Cost Effectiveness of Integrated Medicine in Patients With Cancer Receiving Anticancer Chemotherapy

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Abstract

Purpose: Ambulatory chemotherapy is patient friendly but may result in toxicity-induced unscheduled hospitalizations (TIUHs). This emerging issue may increase health care costs. We studied the cost effectiveness of a hospital-home monitoring program based on systematic iterative telephone calls after chemotherapy.

Patients and Methods: We retrospectively evaluated the rates of chemotherapy-induced unscheduled hospitalizations in patients who were treated in August 2008. Patients were contacted by telephone 1 day before chemotherapy and on the second and eighth days after undergoing chemotherapy. Costs associated with TIUHs were calculated and compared with those of a cohort concomitantly treated using the standard follow-up procedure.

Results: A total of 259 patients entered the hospital-home monitoring program. They were compared with 86 patients who

had similar characteristics but underwent the standard treatment and follow-up procedure. Inclusion in the hospital-home monitoring program resulted in patients experiencing TIUHs approximately half as frequently as patients in the other group (2.4% v 4.9%; $P < .01$). Patients in the program experienced TIUHs for a median length of stay of 4 days, representing a nonsignificant reduction in duration of hospitalization (P not significant). Consequently, through a two-fold reduction in TIUH annual incidence, this program represents a reduction in unscheduled hospitalizations per year of 383 days, decreasing hospital costs by €201,468 (\$292,468) per year.

Conclusion: The hospital-home monitoring program is a cost-effective strategy for offering ambulatory chemotherapy treatment to patients with cancer. This program has become our standard procedure for ambulatory chemotherapy in patients with cancer.

Introduction

Cancer is a major public health problem in the United States and worldwide.¹ One in four deaths that currently occur in the United States results from cancer. In 2006, the numbers of cases and deaths in the United States were 1,529,560 and 569,400, respectively. However, in France, the number of people diagnosed with cancer is approximately 320,000 per year, and the annual mortality rate is roughly 146,000 per year.²

Alongside this epidemic trend, another current issue of importance is the growing complexity found in patients with cancer. Olsen³ defined the patient complexity as an index variable, which increases with the level of complexity. The complexity index covers factors such as need for health care services and sociodemographics. We define complexity as the status of a patient whose case leaves a physician unable to capture a complete picture of the patient's needs and/or risk exposure during anticancer treatment. Moreover, this complexity found in the assessment and treatment of patients with cancer increases because of aging and frequent concomitant severe chronic diseases and is also intensified by the increased lifespan with metastatic cancer and by the recent introduction of anticancer agents with specific toxicity to the vascular tree. For example, the anti-vascular endothelial growth factor receptor agent bevacizumab induces frequent cardiovascular toxicities such as hypertension,

which requires specific monitoring procedures and therapeutic management.⁴

The course of disease in patients has become increasingly unpredictable, resulting in equally unpredictable adverse events, which often lead to unscheduled hospitalizations. Our proposed response to this complexity that physicians face is therefore a more integrative approach to medicine. Integration requires both a multidisciplinary global patient approach and a dedicated organization that facilitates coherent actions and consistent follow-up. This type of service can be optimized by facilitating collaboration within the medical community in a single location and by creating an open network of communication between health care professionals and patients.

Nonetheless, the development of ambulatory chemotherapy poses some challenges. Even though patients remain in the hospital for shorter periods of time, they still require careful monitoring to prevent severe complications from occurring. Moreover, patients will be out of the care of their physicians at a time when the risk of adverse events occurring is high.

New anticancer agents have a narrow therapeutic index and unpredictable toxicity, particularly vascular agents, and are administered only to selected patients during development. However, they must then be used in patients who are frail and vulnerable and who usually suffer from comorbidities

ties. Therefore, to increase quality and safety control, cancer treatments can be subdivided into several steps or checkpoints. Usually, the first checkpoint before chemotherapy is a medical consultation that includes physical and biologic examinations. This step is therefore dependent on the referent physician, and it does not include an evaluation between chemotherapy cycles, leaving the patient no choice but to receive medical attention immediately before his or her next chemotherapy administration. We have created a second checkpoint that proposes the use of a multidisciplinary team dedicated to risk assessment. Before the first chemotherapy administration, the team evaluates the patient's nutritional status, level of psychologic distress, and socioeconomic status, while simultaneously noting comorbidities and level of risk of drug interactions.⁵ Furthermore, we created a third checkpoint to offer patients highly individualized follow-up after receiving chemotherapy. This step consists of a team that automatically contacts the patient three times before his or her next chemotherapy administration.

