

# Home-Based Hospice Care Reduces End-of-Life Expenditure in Taiwan

## *A Population-Based Study*

*Li-Fu Chen, MD, Chun-Ming Chang, MD, and Chih-Yuan Huang, MD*

**Abstract:** Inpatient hospice care can reduce futile treatment and medical costs. However, the cost trimming effect of home-based hospice care in hospital has yet not been explored. This study evaluates the impact of home-based hospice care on end-of-life expenditure in hospitals with different spending intensity.

This is a population-based retrospective study in Taiwan. Cancer decedents were identified in the National Health Insurance Research Database (NHIRD) from 2009 to 2011. They are categorized by hospital spending intensity. A hierarchical linear regression model with a random-intercept model was used to analyze the relationship between end-of-life expenditure (dependent variable) with and without home-based hospice, and both patient-level and hospital-level characteristics.

A total of 78,613 cancer decedents were identified in the NHIRD from 2009 to 2011. Of these decedents, 17,638, 43,286, and 17,689 were categorized by hospital spending intensity as high, moderate, and low, respectively. Decedents with home-based hospice care were associated with US\$2452 less in expenditure per patient compared with those without home-based hospice care. The majority of savings occurred in the last 3 months of life. These savings with home-based hospice care were consistent in hospitals with different levels of spending intensity.

Home-based hospice reduced one-fifth expenditure at the end of life of cancer decedents treated in hospitals with different spending intensity.

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**Abbreviations:** CCIS = Charlson Comorbidity Index Score, EOL = end of life, HSI = hospital spending intensity, ICD-9-CM = International Classification of Disease, 9th Revision, Clinical Modification, NHIRD = National Health Insurance Research Database, SD = standard deviation, SES = socioeconomic status.

## INTRODUCTION

End-of-life (EOL) care is an issue in terminal decedents with cancer. In the United States, more than 1 quarter of Medicare spending was consumed by EOL care of decedents in their last year of life.<sup>1</sup> Futile treatment has been discussed extensively. And in Canada, decedents with <6 months of life comprised 1.1% of the population but consumed more than one-fifth of healthcare spending.<sup>2</sup> Hospice care is a management to reduce the expenditure and increase quality of life at the EOL.

Hospice care can benefit terminally ill patients by increasing family satisfaction,<sup>3</sup> and reduce futile treatment and medical costs.<sup>4,5</sup> On the other hand, hospice disenrollment is a marker for higher healthcare use and expenditure for care.<sup>6</sup> Many studies have investigated the relationship between inpatients hospice care and EOL treatment and costs.<sup>7,8</sup> Contrasted with inpatient hospice care, the cost trimming effect of home-based hospice care in hospitals with different spending intensity has yet not been explored. Although it has been mentioned early in 1992.<sup>9</sup> As the telemedicine systems develop, home-based hospice is becoming more feasible and convenient.<sup>10,11</sup> Rural area previous in lack of hospice may benefit from home-based hospice care.<sup>12</sup>

The aim of this study was to increase our understanding about the expenditure-reducing effect of home-based hospice care in hospitals with different levels of spending intensity. We investigated whether home-based hospice care can reduce EOL costs in all kinds of hospitals.

## METHODS

### Ethics Statement

This study was approved by the Institutional Review Board of Buddhist Dalin Tzu Chi General Hospital, Chiayi, Taiwan. The institutional review board stated that written consents from patients were not required for this study because the identification numbers and personal information about participants were not included in the secondary files.

### Database

The data for this study were collected from the Taiwan National Health Insurance Research Database (NHIRD) from the years 2009 through 2011. This dataset has been organized and managed by the Taiwan National Health Research Institutes

but collected by the Taiwan National Health Insurance Program since 1995. The program covers approximately 99% of the residents in Taiwan and has contracts with 97% of medical providers nationwide. To verify the accuracy of diagnosis, the Taiwan Bureau of National Health Insurance randomly interviews patients and reviews the charts of 1 per 100 ambulatory and 1 per 20 inpatient claims.<sup>13</sup> Taiwan's NHI has the unique characteristics of universal insurance coverage and a single-payer system with the government as sole insurer.

