Home parenteral nutrition: a direct cost study in approved centers of Montpellier and Strasbourg

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SUMMARY

Aim — Home Parenteral Nutrition (HPN) is an expensive but relatively cost-effective therapy. In France, HPN has been organized around regionally located approved major centers. Few French studies have focused on the economic costs of HPN. The objective of this study was to assess the direct costs of HPN in two approved centers.

Patients and methods — Included patients and their nurses filled in a questionnaire in a prospective analysis. The questionnaires were complemented by data from the dispensary, the head of the institution’s financial administration and different organizations. Cost were calculated according to the national health insurance fund and hospitalisation prices for 2003.

Results — The direct cost was on average 83 € per patient per day: 58% for drugs and material, 16% for hospital personnel, 16% for non-institutional caregivers, 4% for patient transportation, 4% for material transportation, and 2% for laboratory tests. The costs reimbursed by the national health insurance fund for laboratory tests, non-institutional caregivers and patient transportation were on average 18 € per patient per day. Hospital funds provided 78% of the total costs. Daily costs were lower in Strasbourg as compared with Montpellier (62.1 vs 103.3 €).

Conclusion — The cost of the products administered accounts for the majority of daily costs of home parenteral nutrition which is essentially funded by hospital resources. The lower daily costs per patient in Strasbourg may be related to greater patient independence.

Introduction

In France, since 1984, home parenteral nutrition (HPN) is organized around approved centers in regional university hospitals (14 adult and 5 pediatric centers). Indications recorded for 1993-1995 [1] were Crohn’s disease (17%), mesenteric infarction (19%), radiation-induced enteritis (12%), AIDS, cancer and other diseases (19%). The proportions of indications changed little in 1997 [2], but with a decrease in the proportion of undernourished persons with AIDS from 13% to 0.5% subsequent to the introduction of triple therapy regimens and an increase in the proportion of cancer patients from 20% to 27% related to a more interventional approach to cancer therapy.

HPN is an expensive therapy. In the United States the estimated cost is $150 000 to $250 000 per patient per year [3]. According to audits in Toronto [4] and England [5], the cost-effectiveness of long-term HPN is however favorable compared with the same type of treatment administered in the hospital setting [6]. Considering the few data on economic analysis in France [7-9], the growing development of HPN, particularly outside approved centers since the introduction of reimbursable parenteral nutrition pouches in 2001, and the current context of cost containment, the aim of this study was to evaluate the direct costs of HPN administered via approved centers in Montpellier and Strasbourg (France).
Patients and methods

Patients

This prospective study was conducted among patients attending approved regional HPN centers in Montpellier and Strasbourg. All patients on HPN in October 2002 then in February 2003 were included in this study after giving their informed consent.

Identification and evaluation of consumed products

Expenditures for drugs, materials, product transportation, laboratory tests, patient transportation, and healthcare personnel were studied. In order to determine the number of laboratory tests performed, the means of transportation used and the amount of home care provided by physicians and nurses, a questionnaire concerning a 4-week period was sent to patients and nurses. Data were also collected from the medical files, the dispensary (number and quality of pouches, single-use materials, delivery rate), and the institution’s financial services (equipment use and delivery). A five-year depreciation schedule was used of institutional delivery rate), and the institution’s financial services (equipment use and delivery).

Cost estimates

Costs were estimated from the official schedule established by the French National Health Insurance Fund (Sécurité Sociale) and applied since April 2003 (home visit by primary care physician, home visit by nurse, laboratory tests, patient transportation) or as determined from hospital funds budgeted for 2003:

- total cost (including social benefits) of healthcare personnel involved in HPN (physicians, nurses, pharmacists);
- transportation costs;
- single-use material, drugs, preparation of parenteral nutrition bags;
- equipment, maintenance, delivery.

Results

Study population

The characteristic features of the study population (sex-ratio, age, indications for HPN) are summarized in table I. The majority of patients in our HPN population had a short bowel (14/22 patients) subsequent to tumor resection or another reason (volevulus of common mesenterium, post-ischemic disease, Crohn’s disease, other). For patients with a tumor, most were considered to be cured or in prolonged remission (more than two months). In the Strasbourg center population, 64% of patients had an indwelling tunnelled catheter. In the Montpellier population, 91% of patients had an implanted chamber. A self-care administration scheme was used by 82% of patients in the Strasbourg population and by 18% of the Montpellier population. Nutritional bags were custom-prepared in both centers.