The challenge lies in evaluating whether increased contact and medical attention between health care professionals and patients improve the outcome of treatment in patients with cancer. Consequently, this study focused on the feasibility and cost effectiveness of a more integrated strategy, such as the one we are proposing, for assessing risk factors and delivering appropriate follow-up care in patients with cancer undergoing chemotherapy.

Patients and Methods

Before the initiation of this study, the project was approved by the local review board of the Cochin Hospital Department of Oncology. Qualified research assistants obtained informed consent from participating patients, reviewed the assessment instruments with them, and answered questions as needed.

Patients

The objective of this study was to evaluate the cost and efficacy of using a medical team to monitor, by way of interactive telephone evaluations, a cohort of patients who were, at the time, receiving ambulatory chemotherapy for solid tumors. All consecutive patients receiving chemotherapy infusions in our institution during August 2008 were included

in the present study. No exclusion criteria were defined, and there were no missing data. We used the hospital discharge database to monitor all adverse drug reactions or severe complications requiring hospitalizations. Furthermore, every patient included in the study was observed until disease progression or end of chemotherapy.

During the same period, all of the patients who were hospitalized for chemotherapy in two different inpatients units (gastroenterology and thoracic oncology units) located in the same tertiary cancer center in Paris, France, were analyzed and evaluated for both the frequency and cost of toxicity-induced unscheduled hospitalizations (TIUHs).

Medical and Economic Data

The economic data collected for the purpose of this study included a detailed list of the chemotherapy regimens and doses administered to the patients as well as chemotherapy-induced adverse effects that led to unscheduled hospitalizations. Primary analyses included only those items that were directly attributed to toxicity or its treatment. Also, the economic cost was based on the medical and nonmedical costs of chemotherapy. The direct medical costs included hospitalization fees (treatment administration), medical and technical procedures (consultations, laboratory tests, and x-rays), drug treatments, and patient stays at recovery homes. Medical and nonmedical caregiver costs were calculated following a grid average for each specialist. Direct nonmedical costs refer to nonmedical consultations (dietician, physiotherapy, psychologist), transport (ambulance, nonemergency medical transport, private car), and costs associated with home care (nurses). Communication between physicians and patients was estimated to last an average of 15 minutes. Thus, standard unit costs were multiplied by the average number of calls, hospitalizations, biologic examinations, and the average cost of medical devices to arrive at the average cost per person. Overhead expenses are defined as costs necessary to the continued functioning of the activity but that cannot be immediately associated with the products/services. Overhead expenses were considered to be similar for both groups and not included in the total cost.

Finally, the total average cost for toxicity-related hospitalizations was derived for each participant. Cost calculations were

Figure 1. Hospital-home monitoring program.

made in euros and in US dollars according to the conversion rate on August 27, 2011 (€1 = \$1.4498).

Hospital-Home Monitoring Program

The hospital-home monitoring program was systematically conducted among outpatients receiving chemotherapy, using a standardized five-step procedure:

1. At the time of treatment initiation, a clinical evaluation and chemotherapy regimen are set up and validated by a multidisciplinary staff consisting of an oncologist, pharmacologist, pharmacist, dietician, and psychologist. As a team, they evaluate the risk of toxicity by assessing for vulnerability, comorbidities, concurrent medication, and risk for overexposure of anticancer agents. The team then arrives at a set of conclusions regarding the validity of the standard procedure, dose reduction, and drug substitution and reinforcement of follow-up.
2. Two days before administering chemotherapy to a patient, a medical call is conducted with him or her to determine their general condition as well as rate of weight loss. This step proposes that the patient undergo biologic examinations, out of the hospital, 2 days before chemotherapy (Fig 1). Results are sent by fax to the physician.
3. After the medical call and review of biologic tests, 1 day before the planned treatment date, the oncologist proceeds to electronically confirm with the pharmacist the patient's chemotherapy prescription.
4. The day of chemotherapy, the patient undergoes a medical examination in the outpatient unit, where he or she is afterward infused with the drugs and discharged.
5. The physician conducts follow-up with patient by calling him or her twice, on the second and eighth days, after chemotherapy to collect data on treatment toxicity and potentially serious adverse events and to provide the patient with recommendations. These can range from setting up an appointment with the physician to identifying whether the patient needs hospitalization and continuing to educate the patient. In contrast to the hospital-home model, the standard procedure does not include this last step.

