

# ▶ A cost-minimization analysis of oncology home care versus hospital care

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### Summary

We compared the costs of patient care for two groups of 10 oncology patients. The test group was treated at home and had access to 24 h telephone support, and the control group was treated in hospital, either as inpatients or as outpatients. Direct variable costs were provided by health insurance companies. The time invested by the health-care staff was recorded. The amount of time devoted to patients was more uniform in hospital than in the patients' homes, which suggests that patients at home received a less generic, more specific form of care. The nurses spent four times as long caring for home care patients as for hospital patients. The total cost of home care was 64% of that of hospital care, although this difference was not significant. The mean daily costs were three times lower at home than in hospital. All direct costs, except laboratory tests, were lower at home. Pharmaceutical costs were six times lower at home. Telephone support for home oncology care was cost saving and avoided 27 nursing home visits, which represented 35 working hours and Pta270,000 in savings to the health insurance companies.

### Introduction

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The European Health Committee of the Council of Europe has suggested that home hospitalization — which involves performing the principal diagnostic and therapeutic interventions normally done in hospital in the patient's home — is particularly cost-effective for severely ill patients<sup>1</sup>. Telemedicine support at home is recommended in all cases where home care is indicated<sup>2</sup>. It is generally accepted that the telephone is a simple and effective means of providing telemedicine support.

The main reasons for instituting home telecare are to maintain a good quality of life for the patient and to reduce the need for hospitalization while still allowing treatment to proceed. Elderly and oncology patients are often well suited to these services. About 60% of tumours are found in patients aged over 65 years, who are often affected by concomitant pathologies or functional limitations that prevent them from

receiving the standard treatments given to younger adult patients<sup>3,4</sup>.

In the Spanish health-care system<sup>5-7</sup> the term 'home care' is used for two different types of service: periodical social and medical assistance at home, usually provided at predetermined times, and true home hospitalization, which includes the delivery at the patient's home of treatments that would otherwise be given in hospital. Few centres in Spain offer the latter modality, and the Oncology Service of the Delfos Clinic appears to be the only one that provides home hospitalization comparable to that available in other European countries.

Because home care is assumed to be more expensive, health insurance providers in Spain refuse to support it, and so it is not widely used. Cost control and patient satisfaction among terminally ill patients within the Spanish health-care system have been measured recently: the mean cost of providing palliative home treatment to 1407 patients was Pta280,000 per patient (Pta100 is \$0.57, EU0.60); a series of 3522 home-assisted patients with 24 h telephone support avoided 9452 days of hospitalization — worth Pta40,000 per day — and reduced emergency department attendances by 4348 a year. Similar information about cost-benefit<sup>8-10</sup> and cost-utility improvement<sup>11</sup> has been reported in other countries.

Accepted 12 February 2001

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The present study was an economic cost-minimization study of telephone-supported home care versus hospital care. We studied two groups of privately insured oncology patients: a test group of home-hospitalized telephone-supported patients and a control group treated in hospital and followed up in the outpatient clinic.

## Methods

Two groups of oncology patients were selected. All patients were privately insured and treated by the Delfos Clinic by the same health-care staff. The control group comprised a retrospective series of successive patients treated in hospital. The test group (receiving home care) comprised all prospective patients who fulfilled the following selection criteria:

- (1) a need for hospital care;
- (2) in receipt of medical care which could be delivered at home;
- (3) intervals between parenteral treatment greater than 8 h;
- (4) acceptance of terms by both patient and family;
- (5) written consent from the patient or family.

Non-fulfilment of one of the above criteria was an indication for hospital admission. Home care was discontinued and hospital admission was indicated when:

- (1) therapy was provided more than three times a day or at intervals shorter than 8 h;
- (2) home facilities became insufficient;
- (3) there was a lack of cooperation from the patient's family;
- (4) the patient's family experienced high levels of stress.