Direct cost estimates

OVERALL COSTS

Direct costs included all costs directly attributable to the patient’s disease and/or treatment. Total direct costs in the present study amounted to 30,232 € per patient per year, i.e. on average 2,519 €/month and 83 €/day.

Medical costs (personnel, nutrition bags, material, laboratory tests) accounted for 92% of overall costs. Non-medical costs (waste disposal, material delivery, patient transportation) accounted for 8% of overall costs.

Part of the direct cost was included in the institution’s global budget (personnel, nutrition bags, material, delivery) and accounted for 78% of overall costs, i.e. 65 € per patient per day. Another part of costs (laboratory tests, non-institutional personnel, patient transportation) was financed by the Health Insurance Fund directly and accounted on average for 22% of overall costs, i.e. 18 € per patient per day.

Costs are listed by expenditure in table II. Direct costs could be divided into several categories: nutritional bags, equipment and consumable products, hospital personnel, non-institutional personnel, patient transportation, delivery of nutrition bags and consumables, laboratory tests.

NUTRITIONAL BAGS, CONSUMABLES, EQUIPMENT

This category accounted for 58% of overall direct costs, i.e. on average 48 € per patient per day. The cost of the nutrition bags included nutrients (carbohydrates, amino acids, lipids, electrolytes, trace elements, vitamins) and preparation (performed by a subcontractor, Fasonut). In both centers, nutrients accounted for approximately 32% of the bag costs and preparation 68%. Tertiary admixtures were used for 87% of the pouches (93% in Montpellier and 80% in Strasbourg) and binary admixtures in 13%. Mean monthly consumption was 15 bags per patient in both centers, giving a mean cost per bag of 72 € (both centers).

Single-use material included connecting kits, needles, lines, stoppers, compresses and dressings. The patient also used hair nets, sterile gloves, face masks, blouses, and antisepsics (hand washing and disinfection of infusion site), 0.9% sodium chloride solution and heparin to rinse the lines.

In Montpellier, fixed costs for equipment were established on a daily basis and included material rent, transportation, and maintenance. In Strasbourg, fixed costs for equipment included material purchase, preventive and corrective maintenance, and transportation of heavy equipment (refrigerator, pump, line post) at the beginning and end of home treatment performed by the Strasbourg University Hospitals.

Costs of disposing of waste material and sharp objects was included in the costs for nursing personnel in Montpellier and in the fixed institutional costs or nursing personnel in Strasbourg.

HOSPITAL PERSONNEL

Estimated expenditures for hospital personnel were 14 € per patient per day, i.e. 16% of overall direct costs. Hospital personnel devoted only part of their time to HPN.

In Strasbourg, nursing care was provided by a nurse from the gastroenterology unit who also was responsible for patient education during hospitalization (one-third of this nurse’s time was counted for HPN). In Montpellier, care for HPN patients was provided by a part-time nurse and a part-time head nurse from the home care team who visited the patient at home to check bag preservation and conditions in patient’s home and train the patient (or caregiver) in the techniques of parenteral nutrition. Medical interventions were performed by a hospital physician in Strasbourg (one-fifth of physician’s time) and by a hospital physician (one-tenth of physician’s time) and a resident (one-tenth of resident’s time) in Montpellier. In both centers, the hospital practitioners also participated in other activities of the unit (patient care, endoscopic procedures, outpatient consultations, teaching and research).

Dispensary personnel counted for HPN in Montpellier included one pharmacist (10% of time), one pharmacy assistant (40% of time), and one general service assistant (50% of time). In Strasbourg, dispensary personnel were one pharmacist (10% of time), one resident in pharmacy (15% of time), one pharmacy assistant (10% of time) and one administrative agent (1% of time).
### Table I. – Patient characteristics.
*Caractéristiques des malades.*

