAL TAKE UP THE NUMBERS OF PATIENTS RECRUITED TO THE TRIAL AND RANDOMISED TO HAH WAS SUBSTANTIALLY BELOW THAT ENVISAGED IN NORMAL CLINICAL PRACTICE. THE HAH TEAM LEADER ESTIMATES THAT THE ALLOCATED STAFFING COULD COMFORTABLY MANAGE 50% MORE CASES THAN WAS SUPPORTED IN THE TRIAL. THE MAIN COST OF HAH IS SALARIES £148 400 PER ANNUM, IMPLYING A COST OF £707 PER PATIENT. HOWEVER, WITH 50% GREATER THROUGHPUT, THE STAFFING COST OF AN INTEGRATED SERVICE MAY REDUCE TO £470 PER PATIENT.

The other major cost incurred by home care is nurse travel to patient homes. Visits logged by nurses for study patients averaged 3.68 visits per patient, with a small number of additional unplanned visits noted. The costing basis for nurse travel to patients is different from that used to cost private travel by patients’ families. As nurses’ cars were used extensively for work it is appropriate to cost such visits on an average cost basis, which incorporates costs such as depreciation and maintenance. The travel reimbursement provided to nurses (40p per mile) was specifically calculated to reflect the average cost of such travel and hence was used in our analysis. Costing visits per patient at the average distance per visit of 10 miles and applying the 40p standard mileage rate yields a mean travel cost per patient of £16.

**Total NHS costs and sensitivity**

Total NHS costs per patient appear £130 greater for HAH than HC (£870 £741). The two main sources of uncertainty are the unit cost per bed day, and the throughput of the HAH service. Using national average costs (interquartile range) in place of local costs yields a net cost difference of +£165 (+£86) – (+£279)). However, assuming 50% greater throughput alters the balance of cost considerably to –£107 with local costs, and –£72 (–£151) – (+£42) using national costs.

**DISCUSSION**

Direct costs incurred by families in the trial were generally very low, and where measurable were either similar between the two arms, or in favour of home care, because of the shorter period of involvement with the hospital. There is no evidence that home care incurs greater loss of working time, or that home care transfers the “burden of care” from health service professionals to families. There is evidence that wherever possible the initiation of HAH care should not be delayed, as this increases the likelihood of parents losing working time.

In terms of direct costs to the NHS over claims are suitably modest. There appears currently to be no significant difference in cost between HAH and traditional inpatient care with both services operating below full capacity. As the HAH service grows it is likely to experience significant economies of scale (largely related to closer grouping of clients) which may provide it with a cost advantage for a restricted group of clients in

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Mean time spent on care activities undertaken by families of patients</th>
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<tbody>
<tr>
<td></td>
<td>Mean care time per patient (min)</td>
</tr>
<tr>
<td>Care activities</td>
<td>Hospital care (n=56)</td>
</tr>
<tr>
<td>Physical</td>
<td></td>
</tr>
<tr>
<td>Changing nappies</td>
<td>26</td>
</tr>
<tr>
<td>Feeding</td>
<td>98</td>
</tr>
<tr>
<td>Bathing</td>
<td>27</td>
</tr>
<tr>
<td>Taking temperature</td>
<td>2</td>
</tr>
<tr>
<td>Medication</td>
<td>5</td>
</tr>
<tr>
<td>Putting to bed</td>
<td>11</td>
</tr>
<tr>
<td>All physical care activities</td>
<td>169</td>
</tr>
<tr>
<td>Social</td>
<td></td>
</tr>
<tr>
<td>Talking/singing</td>
<td>14</td>
</tr>
<tr>
<td>Cuddling</td>
<td>38</td>
</tr>
<tr>
<td>All social care activities</td>
<td>185</td>
</tr>
<tr>
<td>All care activities</td>
<td>355</td>
</tr>
</tbody>
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*† test with equal variances.
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What do we already know?

- Previous economic analyses of hospital at home schemes related only to specific adult populations and have focused mainly on comparative NHS costs.
- Results have been equivocal: some suggesting that Hospital at Home is cheaper, and others the contrary.
- In paediatric hospital at home schemes the prime concern is to improve children’s experience of healthcare rather than to reduce costs.

What further information does this paper provide?

- Care delivered at home does not cause any change in working time lost when children are acutely ill, and private, out of pocket costs borne by parents/carers of children are reduced.
- There is no transfer of carer burden from professionals to families, and in fact the time parents need to spend in social interaction with their child is reduced at home. Most parents and children prefer to receive care at home.
- NHS costs of care are not reduced by hospital at home, but may be comparable with inpatient care.

Hospital at Home is a good deal for children and their families

An economic study of Hospital at Home care for some acutely ill children has shown that parents are better off when they care for their children at home under nurse supervision—they have fewer out of pocket expenses, do not need to take more time off work, and need to spend less time each day amusing the child.

Hospital at Home is no cheaper for the NHS than conventional care, but need not cost more, if carefully implemented. The challenge to planners is to introduce cost effective schemes, while maintaining clinical standards and user satisfaction.

paediatric HAH, and the balance of cost advantage for the NHS is not clearly in favour of either option, decisions should be based on other criteria in the first instance, most notably the strong preferences of most families in favour of HAH.

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REFERENCES