Short Communication

Costs of outpatient parenteral antimicrobial therapy (OPAT) administered by Hospital at Home units in Spain

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ABSTRACT

The aim of this study was to assess the direct healthcare costs of outpatient parenteral antimicrobial therapy (OPAT) administered by Hospital at Home (HaH) units in Spain. An observational, multicentre, economic evaluation of retrospective cohorts was conducted. Patients were treated at home by the HaH units of three Spanish hospitals between January 2012 and December 2013. From the cost accounting of HaH OPAT (staff, pharmacy, transportation, diagnostic tests and structural), the cost of each outpatient course was obtained following a top-down strategy based on the use of resources. Costs associated with inpatient stay, if any, were estimated based on length of stay and ICD-9-CM diagnosis. There were 1324 HaH episodes in 1190 patients (median age 70 years). The median (interquartile range) stay at home was 10 days (7–15 days). Of the OPAT episodes, 91.5% resulted in cure or improvement on completion of intravenous therapy. The mean total cost of each infectious episode was €6707 [95% confidence interval (CI) €6189–7406]. The mean cost per OPAT episode was €1356 (95% CI €1247–1560), mainly distributed between healthcare staff costs (46%) and pharmacy costs (39%). The mean cost of inpatient hospitalisation of an infectious episode was €4357 (95% CI €3947–4977). The cost per day of inpatient hospitalisation was €519, whilst the cost per day of OPAT was €98, meaning a saving of 81%. This study shows that OPAT administered by HaH units resulted in lower costs compared with inpatient care in Spain.

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1. Introduction

According to the Spanish Ministry of Health, in 2013 there were at least 390,000 hospital admissions with diagnoses related to infectious diseases, with a total cost of more than €1600 million [1]. Most patients admitted with infections receive intravenous (i.v.) antibiotic treatment, and an unknown number remain hospitalised only to complete parenteral treatment.

Outpatient parenteral antimicrobial therapy (OPAT) is being increasingly used worldwide [2]. The rationale for OPAT is that it increases the availability of hospital beds by reducing or avoiding hospital stays [3] and by releasing beds blocked by patients with multidrug-resistant infections [4].

Hospital at Home (HaH), which provides hospital-level care at home to patients who would otherwise remain hospitalised, is a suitable care model for OPAT [5]. In Spain, HaH is hospital-based and consists of specifically dedicated physicians and nurses who monitor patients daily and make home visits [6], including patients with greater severity and dependence and those in the acute phase of the disease process [7]. The first HaH unit was established in the Gregorio Marañón Hospital (Madrid, Spain), followed by the gradual introduction of other units in the rest of the country, including the Hospital of Torrejón and the Sabadell Hospital. These three HaH units have more than 5 years of experience. Nowadays, these three hospitals have more than 250 inpatient beds. Although the three units share a similar care model, there are differences in the frequency of visits, the proportion of physicians/nurses and family involvement in the administration of i.v. treatment. To determine the efficacy of the OPAT model in Spain and to broaden its use, these three hospitals created a database (OPAT registry) [8]. This registry
was set up to prospectively register patient characteristics, antimicrobial treatment and clinical outcomes. Previous to this study, there was an evaluation of the efficacy and safety of OPAT in the Spanish HaH model [8]. However, Spanish economic studies on the use of HaH for OPAT are lacking.

The objective of this study was to perform an economic analysis of OPAT administered and monitored by HaH units, including costs and the estimated savings compared with conventional hospitalisation.

2. Materials and methods

2.1. Study design and population

An observational, multicentre, economic evaluation of retrospective cohorts was performed. Patients were treated at home by the OPAT units of three Spanish university hospitals (Hospital Gregorio Marañón, Hospital of Torrejón and Sabadell Hospital) during 2012 and 2013.

Patients meeting the following defined criteria were enrolled into the OPAT service: diagnostic certainty of infection; requirement for i.v. antimicrobials; adequate venous access; and appropriate level of understanding and cooperation of the patient and caregiver. The study was approved by the Spanish Regulatory Agency (AEMPS) and was classified as Post-Authorisation Study—Other Designs (EPA-OD) and was also approved by the Ethics Committee of Getafe Hospital (Madrid, Spain).