<table>
<thead>
<tr>
<th></th>
<th>Strasbourg</th>
<th>Montpellier</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients contacted</td>
<td>15</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Patients included&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Sex ratio M/F</td>
<td>6/5</td>
<td>4/7</td>
<td>10/12</td>
</tr>
<tr>
<td>Age (years)</td>
<td>51 (17-70)</td>
<td>61 (35-83)</td>
<td>56 (17-83)</td>
</tr>
<tr>
<td>Residence by administrative district (N)</td>
<td>Bas-Rhin (4)</td>
<td>Hérault (5)</td>
<td>Haut-Rhin (1)</td>
</tr>
<tr>
<td>Indications for home parenteral nutrition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short bowel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non tumoral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After tumor resection</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>1 and 2&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Peritoneal carcinomatosis</td>
<td>0</td>
<td>2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2</td>
</tr>
<tr>
<td>Chronic intestinal pseudo-obstruction (non tumoral)</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Radiated bowel</td>
<td>2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Digestive fistulae</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

<sup>a</sup> patients who responded and accepted to participate were included in the study.;<sup>b</sup> active tumor at the time of the study;<sup>c</sup> tumor not active at the time of the study.

### Table II. – Mean direct costs in € per patient per day receiving home parenteral nutrition managed by the approved centers of Montpellier and Strasbourg.
*Coûts directs moyens en € par malade par jour pris en charge dans les centres agréés de NPAD<sup>a</sup> de Montpellier et de Strasbourg.*

<table>
<thead>
<tr>
<th></th>
<th>Montpellier</th>
<th>Strasbourg</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bags, consumable products, equipment</td>
<td>49.6 (48 %)</td>
<td>47 (76 %)</td>
<td>48.3 (58 %)</td>
</tr>
<tr>
<td>Bags (preparation + raw materials)</td>
<td>39.3(27.4 + 11.9)</td>
<td>38.1(25.6 + 12.5)</td>
<td>38.7(26.5 + 12.2)</td>
</tr>
<tr>
<td>Single-use products</td>
<td>5.9</td>
<td>6.4</td>
<td>6.2</td>
</tr>
<tr>
<td>Equipment (fixed costs)</td>
<td>3.8</td>
<td>1.9</td>
<td>2.9</td>
</tr>
<tr>
<td>Waste disposal</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Hospital personnel</td>
<td>18.5 (18 %)</td>
<td>8.8 (14 %)</td>
<td>13.6 (16 %)</td>
</tr>
<tr>
<td>Nurse</td>
<td>7.5</td>
<td>2.6</td>
<td>5</td>
</tr>
<tr>
<td>Physician</td>
<td>2.7</td>
<td>3.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>8.3</td>
<td>2.5</td>
<td>5.4</td>
</tr>
<tr>
<td>Non-institutional personnel</td>
<td>24.7 (24 %)</td>
<td>2.2 (3 %)</td>
<td>13.4 (16 %)</td>
</tr>
<tr>
<td>Nurse</td>
<td>23.1</td>
<td>2.2</td>
<td>12.6</td>
</tr>
<tr>
<td>Physician</td>
<td>1.6</td>
<td>0</td>
<td>0.8</td>
</tr>
<tr>
<td>Patient transportation</td>
<td>3.2 (3 %)</td>
<td>2.9 (5 %)</td>
<td>3 (4 %)</td>
</tr>
<tr>
<td>Consultations and laboratory tests</td>
<td>0</td>
<td>1.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>3.2</td>
<td>1.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Delivery of bags and consumable products</td>
<td>5.8 (6 %)</td>
<td>0 (0 %)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.9 (4 %)</td>
</tr>
<tr>
<td>Laboratory tests</td>
<td>1.6 (1 %)</td>
<td>1.3 (2 %)</td>
<td>1.4 (2 %)</td>
</tr>
<tr>
<td>Total</td>
<td>103.3</td>
<td>62.1</td>
<td>82.7</td>
</tr>
</tbody>
</table>

<sup>a</sup> HPN = Home Parenteral Nutrition;<sup>b</sup> because included in price of preparation.
NON-INSTITUTIONAL PERSONNEL

Expenditures for non-institutional personnel accounted for 16% of overall direct costs, i.e. 14 € per patient per day. The home care nurse connected and disconnected the parenteral lines. Time spent for training at the beginning of treatment was not taken into consideration. Differences between centers were related to the proportion of independent patients who connected and disconnected their lines themselves: 2/11 (18%) at the Montpellier center and 9/11 (82%) at the Strasbourg center. In the Montpellier population, visits by the primary care physician were scheduled regularly or as needed (1.5 visits per month per patient on average). In the Strasbourg population, visits by the primary care physician were not scheduled systematically during the four weeks of the study. Patients however consulted their physician for minor problems related to their HPN or other health problems unrelated to the disease underlying HPN.