Under the standard procedure, patients are admitted to the inpatient unit, where they undergo biologic and physical examinations and where they are tested for toxicity related to their previous chemotherapy cycle. Subsequently, under the standard procedure, chemotherapy prescription is electronically validated and the treatment administered, with much less patient-physician interaction and communication along the way.

Results

Patient Characteristics

A total of 345 patients receiving chemotherapy were included in the study. A total of 259 outpatients received 2,374 cycles (median per patient, eight; range, one to 24), whereas 86 patients from the inpatient group received a total of 371 cycles (median

Table 1. Patient Characteristics

Characteristic	Inpatient Procedure (n = 86)		Experimental Ambulatory Procedure (n = 259)		P
	No.	%	No.	%	
Age, years					.91
Mean		63.3		64.8	
SD		14.3		12.9	
Sex, %					.36
Male		60		66	
Female		40		34	
Primary tumor site, %					.04
Colon and rectum		21.2		16.4	
Lung		13.2		14.1	
Stomach		15.4		12.4	
Pancreas		18.8		13.8	
Liver		13.7		11.2	
Biliary tract		14.6		13.6	
Ovarian		—		8.6	
Prostate		—		6.9	
Other		4.1		3.0	
Chemotherapy regimen					
Fluorouracil based	71	75.5	90	34.7	< .01
Platinum based	80	85.1	189	73.0	< .01
Taxane based	7	7.5	132	29.3	< .01
No. of chemotherapy cycles					< .01
Total	371		2,374		
Mean		4		9.2	
SD		3.9		6.1	
Median per patient		2		8	
Range		1-22		1-32	
No. of TIUHs					
Total	18	4.9	57	2.4	< .01
Per chemotherapy regimen		4.8		1.9	
Fluorouracil based		6.0		2.5	< .01
Platinum based		3.1		2.3	< .01
Taxane based		2.6		2.5	.28
Other					.72
Length of stay, days					.91
Mean		10		6.1	
SD		9.0		5.5	
Median per patient		7		4	
Range		1-26		1-23	

Abbreviations: SD, standard deviation; TIUH, toxicity-induced unscheduled hospitalization.

per patient, four; range one to 10). Table 1 lists patients' characteristics. In the outpatient group, median age was 64 years (range, 17 to 87 years) compared with 66 years (range, 24 to 85) in the inpatient group. Both groups of patients developed digestive carcinoma, at a rate of 67.4% in the outpatient group and 86.8% in the inpatient group. By the same token, 46 patients who were cared for as outpatients experienced 57 TIUHs, and 14

Figure 2. Overall cost of patients with and without serious adverse events (SAEs) among (A) outpatients and (B) inpatients. Overall cost per chemotherapy among (C) outpatients and (D) inpatients. (E) An SAE incidence drop from 4.9% to 2.4% would reduce the overall SAE cost per year.

inpatients experienced 18 TIUHs. The mean length of stay per TIUH was 6.1 ± 5.5 days standard deviation (SD) for patients whose procedure was ambulatory versus 10 ± 9.0 days SD for patients who received hospital procedures (*P* not significant).

Chemotherapy Costs

The average costs of chemotherapy-related hospitalizations in the outpatient group were $€7,989 \pm €990$ SD ($\$11,583$) per

patient with TIUHs and $€3,858 \pm €337$ SD ($\$5,595$) for those without TIUHs, whereas for inpatients receiving the standard of care, costs were $€17,572 \pm €4,163$ SD ($\$25,476$) per patient with TIUHs and $€8,431 \pm €1,770$ SD ($\$12,224$) for those without TIUHs (Figs 2A to 2E). In addition to the cost of each chemotherapy-related hospitalization, additional costs associated with both outpatients and inpatients amounted to $€378$ ($\$548$) and $€1,095$ ($\$1,587$), respectively, stressing the need to avoid TIUHs.