Medical attention provided at home comprised two services: home visits and 24 h telephone support from a doctor, and/or hospital-like care by a specialized nurse team dispensing specific treatments (e.g. chemotherapy, parenteral feeding, intravenous therapy, blood transfusions of plasma derivatives, pain treatment and functional rehabilitation).

The cost comparison was based on the variable costs paid by insurance companies, excluding equipment maintenance, telecommunications, training and unproductive staff travel time, although these were accounted for in the contractual fees, which therefore roughly included indirect and capital costs. In order to

simplify the analysis, payments provided by insurance companies were taken as variable direct costs.

## Home care group

The test group comprised all patients treated from January to October 1997. Thereafter the insurance company adopted a policy of ceasing payment for all home hospitalization services, as a cost-saving measure, and this therefore limited the sample size attained.

The personnel supporting the service included four doctors (two oncologists, one internist and one surgeon) and five nurses. The number of nurses involved depended on the number of patients and their requirements. There was a doctor permanently on call in charge of telephone support and home visits. After the 24 h telephone support was established, the details of the types of call made and medical interventions were recorded in a log<sup>1</sup> (Table 1).

As indicated above, two types of service were provided to patients in the home-care group: A1 was home visits (if required) and telephone support from doctors on call; and A2 was home hospitalization, which involved the whole medical team (the other doctors and the nurses). The decision to use A1 or A2 support was made by the oncologist, on a non-permanent basis, according to treatment requirements (Table 2). Most patients received both kinds of support during the study (see Table 3).

## Control group

The control group comprised a retrospective series of successive patients treated in hospital during the same period of the same year.

**Table 1** Observations recorded in each telephone call

Observation	Comment
Name	
Pathology	Tumour type
Karnofski index <sup>13</sup>	Less than 50%; 50–80%; 80–100%
Date and time	
Duration of the telephone call	In min
Reason for the telephone call	
Person originating the call	Patient, family member, doctor, other
Type of telephone call	Resolved/did not resolve the presenting problem
Medical service	Diagnosis, treatment, psychological support, informative
Treatment	Treatment type
Importance of the telephone call	Rated no, to some extent, yes or very important
Consequences if the call had not taken place	Go to another doctor, diagnostic delay, hospital visit, casualty presentation, none

**Table 2** Patients and types of treatment

Medical care	No. of patients (male/female)	Chemotherapy	Palliative care	Both treatments	Mean age (years)
Home care	10 (7/3)	1	5	4	76
Hospital care	10 (7/3)	0	4	6	61

The selection criteria were that patients had to have a similar frequency of chemotherapy treatment to the home care patients (i.e. less than three times a day or at intervals longer than 8 h), as well as similar chemotherapy agents.

Two types of service were provided to the control patients: B1 was outpatient care and B2 was inpatient care (i.e. hospital bed stay). Most patients received both kinds of support during the study (see Table 4).

The personnel supporting both services were three doctors (one oncologist, one internist and one surgeon) and three nurses specializing in oncology treatments.

### Evaluation of direct costs

In both care modalities, direct costs were obtained from the clinic's administrative files and included: medical services, nurse team services, treatment expenses, and laboratory and radiology charges.

The test group involved only one insurance company (the only one supporting home care). The control group involved several private insurance companies with different payment schemes. These schemes involved the payment of a daily flat-rate fee for hospital bed occupation, which sometimes included standard laboratory analyses and radiological examinations. In the results reported below, costs

related to B1 (outpatient care) included medical visits only while B2 (inpatient care) included the daily flat-rate fee, various examinations and treatment.

The expenses were divided into: costs derived from medical doctors and nurse team support, costs linked to laboratory and radiological examinations, and costs linked to palliative therapy or chemotherapy.

The study also evaluated the time devoted by the doctor–nurse team in the A1/A2 visits (time in travelling back and forth, and time at the patient's home) and in the B1/B2 modality (time taken in patient examination and hygiene, reviewing tests and treatment indications, and consultations between doctors, as well as treatment administration and regular monitoring by nurses at intervals of 6 h).