## Setting

This is a retrospective, population-based study. This study enrolled decedents with cancer diagnoses during the study period (2009–2011). We calculated the expenditure for each decedent for 6 months before death. To determine the factors associated with EOL expenditure, decedents and hospital-level characteristics were identified and analyzed with hierarchical linear regression using a random-intercept model to solve the cluster effect of hospitals. We specifically looked at the impact of home-based hospice care trends in EOL expenditure for 6 months before death. We also looked at home-based hospice care as a modifying factor in hospital spending intensity (HSI).

## Participants

A total of 78,613 cancer decedents were identified in the NHIRD from 2009 to 2011. Cancer diagnoses were identified by the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 140.x to 239.x, and the diagnoses were verified by comparing them with the Catastrophic Illness dataset. Decedents were identified by a record of death during the study period (2009–2011).

## Home-Based Hospice Care

Home-based hospice care was identified by outpatient claims with case type code 65.

## Hospital Spending Intensity Index

The HSI index was calculated from the expenditure of a different cohort in their last 6 months of life in the same hospital to reduce the potential “reverse causality effect.” Similar work can be found in previous study by Chang et al<sup>14</sup> and Stukel et al.<sup>15</sup> Because Stukel et al<sup>15</sup> found that EOL expenditure and acute-care expenditure were highly correlated ( $r=0.81$ ), EOL expenditure can represent the intensity of hospital care provided to patients, such as the usage of intensive care units, physician visits, specialist consultations, and diagnostic tests. It was categorized into approximate terciles of high, medium, and low hospital spending index.

## Measurements

The key independent variable was the total amount of the healthcare expenditure for the last 6 months of life for the cancer decedents. The analysis was further stratified by the HSI. Disease severity was estimated by using the Deyo adaptation of the Charlson Comorbidity Index Score (CCIS), which was derived from inpatient diagnoses in the last 6 months of life.<sup>16,17</sup> Socioeconomic status (SES) was classified into 3 groups by individual income as our previous study.<sup>18</sup> Diagnosis and metastatic status were combined to identify 7 subgroups (I–VII) of cancers that were homogeneous in terms of survival and disease course.<sup>19</sup> Metastatic status was identified by using ICD-9 codes 196.xx to 199.xx. Subgroups included 4 cancer types:

germ cell tumors and prostate cancer; lung, liver, and pancreatic cancer; hematologic malignancies; and all other cancers. Other patient characteristics included age, gender, and region of patients' residence and primary physician's specialty. Hospital characteristics included district caseload, urbanization, and geographic region. The methods of recording and definitions of these variables were described in our previous studies.<sup>20,21</sup>

## Statistical Methods

The SPSS version 15 (SPSS, Inc., Chicago, IL) was used to analyze the data. We used  $\chi^2$  test for categorical variables and 1-way ANOVA test for continuous variables in Table 1. **We performed multilevel analysis (hierarchical linear regression) using hospital as a random-intercept model to compare the EOL medical expenditure in their last 6 months of life between cancer decedents with and without home-based hospice care in Table 2. We also used multilevel analysis using a random-intercept model to compare the EOL medical expenditure in their last 6 months of life between cancer decedents with and without home-based hospice care by different hospital spending intensities in Table 3. The model was chosen because of the potential clustering effect exerted by a hospital. Hospital-level policies, procedures, or physician compensation mechanisms may produce differential EOL expenditure patterns in each hospital. A value of  $P < 0.05$  was used to determine statistical significance.**

## RESULTS

A total of 78,613 decedents with cancer diagnoses were identified in the NHIRD database from 2009 to 2011. According to the HSI levels of the hospitals, we identified 17,638, 43,286, and 17,689 decedents admitted to hospitals with high, moderate, and low HSI, respectively. Eight percent of decedents had used home-based hospice care in their last 6 months of life. The median medical cost of aggressive management in the last 6 months of life was US\$10,053 per decedents without home-based hospice use and US\$7734 per decedents with home-based hospice. The baseline characteristics of these decedents are shown in Table 1.

The EOL cost for cancer decedents increased each month as they approached death except for the last 1 in Figure 1. Cancer decedents with home-based hospice care were associated with much less EOL cost than those without home-based hospice care. A similar pattern was found in hospitals with different levels of spending intensity in Figure 2, especially over the last 3 months, during which home-based hospice care was mostly responsible for reducing the cost.