Beneficial Effect of Experimental Procedure

TIUHs per chemotherapy cycle averaged 4.9% in the inpatient group; however, this rate was lower in the outpatient group (2.4%; $P < .01$). Considering that the reduction in frequency of unexpected hospitalizations dropped from 4.9% to 2.4% with the hospital-home monitoring program, we assume that 62 TIUHs per year could have been avoided. Furthermore, with a mean of 6.2 days in length of hospitalization, treatment through the hospital-home program yields 383 fewer days of hospitalizations per year and a decrease in costs of approximately €201,468 (\$292,089) per year.

Discussion

This study highlights the cost effectiveness of using an integrative care approach that includes cautious evaluation and active relational assistance when treating patients with cancer who undergo chemotherapy. At the same time, this type of outpatient program is flourishing because of the time constraints of physicians and hospitals. Our study pinpointed a beneficial effect of a structured hospital-home monitoring program. This proposed modification of treating patients with cancer consists of treatment via an ambulatory unit as well as a treatment protocol that includes more interaction and check-in calls with patients. First, telephone calls help physicians to identify the frailty of the patient situation and to anticipate a potential inadequacy between patient status and outpatient chemotherapy. Second, the follow-up telephone call practice, also known as postdischarge call back, has already been adopted by many hospitals nationwide.⁶ Even though these interactions are not billable to payers, they have been recommended by industry experts as a means of improving continuity of care and providing customer feedback to the frontline staff.⁷ This study points out the effectiveness of a postdischarge call back as well as a telephone call made to the patient before chemotherapy. With this method, chemotherapy was prepared before patient's arrival, and hospital stay was reduced to the duration of chemotherapy infusion.

Furthermore, clinical follow-up provides a vital opportunity to answer patients' questions about medications and chemotherapy management, while reinforcing the importance of physician follow-up outside the actual hospital setting. These activities help prevent the occurrence of adverse events after discharge. In this study, we found that 4.9% of patients were rehospitalized overnight because of treatment toxicities. Previous studies have shown 4%, 30%, and 24% rates of grade 3 and 4 toxicities for fluorouracil-, platinum-, and taxane-based chemotherapies, respectively.^{8,9} The outpatient program demonstrated a decrease in TIUHs from a rate of 4.9% to 2.4%. Previous studies have stressed the impact of telephone interventions on patient satisfaction and readmissions.¹⁰⁻¹²

Preventing hospital readmission is a critical issue, but the effectiveness of increased physician-patient interactions

through telephone calls and biologic examinations has not been proven efficient previously. Lower rates of patient readmissions is beneficial and a significant cost-saving strategy for hospitals, and they can be achieved through the interventions pinpointed by the present study.

Aside from clinical consequences, routine care of serious medical complications, such as febrile neutropenia, has a considerable economic impact, especially in an inpatient setting.¹³ Currently, economy-related health literature is mainly focused on febrile neutropenia. With a mean cost of €13,181 (\$19,110) per treatment for each episode of febrile neutropenia, the total overall cost per patient rapidly increases.¹⁴ Moreover, the cancer type and level of care seem to have a substantial impact on management costs of febrile neutropenia.¹⁵ In a pilot study involving patients with cancer from a community oncology center, total direct cost for inpatients being treated for lymphoma averaged €12,325 (\$17,869) per patient, compared with a total cost of €7,142 (\$10,354) for patients with breast cancer.¹⁶ On the other hand, direct costs for outpatients were remarkably lower (lymphoma, €3,934 [\$5,704]; breast cancer, €755 [\$1,094]), similar to our findings, which illustrate how direct costs for treatment are lower for outpatients than for inpatients. Interestingly, the overall cost of a TIUH is not related to the patient's origin on a per-patient basis. However, we showed that reducing the number of TIUHs does have a positive effect on overall cost reduction.

This knowledge, therefore, allows us to continue a practice of routine procedure that simultaneously reduces the rate of hospital readmission. In the near future, hospitals could be penalized for high readmission rates and be encouraged to seek better practice methods that improve patients' experiences, prevent readmission, and reduce overall health care costs.

In conclusion, this method of delivering care helps meet the need for personalized care in patients with cancer, encompassing cautious evaluation, attention to patients' needs, investment in active relational support, and efficiency in the use of hospitalization tools. The hospital-home monitoring program reduced the number and duration of readmissions and, as a result, hospital-related costs.

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