PATIENT TRANSPORTATION

Expenditures for patient transportation were 3 € per day per patient, i.e. 4% of overall direct costs. Patients used transportation services to attend consultations with their physician or for laboratory test or hospitalizations. Transportation costs invoiced by the health insurance fund were: chauffeured vehicle, ambulance, private vehicle or train. Prices were set in accordance with the healthcare (Sécurité sociale) code article R-322.10. In Montpellier, the cost of transportation for laboratory tests and consultations was noted zero euros because all tests were performed at laboratories close to the patient’s home. In Strasbourg, routine laboratory tests were also performed near the patient’s home and thus did not induce supplementary cost; more specialized tests (vitamins, trace elements, etc.) were performed at the hospital.

DELIVERY OF BAGS AND CONSUMABLE PRODUCTS

Expenditures to deliver nutritional bags was 3 € per patient per day, i.e. 4% of overall direct costs. Pouches were delivered by the subcontractor who prepared them. The cost of delivering single-use material and nutritional bags varied with distance to the patient’s home in Montpellier and was included in the overall cost of preparing the bags in Strasbourg.

LABORATORY TESTS

Expenditures for laboratory tests involved on average 2% of the direct costs for HPN, i.e. about 1 € per patient per day. In Montpellier, costs varied between patients. Tests generally included blood cell and platelet counts, electrolytes, serum albumin and renal and hepatic function tests. In Strasbourg, regular surveillance included a standard set of tests every three months. Tests included blood cell and platelet counts, electrolytes, BUN, creatinine, liver enzymes, CRP, serum albumin and prealbumin, at each surveillance, plus, for every other surveillance, serum glucose, lipids, fatty acids (chromatography), trace elements, and vitamins.

Discussion

Our study enabled an evaluation of the direct costs of HPN in patients managed by two approved parenteral nutrition centers in Montpellier and Strasbourg. On average, the cost of HPN was 83 € per patient per day. Cost assessments conducted in the United States [10-13] have sometimes included the costs of complications and rehospitalizations [14]. The methods used to estimate costs have not always been the same: expenditures effectively paid by the paying institution without real cost assessment [14, 15] or evaluation of real costs. However, due to differences in healthcare systems, results of studies conducted in the United States cannot be applied in France. In France, costs related to nutritional techniques are poorly known. The cost of HPN has been estimated at about 106 € per patient per day in centers with well developed logistics [7] and, in another study conducted in 1989, at about 114 € or three to nine times less expensive than hospitalization for nutritional assistance [8]. Unfortunately, these reports did not detail costs and as such are difficult to interpret. A study conducted in Strasbourg in 1998 [9] reported a cost of 45.8 € per patient per day including the cost of the bag, bag delivery, equipment costs, consumables, and pharmaceutical personnel. In our study, the estimate for these same costs was 48.9 €. The price of the bag prepared by a subcontractor was on average 72 € in our study, a price comparable to the 70 € per bag reported by a subcontractor of the Nice University Hospital [16]. The average cost for home hospitalization reported by the health services in France in 2001 was 122 € [17]. This cost included: healthcare, drugs, equipment, laboratory tests, personnel (medical fees and other), and ambulances. According to the report of the National Audit Office of September 2002 [18] the cost of home hospitalization applied by private institutions in 1999 ranged from 60 to 190 € per day. The average overall cost of 83 € per patient per day in our study is coherent with home hospitalization estimates.

In our study, 78% of overall direct costs were attributed to the institution’s global budget (hospital personnel, nutritional bags, equipment, delivery), while the health insurance fund paid 18 € per patient per day for laboratory tests, non-institutional personnel, and patient transportation. The convention given in the appendix of the health ministry directive of December 18, 1984 concerning HPN establishes a model where expenditures for parental nutrition (nutrient solutions and products) are included in the overall hospital budget whereas expenditures for personnel required for home care (hospital or non-institutional personnel) are not, the later expenditures being covered by a separate payment by the healthcare insurance fund. The source of funding for patient transportation and laboratory tests, two categories of expenditures which are not specific for HPN, was not specified in the directive.