2.2. Data collection (the Spanish OPAT registry)

Using the OPAT registry [8], all OPAT episodes from January 2012 to December 2013 were retrospectively reviewed. The main outcomes recorded were the diagnosis indicating the need for treatment, medical and nursing visits (scheduled and unscheduled), emergency room (ER) visits, antimicrobial agent and treatment duration, venous access and clinical outcomes. Adverse effects (AEs) of antimicrobial treatment as well as complications related to venous access or poor post-infection outcomes were collected when they involved transfer to hospital and/or changes in the dosage of the antimicrobial or its suspension. When necessary (e.g. missing data, data inconsistencies, etc.), medical records were reviewed.

2.3. Complete infectious episode and OPAT episode

The analysis was based on complete infectious episodes, which covered the time from inpatient hospitalisation, if any, until HaH discharge, including possible returns to the hospital related to the infectious process (Fig. 1).

2.4. Costs and economic evaluation

Costs were estimated from the National Health System perspective. Costs of delivering the OPAT service were based on the resource use collected in the OPAT registry and the cost accounting of each participating centre, anonymised as A, B and C (Table 1). A top-down strategy was used to quantify the costs associated with an OPAT episode (broken down according to the resource use reported in the OPAT registry per centre per year). The cost components of the cost accounting were: (i) staff, cost of employment (terms of costs to employers); (ii) pharmacy, including drugs and costs of consumption of consumables (ca. 90% corresponded to drugs and the rest to catheters, healthcare materials, disinfectants, etc.); (iii) transportation, including only transportation of staff to patients’ homes; (iv) diagnostic tests, including OPAT service consumption of other services (diagnostic tests, interservice consultations, laboratory tests, etc.).

### Table 1

<table>
<thead>
<tr>
<th>Cost accounting of each centre by year (€)</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Staff</td>
<td>194 970.36</td>
<td>144 766.37</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>121 038.33</td>
<td>61 770.00</td>
</tr>
<tr>
<td>Transportation</td>
<td>32 066.48</td>
<td>5585.84</td>
</tr>
<tr>
<td>Diagnostic tests</td>
<td>26 405.92</td>
<td>14 895.58</td>
</tr>
<tr>
<td>Structural</td>
<td>15 544.20</td>
<td>9309.73</td>
</tr>
<tr>
<td>Total</td>
<td>390 025.29</td>
<td>236 327.52</td>
</tr>
</tbody>
</table>

HaH, hospital-at-home; OPAT, outpatient parenteral antimicrobial therapy; ER, emergency room; AE, adverse effects.

Fig. 1. Depiction of the entire infectious episodes, covering the time from inpatient hospitalisation, if any, until HaH discharge, including possible returns to the hospital related to the infectious process.
computing, etc.); and (v) structural, including hospital management and maintenance of HaH hospital facilities (electricity, cleaning, building maintenance, etc.).

To apply the top-down strategy, relative value units (RVU) were estimated. RVU are a numeric factor that transform a set of heterogeneous elements into a set of homogeneous elements according to the relative cost of each element with respect to the baseline reference (Supplementary Table S1).

To determine the percentage of the cost accounting attributable to each episode, the following steps were made:

- For each component, resource use per episode was multiplied by the corresponding RVU, which provided a numeric value that acted as a specific weighting for each episode.
- The specific weight of each episode was divided between the sum of the weighting of all the episodes. Multiplying by 100 these divisions, the percentages of the cost accounting corresponding to each episode were obtained.
- Steps 1 and 2 were followed for each cost accounting component.

Each cost component was allocated between the episodes as follows:

- Staff: staff costs were allocated between OPAT episodes according to the number of scheduled and unscheduled physician and/or nursing visits, represented as RVU calculated according to the representative tariffs [9].
- Pharmacy: RVUs were used to distribute pharmacy costs, taking into account the unit cost of the active ingredient, the dosage and the schedule of antimicrobial therapy. Thus, each episode had an associated weight according to the unit cost of the drug [10] and the total dose administered during the OPAT episode.
- Transportation: transport costs were distributed between OPAT episodes according to the total number of scheduled/unscheduled visits.
- Diagnostic tests: the OPAT registry did not include data on diagnostic tests or consultations between units. Therefore, this cost accounting component was divided equally between OPAT episodes.
- Structural: structural costs were distributed between the OPAT episodes according to the length of outpatient stay.