The median EOL expenditure per decedent in the last 6 months of life was US\$9804. Home-based hospital care was associated with US\$2452 less in cost (–19.8%) in Table 2. Other variables were not shown here. That is, low SES, low HSI, CCIS 1 or 0, and living in a rural area were also associated with less cost. Male gender, age >65, and care by an oncologist were associated with higher cost. The year 2011 cost less than 2009. Different cancer groups were associated with various EOL costs. Of these, hematologic malignancy cost extraordinarily more. We have further analyzed that in another article.<sup>22</sup>

In multivariate analysis using a random-intercept model according to different hospital spending intensities, home-based hospice reduced US\$2811 (20.4%), US\$2677 (21.2%), and US\$1682 (16.2%) in cost per decedents among cancer decedents treated by high, medium, and low hospital intensity, respectively, in Table 3.

**TABLE 1.** Baseline Characteristics of Cancer Decedents From 2009 to 2011 (n = 78,613)

Parameters	Total		Home-Based Hospice Care				P Value
			No Use Hospice		Use Hospice		
	N	%	N	%	N	%	
Total	78,613	100	72,318	92.0	6295	8.0	
Medical cost of aggressive management in the last 6 months of life, median (1st quartile, 3rd quartile)	9804 (5125, 16,588)	10,053 (5209, 16,947)	7734 (4425, 12,667)	<0.001			
Patients' characteristics							
Gender							<0.001
Male	51,460	65.5	48,016	66.4	3444	54.7	
Female	27,153	34.5	24,302	33.6	2851	45.3	
Mean age, yr (±SD)	67 ± 14	67 ± 15	70 ± 14	<0.001			
Age group, yr							<0.001
<65	32,800	41.7	30,688	42.4	2112	33.6	
≥65	45,813	58.3	41,630	57.6	4183	66.4	
CCIS							<0.001
0 or 1	33,279	42.3	30,348	42.0	2931	46.6	
2	9748	12.4	9163	12.7	585	9.3	
3	6191	7.9	5826	8.1	365	5.8	
4	29,395	37.4	26,981	37.3	2414	38.3	
Cancer group							<0.001
I	745	0.9	731	1.0	14	0.2	
II	1733	2.2	1538	2.1	195	3.1	
III	12,578	16.0	11,883	16.4	695	11.0	
IV	21,264	27.0	19,374	26.8	1890	30.0	
V	12,607	16.0	11,904	16.5	703	11.2	
VI	26,923	34.2	24,227	33.5	2696	42.8	
VII	2763	3.5	2661	3.7	102	1.6	
Primary physician's specialty							0.007
Oncologist	12,517	15.9	11,440	15.8	1077	82.9	
Other	66,096	84.1	60,878	84.2	5218	17.1	
Socioeconomic status							<0.001
High	7636	9.7	7162	9.9	473	7.5	
Medium	27,955	35.6	25,677	35.5	2278	36.2	
Low	43,023	54.7	39,479	54.6	3544	56.3	
Urbanization							0.061
Urban, suburban	53,864	68.5	49,617	68.6	4247	67.5	
Rural	24,749	31.5	22,701	31.4	2048	32.5	
Geographic region							<0.001
Northern, Central	53,266	67.8	49,871	69.0	3395	54.0	
Southern, Eastern	25,332	32.2	22,435	31.0	2897	46.0	
Hospital characteristics							0.310
Hospital characteristics							
Medical center	45,421	57.8	41,822	57.8	3599	57.2	
Regional, district	33,192	42.2	30,496	42.2	2696	42.8	
Caseload group							<0.001
High	26,628	33.9	24,416	33.8	2212	35.1	
Medium	26,404	33.6	23,724	32.8	2680	42.6	
Low	25,581	32.5	24,178	33.4	1403	22.3	
Hospital spending index							<0.001
Low	17,638	22.4	16,097	22.3	1541	24.5	
Medium	43,286	55.1	39,376	54.4	3910	62.1	
High	17,689	22.5	16,845	23.3	844	13.4	

Cancer group I = nonmetastatic germ-cell tumors and prostate cancer; II = metastatic germ-cell tumors and prostate cancer; III = nonmetastatic lung, liver, and pancreatic cancer; IV = metastatic lung, liver, and pancreatic cancer; V = all other nonmetastatic cancer; VI = all other metastatic cancer; and VII = hematologic malignancies. CCIS = Charlson Comorbidity Index Score; SD = standard deviation.