Daily cost figures were different for Montpellier and Strasbourg. This difference, largely related to hospital and non-institutional personnel costs, essentially results from differences in patient independence and local organization of patient education and pharmaceutical and administrative activities. At the Montpellier center, personnel costs included time for coordination of care performed by non-hospital nurses in addition to specific training sessions for these caregivers. This increased nursing personnel cost 2.8-fold in Montpellier. Eighty-two percent of the patients in Strasbourg were independent (versus 18% in Montpellier), a proportion which is higher than reported for the Greater Paris area (60%) [19]. France nationwide [1] and Europe (48%) [2]. It is also higher than the 36% reported by Reimund et al. in Strasbourg in 2002 [20]. Although it is difficult to estimate the cost of education, hospital personnel working in different settings in the two centers devoted different proportions of their time to HPN. In Strasbourg, patient education for HPN was part of the hospitalization costs while in Montpellier, personnel visited the patient’s home to set up the HPN and train the non-institutional caregiver. In Montpellier, patient care was oriented towards coordination with other noninstitutional healthcare workers. In Strasbourg, the approved center has two hospital beds devoted to the education of HPN patients. Such beds are not available in Montpellier and the difference in cost was not detailed in our study.

Our analysis enabled an approximate estimate of direct patient-related medical and non-medical costs for patients man-
aged by an approved center for HPN. Like most of the French studies on artificial nutrition which generally limit cost estimates to medical expenditures, costs related to complications and hospitalizations, fixed structural costs, and indirect costs (e.g. unemployment) were not detailed in our study. For the Montpellier center, the cost analysis provides an estimate of the cost of HPN managed outside an approved center since the cost evaluations involved a hospital-community care network with non-institutional caregivers, caregiver training, and work of the coordinating nurse. These audit figures are of particular interest for funding institutions which are currently updating cost schedules which are now detailed per care activity. Except for the situation where HPN is delivered within a system of home hospitalization, HPN in France is financed by national funds for designated missions “missions d’intérêt général et d’aide à la contractualisation” (MIGAC) [21].

This study was conducted within a context of developing parenteral nutrition, whether managed by approved centers or not. Since 2001, when parenteral nutrition bags were inscribed on the list of reimbursable medical products, the number of admixture units sold in France (figure 1) has increased steadily. Trivé 1000® delivered in glass bottles has been removed from the market, but sales of Clinomel®, which was later replaced by Oliclinomel®, increased three-fold between February 2003 and March 2005. For Kabien® sales increased nine-fold during this same period. Prescriptions of bags of Clinimix®, Nutriflex Lipide® and Perikabiven® are exceptional but sales of these products have increased. In France parenteral nutrition managed in an approved center is reserved for specific indications (intestinal malabsorption, chronic intestinal obstruction or pseudo-obstruction, inflammatory bowel disease). These patients have a long life expectancy (>2 months) and the medical and technical expertise of approved centers guarantees safe and effective long-term treatment [22, 23]. The advantages of this type of management include the fact that the custom-prepared bags can be readily adapted to the patient’s needs and the availability of healthcare givers working in these centers (medical personnel, technical assistance, and pharmaceutical expertise) [24]. Management of HPN outside approved centers would appear to be more adapted to short-term situations or to patients requiring complementary nutritional support. It would also be indicated for patients with cancer or AIDS whose need of parenteral nutrition

![Graph showing number of parenteral nutrition complete admixtures sold in France (December 2001–March 2005).](image)
lies outside the indications accepted by approved centers. It would be useful to evaluate the cost of HPN performed outside the setting of an approved center as a function of the type of patient or disease (stage) involved. The biggest problem with this type of study would be the lack of coordination of management practices and centralized data collection as can readily be achieved in approved centers participating in a national registry [25].

In conclusion, the cost of HPN managed within the framework of two approved centers in Montpellier and Strasbourg can be estimated at 83 € per patient per day. Expenditures include 58% for nutritional bags, consumable products and equipment, 16% for hospital personnel, 16% for non-institutional personnel, 4% for delivery of pouches and consumable products, and 2% for laboratory tests. Costs were lower for patients in the Strasbourg population partly because they were more independent and received educational information during their hospitalization so less time was needed for care coordination.

RÉFÉRENCES