Using these methods, the total annual cost of the OPAT service was divided by the corresponding episodes per year and centre. In addition, other costs were added to the cost of the OPAT episode:

- ER visits: patients attending the ER during the outpatient stay, which would not have occurred in hospitalised patients.
- AEs and complications: AEs or infection/catheter complications that occur during the outpatient stay may require hospitalisation or therapeutic changes, or both. When AEs/complications required transfer to hospital, the cost of an ER visit was added. If AEs/complications implied hospitalisation, the added cost was taken as that of the ICD-9-CM diagnosis. The ICD-9-CM costs were assessed in 2012/2013 costs [1].
- Inpatient stay: the cost of inpatient stays, if any, was estimated according to the cost per day of stay of the ICD-9-CM diagnosis.
- Re-admissions within 30 days: if HaH discharge was followed by re-admission within 30 days, the cost was added to the cost of the original episode. If re-admission was in the OPAT service, the OPAT registry provided the data required to calculate the cost of re-admission, proceeding as above. Conversely, if re-admission within 30 days was on a full inpatient basis, the cost was estimated according to the cost of the ICD-9-CM diagnosis of the original episode.
- Related return: if the destination on discharge was a related return to the hospital of origin, the cost was added according to the cost of the ICD-9-CM diagnosis.

Thus, the total cost per complete infectious episode included: the cost of inpatient stays, if any; the cost of the HaH stay (the OPAT-specific cost); and re-admissions, if any.

2.5. Statistical analysis

All analyses were performed using complete infectious episodes as the unit of analysis. Univariate descriptive analyses of demographics and clinical characteristics, efficacy outcomes, use of resources and costs were made. Quantitative variables were described using the median and interquartile range (IQR), and qualitative variables were described using frequency and percentage. For cost variables, the mean and 95% confidence interval (CI) were reported. CIs were obtained by bootstrapping, given the non-normality of the outcomes. The total cost per episode was divided between the cost of the inpatient stay, the cost of the HaH stay and the cost of re-admissions.

3. Results

3.1. Patient characteristics and clinical outcomes

During the 2-year study period, 1324 admissions to HaH units for OPAT due to infections in 1190 patients were recorded. Most patients were male (58.9%), with a median age of 70 years (IQR, 54.2–79.1 years). The Charlson comorbidity index was ≥4 in 21.8% of cases. The most frequent types of infection were complicated urinary tract infections (29.8%), respiratory infections (23.2%) and intra-abdominal infections (19.9%).

The median stay attributable to the full infectious process was 15 days (IQR, 10–26 days), of which 4 days (IQR, 0–10 days) corresponded to the median conventional hospital stay, if any. The most commonly used antimicrobials were ertapenem (32.3%) and ceftriaxone (25.2%).

The median number of home visits per day of HaH (scheduled and urgent) by HaH medical and nursing staff was 1.33 (IQR, 1.05–1.57).

The infection was cured or improved in 91.5% of cases. There were seven deaths, with a mortality rate of 5.29 (95% CI 1.38–9.19) per 1000 OPAT episodes. There were 10.6% re-admissions for any reason within 30 days after discharge.

3.2. Cost results

Table 2 shows the costs of the complete infectious process. The mean (95% CI) cost was €6707 (€6189–7406), with the cost of HaH
being €1156 (€1247–1560), 20.2% of the cost of the complete infectious episode. The mean cost of HaH included healthcare staff costs (46%), pharmacy costs (39%), overheads and support (transport, indirect and structural) (13%), and ER visits and the costs of drug AEs and complications (2%).

The mean inpatient cost was €4357 which, considering a mean stay of 8.4 days, supposed a cost per day of €518.7 versus €98.3 per day of HaH stay.

The cost of HaH admission for OPAT plus the cost of returns/re-admissions in the 30 days after discharge resulted in a mean cost per OPAT episode of €2350 (excluding prior hospitalisation costs) and remained far lower than the mean cost of inpatient hospitalisation.

4. Discussion

The main objective of this study was to determine the mean cost of OPAT administered by HaH units in Spain according to the cost accounting of the three study centres. Unlike other studies, the cost incurred during hospitalisation prior to HaH admission was taken into account. Therefore, we were able to estimate the cost of the complete infectious process. A notable difference was found between the cost per day of hospitalisation and that of HaH. In a time of financial constraints, OPAT has advantages in the treatment of infectious diseases requiring i.v. treatment and clinical follow-up [11].