**TABLE 2.** Medical Cost for Taiwanese Cancer Decedents From 2009 to 2011 by Multivariate Analysis Using a Random-Intercept Model (n = 78,613)

Parameters	Estimate	P Value
Home-based hospice care		
No use hospice	Reference	
Use hospice	−2452	<0.001

Medical cost of aggressive in the last 6 months of life US\$12,397 ± 10,754. Adjust for the patients' socioeconomic status, gender, age group, Charlson Comorbidity Index Score, cancer group, primary physician's specialty, hospital characteristics, caseload group, urbanization, geographic region, and year.

## DISCUSSION

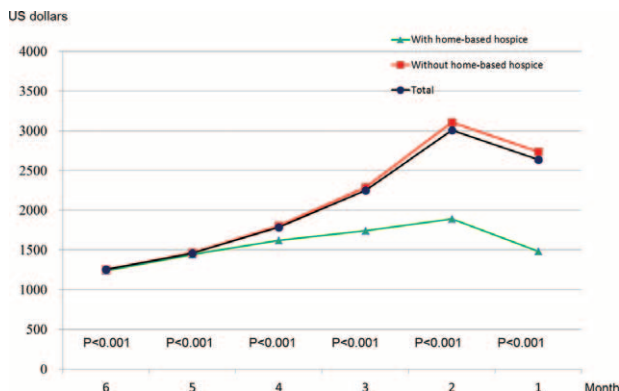
This study found that home-based hospice care was associated with less EOL expenditure in hospitals with different levels of spending intensity. The expenditure at EOL increased as decedents approached death. The gap between EOL expenditure curves of decedents with and without hospice care increased as they approached death as well, especially in the last 3 months. These results have implications for public health policy makers who could offer hospice incentives to healthcare providers because home-based hospice care may help to reduce the expenditure at the EOL among cancer decedents in hospitals with different spending intensities or practice styles. If the incentive covered the profit of health service providers, then they might promote hospice care, and the overall financial burden would thus be reduced.

The strength of this study was that it consisted of huge patient numbers to lessen the effects of minor confounding factors. And we used multilevel analysis to reduce the clustering effect exerted by the practice pattern of a hospital. The Taiwan

**TABLE 3.** Medical Cost for Taiwanese Cancer Decedents From 2009 to 2011 by Multivariate Analysis Using a Random-Intercept Model According to Hospital Spending Intensity

Parameters	Estimate	P Value
High-hospital spending index (mean = 13,776)		
Home-based hospice care		
No use hospice	Reference	
Use hospice	−2811	<0.001
Medium-hospital spending index (mean = 12,655)		
Home-based hospice care		
No use hospice	Reference	
Use hospice	−2677	<0.001
Low-hospital spending index (mean = 10,382)		
Home-based hospice care		
No use hospice	Reference	
Use hospice	−1682	<0.001

Adjusted for the patients' socioeconomic status, gender, age group, Charlson Comorbidity Index Score, cancer group, primary physician's specialty, hospital characteristics, caseload group, urbanization, geographic region, and year.

**FIGURE 1.** Trends of end of life expenditure in the last 6 months among cancer decedents with and without home-based hospice care in Taiwan.

Health Insurance Program has covered approximately 99% of the population since 1995, and a growing body of articles has confirmed the validity of the dataset. We observed a robust influence of home-based hospice care on the expenditure on EOL care in cancer decedent in hospitals, and calculated the amount that could be saved by home-based hospice care. We found no other study which discussed the effect of home-based hospice care on EOL care in hospitals with different practice styles.