An estimate of daily costs per patient was obtained as the average of the mean daily cost per patient. An alternative approach provides an estimate of the daily costs per patient<sup>12</sup> as the ratio between total costs and total days of care; the standard error in the latter case is the standard error of the auxiliary variable  $z = (y - Rx)/\bar{x}$ , where  $y$  and  $x$  are the costs and time of care per patient and  $R$  is the ratio  $\bar{y}/\bar{x}$ .

Statistical comparisons were carried out with Student's *t*-test on mean values and the  $\chi^2$  of case distribution, both with a two-tailed *P* value of 0.05.

**Table 3** Analysis of costs per patient in the home care group

Tumour type	No. of days in care		Doctors		Nurses		Laboratory tests		Treatment		Total cost (Pta)
	A1	A2	no. of home visits	cost (Pta)	no. of home visits	cost (Pta)	no.	cost (Pta)	type	cost (Pta)	
Gastrointestinal	28	30	24	268,314	64	165,000	21	86,100	P + CH	180,944	700,358
Gastrointestinal	141	66	30	1,495,804	152	363,000	20	82,000	P	0	1,940,840
Myeloma	80	19	28	370,803	41	104,500	8	32,800	P + CH	121,733	629,836
Bronchial	68	4	14	208,148	11	22,000	16	65,600	P	820	296,568
Brain	11	11	16	92,329	32	60,500	13	53,300	P	8,281	214,410
Bronchial	0	18	10	101,500	54	99,000	3	12,300	P + CH	90,932	303,732
Breast	0	12	2	63,998	34	66,000	0	0	P + CH	16,949	146,947
Myeloma	254	23	20	1,088,940	48	126,500	29	118,900	CH	0	1,334,340
Urinary bladder	0	7	4	54,166	20	38,500	0	0	P	49,009	141,675
Gastrointestinal	0	4	4	20,000	8	22,000	0	0	P	0	42,000
<i>Total</i>	582	194	152	3,764,002	464	1,067,000	110	451,000	9P + 5CH	468,668	5,750,706
<i>SD</i>	80.9*	18.4	9.6	534,472	41	101,289	10.4	42,565		63,789	614,362

A1 = home support; A2 = home hospitalization; P = palliative treatment; CH = chemotherapy.

\*Significant difference in statistical variances between home care and hospital care groups (compare Table 4).

**Table 4** Analysis of costs per patient in the hospital care group

Tumour type	B1		B2		'Forfeit' costs <sup>a</sup> (Pta)	Radiology examinations		Laboratory tests		Treatment		Total cost (Pta)
	no. of days	Cost (Pta)	no. of days	Cost (Pta)		no.	cost (Pta)	no.	cost (Pta)	type	cost (Pta)	
Breast	11	19,296	17	59,500	401,200	6	38,600	10	13,400	P + CH	834,000	1,365,996
Non-Hodgkin's lymphoma	5	12,060	16	20,704	377,600	1	6,500	3	2,873	P	141,856	561,593
Bronchial	1	2,412	18	23,292	424,800	5	13,810	9	7,815	P + CH	250,557	722,686
Bronchial	8	19,296	24	31,056	566,400	5	15,875	10	9,982	P + CH	612,835	1,255,444
Non-Hodgkin's lymphoma	0	0	24	31,056	566,400	2	13,920	4	24,058	P + CH	234,699	870,133
Gastrointestinal	4	9,648	25	32,350	590,000	11	48,525	11	9,177	P + CH	420,137	1,109,837
Bronchial	8	19,296	22	28,468	519,200	0	0	14	29,612	P	59,860	656,436
Bronchial	0	0	23	29,762	542,800	4	15,895	3	13,384	P + CH	176,351	778,192
Kidney	8	19,296	30	38,820	708,000	7	9,464	19	56,477	P	194,586	1,026,643
Gastrointestinal	0	0	22	28,468	519,200	4	27,775	14	21,743	P	23,570	620,756
<i>Total</i>	45	101,304	221	323,476	5,215,600	45	190,364	97	188,521	10P + 6CH	2,948,451	8,967,716
<i>SD</i>	4.1	8,865.9	4.2	10,733	99,163	3.6	14,956	5.2	15,548		255,905	279,373