Calculating the cost of i.v. antimicrobial therapy in patients receiving only inpatient hospitalisation and assuming the same length of hospital stay as the HaH stay observed in this study results in a cost of ca. €7000, markedly higher than the cost of the HaH stay for OPAT (€1156) that partially or completely replaced hospitalisation. That is, the cost of HaH per OPAT episode was ca. 80% lower.

The results on clinical effectiveness and safety are consistent with other reports. The differences in clinical outcomes may be explained by differences in complexity and the established protocols, and were even observed between the three study centres owing to differences in care models and patient complexity, i.e. treatment success rates of 85–95% or re-admission rates at 30 days of 3–21.6%. It is therefore not surprising to find differences between countries owing to different organisational arrangements in service provision, conditioned by the heterogeneity of resource availability as well as local infrastructure and organisation [12]. What is common to them all is that OPAT provides economic savings while freeing up hospital beds.

Differing cost patterns between HaH and hospitalised patients also helps to explain the cost savings in HaH. In patients with the same complexity, greater pharmaceutical costs and those of complementary tests were found in conventionally hospitalised patients [13]. HaH also adds value by increasing patient satisfaction and health-related quality of life compared with conventional hospitalisation [14]. We believe that future comparisons of OPAT versus conventional hospitalisation should consider health outcomes, such as morbidity, mortality and quality of life, in addition to costs as part of a study of cost effectiveness and incremental cost utility.

This retrospective study has limitations compared with a prospective study randomising patients to hospital or home care. Whilst randomised designs have greater internal validity, we considered it unethical to eliminate the patient’s choice. In any case, small prospective series have obtained results consistent with ours [15].

Comparing costs between HaH and conventional hospitalisation involves some difficulties. As in the current our study, the real cost of HaH is often compared with a mean reference cost for conventional hospitalisation. Thus, if the hospitalisation costs included were higher than the national average, the estimated savings would have been even greater, whilst if the costs were lower than average the estimate would have been lower. The savings represented by HaH may have been overestimated, as the cost of conventional care decreases over time and it is precisely the final days of the episode are the days with a lower cost in relation to the entire episode. Savings may also be overestimated because HaH cares for a selected group of patients (those who are not unstable and do not have co-morbidities requiring hospitalisation) and these episodes may be less expensive than the average, even in the risk avoidance scheme.

This study included re-admission at 30 days as a cost attributable to HaH and understood as an unfavourable result with an associated cost. However, conventional hospitalisation also results in re-admissions. Some studies have found that HaH reduces re-admissions compared with conventional hospitalisation [16]. Thus, the potential savings due to HaH may be underestimated. The attributable savings could also be greater, as some studies have reported that HaH patients have lower mortality [17], less use of antipsychotic medication [18], fewer admissions to care homes [19] and better functional status [20] than conventionally hospitalised patients. Diagnostic coding using the ICD–9–CM, which is designed to accurately group patients with similar aetiological conditions, was another limitation because each diagnosis may include episodes with varying degrees of severity and different resource consumption.

This study shows that HaH-administered OPAT was safe and clinically effective in three Spanish hospitals, with a lower overall cost than conventional hospitalisation. HaH days with OPAT cost 80% less than conventional hospitalisation. These results show OPAT is a viable alternative to conventional hospitalisation for a wide range of infections if there is correct patient selection and close monitoring by HaH units.

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Competing interests: MM-R has received speaker fees from Boehringer Ingelheim, Merck Sharp & Dohme, Novartis and Aldo-Union; VJCR has received speaker fees from Novartis and Merck Sharp & Dohme; AM has received speaker fees from Merck Sharp & Dohme and Boehringer Ingelheim; OE has received speaker fees from Merck Sharp & Dohme, Fresenius Kabi and AbbVie; BA and AJR are employed by Merck Sharp & Dohme, the sponsor of the study; CF was employed by Oblikue Consulting at the time of the execution and analysis of the study, who received financing from Merck Sharp & Dohme to carry out the study.

Ethical approval: This study was approved by the Spanish Regulatory Agency (AEMPS) as study code MER-OPA-2014-01 and was classified as Post-Authorisation Study—Other Designs (EPA-OD), and was also approved by the Ethics Committee of Getafe Hospital (Madrid, Spain) [reference no. MSD-TADE-2014-01].

Appendix. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ijantimicag.2017.02.017.

References