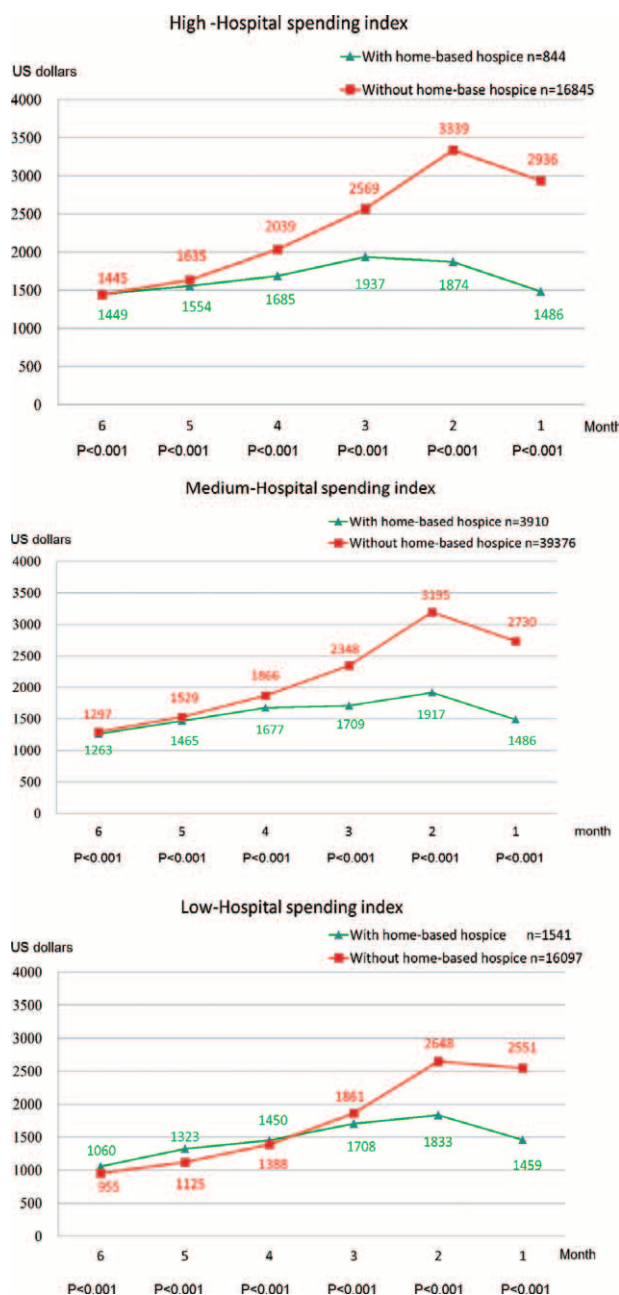
It has been shown that hospice care may reduce medical costs for cancer decedents.<sup>23,24</sup> In Canada, Dumont et al<sup>25</sup> showed that the overall costs of EOL care gradually increased from the fifth to the last month of the patient's life, and informal care costs were particularly high over the last 3 months of life. In Israel, Bentur et al found that 1 quarter of their terminal cancer patients received home-based hospice care. Their average cost was \$13,648 compared with \$18,503 for patients without home-hospice care.<sup>26</sup> Postier et al<sup>27</sup> found that non-cancer patients with at least 6 months of home-based pediatric palliative care exposure showed a significant decrease in total hospital charges of nearly \$275,000 from pre to postprogram admission. Our study showed similar cost trimming effect.

HSI is calculated according to EOL expenditure. Higher spending intensity level was associated with lower mortality in common inpatients conditions.<sup>15,28</sup> Though some studies showed that different HSI levels were not necessarily related to better survival or quality of care.<sup>29,30</sup> HSI levels can still reflect different practice styles.

One limitation of this study was that the cancer diagnosis and co-morbid conditions were acquired from the National Health Insurance claims using ICD-9 codes. These ICD-9 codes could differ from actual condition of the decedents. To decrease the mistakes of coding, the National Health Insurance Bureau in Taiwan randomly reviewed charts and contact with patients to improve the accuracy of diagnosis. Furthermore, some disease diagnoses have been validated in the NHIRD.<sup>31</sup> The data from NHIRD also lack cancer stage, quality of life, laboratory data, and pathology report. However, given the robustness of the evidence and the statistical analysis in this study, these limitations were less likely to compromise the validity of our results.

This study revealed that home-based hospice care was associated with lower EOL expenditure in hospitals with different spending intensity levels. Compared to other countries, the





**FIGURE 2.** Trends of end of life expenditure for cancer decedents with or without home-based hospice care in hospitals with high, medium, and low hospital spending index.

penetration rate of home-based hospice care in Taiwan presents a great opportunity for improvement. Policy makers should consider incentives for home-based hospice care in order to improve its utilization.

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