<sup>a</sup>'Forfeit' costs are preset payments by insurance companies that cover charges for all treatment and diagnostic interventions, and include nursing costs at Pta348,800. B1 = outpatient; B2 = inpatient; P = palliative treatment; CH = chemotherapy.

## Results

### Home care group

Six patients received home hospitalization only (A2) and four received both home support (A1) and home hospitalization (A2). None of the home care group had to be readmitted to hospital care. Their ages ranged from 54 to 84 years. The oncology pathologies were: one breast, one urinary bladder, two bronchial and three gastrointestinal carcinomas, two myelomas and one malignant brain tumour. The types of treatment they received are shown in Table 2. Before home hospitalization, patients had undergone hospital treatment at least three times in the previous two months, with an average of 15.6 days of stay per patient (SD = 7.1, range 8–30 days).

Patients from the home care group spent a total of 194 days on A2 home hospitalization (30% of them

more than 20 days) and 582 days on A1 home support (Table 3). Doctors made 152 home visits and nurses 464. The mean time spent per visit was 1.3 h (SD 0.1) and 1.5 h (SD 0.6), respectively, giving a total of 178 h (SD 12.5) and 696 h (SD 66.3), respectively.

Doctors spent 273 min on the 62 telephone calls received (mean time per call = 4.4 min, SD 2.1). Calls resolved the presenting problem in 27 cases (44%), did not resolve the problem in 33 cases (53%) and were simply informative in 2 (3%). The calls resolving problems were equivalent to 35.1 working hours in total, since the mean time per visit was 1.3 h. A telephone call that resolved the presenting problem was defined as one that did not require a medical intervention related to the same medical problem within the subsequent 10 days<sup>13</sup>. This was checked in the patient's clinical record.

The types of direct costs associated with this type of home care were: home visits and associated medical

**Table 5** Summary of results per patient

Group	Treatment time (days) <sup>a</sup>	Daily cost (Pta)	Doctors' time (h)	Nurses' time (h)
<i>Home care</i>				
Mean	77.6	10,635	17.8	69.6
SD	93.5	5,086	12.5	66.3
<i>Hospital care</i>				
Mean	26.6	33,827	14.5	16.4
SD	5.9	7,938	1.2	6.1
Significance	NS	0.0005	NS	0.01

NS =  $P > 0.05$ .

<sup>a</sup>A1 + A2 or B1 + B2 days.

costs (Pta10,000 per visit); nursing costs (Pta5500 per day per patient); laboratory tests; and pharmaceuticals and other material costs. Treatments not provided by the pharmacy of the hospital were not billed to the insurance companies; they were paid by the patient under the Spanish health-care system's reimbursement policy. Prescriptions were not recorded and an analysis of these costs could not be undertaken. The telephone support was not charged.

Half the patients required laboratory tests costing more than Pta50,000 in total, and two of the patients (20%) required chemotherapy and palliative treatments costing more than Pta100,000 in total. The mean daily costs are summarized in Table 5.

### Control group

Ten consecutive patients were included in the study to make it of comparable size to the test group. Three patients received inpatient care only (B2) and seven patients received both inpatient (B2) and outpatient treatment (B1).

The patients were aged 47–75 years. The oncology pathologies were: one kidney, one breast, two gastrointestinal, four bronchial carcinomas and two non-Hodgkin lymphomas. The treatments received are shown in Table 2.

Patients in the control group occupied hospital beds for 221 days (70% of them for more than 20 days) and required 45 visits to the outpatient department (Table 4). During hospital stays, doctors spent 145 h (SD 1.2) and nurses 164 h (SD 6.1) in total on their treatment. In the outpatient clinic, doctors spent 18.7 h (SD 0.2 h) on these cases, a mean of 0.4 h per visit (SD 0.3).

Direct costs included outpatient visits in the B1 group (at an average cost of Pta2412 each). The B2 costs included: medical and nursing care, beds and meals (at one inclusive flat-rate fee) together with laboratory tests, radiological examinations and treatment billed separately; therapeutic treatments could be included the flat-rate fee or not.

Three patients (30%) required laboratory tests and radiological examinations costing more than Pta50,000 in total, and eight patients (80%) required chemotherapy and palliative treatments costing more than Pta100,000 in total. The mean daily costs are summarized in Table 5.

### Statistical comparison

The two groups had similar periods of inpatient-type treatment (A2 v. B2). The total number of days in home hospitalization was 194 and the total number of bed days was 221; the distribution of patients requiring more than 20 days (30% v. 70%, respectively) was

not significantly different. Conversely, the level of outpatient-type medical support was almost 13 times higher in the home care group (582 days of home support) than in the hospital care group (45 outpatient visits) (A1 v. B1) ( $t = 2.1, P < 0.025$ ); the variances were statistically different ( $P < 0.0001$ ) due to the extreme distribution in the test group (0–254 days).

The time devoted by doctors was similar, but nurses spent four times longer with the home care group (Table 5) ( $t = 2.5, P < 0.01$ ); the variances again differed significantly ( $P < 0.0001$ ).

The total costs of home care were 64% of those for hospital care, although this difference was not significant. The main differences were found among drug treatment costs, which were six times lower in the home care group ( $t = 3.0, P < 0.005$ ). The proportion of patients with costs in this respect above and below Pta100,000 was also significant ( $\chi^2 = 7.2, P < 0.05$ ). The total cost of laboratory and radiology examinations was similar in the two groups.

The major differences were in the mean daily costs, which were three times lower at home ( $t = 7.9, P < 0.0005$ ) (Table 5). The daily costs were estimated as the average of the mean daily costs per patient. This gave values of Pta10,635 and Pta33,827, with standard errors of Pta1608 and Pta2510 for home care and hospital care, respectively. The alternative approach provided an estimate of the daily costs<sup>12</sup> as the ratio between total costs and total days of care — this gave values of Pta7411 and Pta33,713, with standard errors Pta1263 and Pta2700, respectively. Since in the home care group the variance of costs per patient around the regression line increased approximately proportional to the square of time, the best estimate of daily cost per patient is the average of the mean daily cost per patient<sup>12</sup>.

### Discussion

The present study analysed the variable, direct costs as fees paid by the private insurance companies. Such expenses included the cost of personnel, treatment, laboratory tests and radiological examinations, together with the daily cost of a hospital bed stay. The frequency of treatment was recorded in order to make a comparable series.

Other benefits linked to the two modalities of medical care were disregarded since the main concern of the insurance companies was saving costs; that is, they were reluctant to consider cost-utility and cost-effectiveness issues. Therefore, the analysis was based on the assumption of equal cost-effectiveness, which is, in principle, an erroneous premise<sup>7,14</sup> because the

health benefits (e.g. the effect of treatments) and the non-health benefits (e.g. the quality of services) differ in the two health-care modalities.

The cost-minimization analysis was based on two groups of home- and hospital-treated oncology patients (10 per group). The series could not be larger owing to the unilateral decision of the private insurance companies to deny patients home care support for economic reasons, despite published data showing that it is cheaper<sup>8,9</sup>. The two groups were similar in the number of patients, ages, pathologies, frequency of treatment and duration of hospitalization. The study was designed to evaluate the factors that influence the cost of home care.

The absence of outpatient clinic visits was a principal difference between the home care and control patients; this was probably related to the longer surveillance periods and the 24 h telephone support. Home care patients may have also avoided unnecessary attendance at emergency departments for symptoms related to their treatment or disease. These findings contrast with other experience from randomized trials, in which 25% of the costs of 'hospital at home' treatment resulted from transfer to hospital<sup>15</sup>.

In the present study, doctors spent similar overall mean amounts of time per patient attendance in the home care and hospital care groups (in a ratio of 1.2:1, respectively), but nurses devoted significantly more time to the home care patients (in a ratio of 4.2:1;  $P < 0.01$ ). Home care assistance can be carried out only by well trained, coordinated teams, capable of managing a small number of patients, in contrast with the uniform mass care provided in hospitals. Indirect evidence of this was the low variance in the control group for the time spent by caregivers. Increased variance ( $P < 0.0001$ ) in the home care group suggests a more personalized attention to the patients than that provided in hospitals. Patients expressed satisfaction with the nurses' dedication and with the 24 h telephone assistance provided by doctors.

Cost reductions related to health-care efficiency could not be studied with objective measurements. Several factors may be significant in telephone-supported telemedicine:

- (1) any action is immediately registered in the patient's electronic record, which allows better coordination of care;
- (2) treatment design addresses individual demands and aims at the simplest and most efficient patient management;
- (3) the 24 h telephone service avoids not only home visits but also hospital stays or outpatient clinical care for minor problems occurring during treatment.

The organizational aspects of telephone support are of great importance for the efficacy of management and patients' comfort, and can also provide clear cost savings<sup>16-18</sup>. In our series, 27 home visits were avoided during the four-month period of 24 h support, and this represents 35.1 working hours and a total of Pta270,000 (Pta10,000 per visit) savings to the insurance companies. Notwithstanding the recommendations of the European Health Committee of the Council of Europe, the present and previous papers<sup>7</sup> demonstrate that more sophisticated telemedicine techniques, such as the use of mobile control units, may be unnecessary. In addition, we have shown that telephone support increases family cooperation and reduces the level of stress experienced by relatives.

There were no significant differences in the costs of laboratory tests and radiological examinations (at a home:hospital ratio of 1.2:1). The total cost of laboratory tests was apparently greater in the home care group, but this was probably because some insurance companies included such costs in the hospital flat-rate fee per day. Conversely, home patients did not have X-ray examinations. Further suggestions to improve cost reduction might be focused on mobile control units for specific examinations.

Treatment costs (specifically for palliative care and chemotherapy), as in other series<sup>19</sup>, represented the greatest differences between the two groups (at a home:hospital ratio of 1:6.3;  $P < 0.005$ ). In contrast to the suggestion that these differences are related to the non-utilization of high-technology therapy and high-cost drugs in the home care group<sup>20</sup>, we consider them to be related to the greater degree of staff involvement with this group, which allowed the simplest, optimum treatment to be devised for each individual patient, thus maximizing efficacy and efficiency. A collateral finding is that drugs not provided by the hospital pharmacy are paid for by patients, being charged afterwards to the public or private patients' insurance system. Because the number of prescriptions were not recorded in advance, a detailed analysis of this expenditure was not possible. Nevertheless, this does not represent a significant additional cost to the insurance companies, since expensive agents were always provided by the hospital pharmacy and the other prescriptions were mainly for minor pharmacological agents (e.g. bandages, balsamic agents).

In summary, the cost-minimization analysis undertaken in the present study showed significant cost savings for oncology patients nursed at home with telephone support, with an objective reduction in treatment costs and the number of home visits. Team motivation and 24 h telephone support achieved high levels of efficacy and efficiency and directly influenced

overall costs. In our opinion, this type of service should be covered by private insurance companies and 24 h telephone support should be carefully considered for oncology patient care at home.

**Acknowledgements:** This work was done with a grant (TEL 98-995) from the CICYT (Interministerial Commission of Science and Technology of Spain). We thank L Divasson and I León for their assistance with the English language in the preparation of this article.

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