



Original Article

Effect of hospice care on health-care costs for Taiwanese patients with cancer during their last month of life in 2004–2011: A trend analysis

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ABSTRACT

Objective: End-of-life cancer care imposes a heavy financial burden on patients, their families, and their health insurers. The aim of this study was to explore the 8-year (2004–2011) trends in health-care costs for Taiwanese cancer decedents in their last month of life and, specifically, to assess the association of these trends with hospice care. **Materials and Methods:** We conducted a population-based longitudinal study and analyzed data from Taiwan's National Health Insurance Research Database. The data consisted of not only claims information – costs of hospitalization and outpatient department visits – but also the associated patient characteristics, catastrophic illness status, hospice patient designation, and insurance system exit date (the proxy for death). **Results:** A total of 11,104 cancer decedents were enrolled, and 2144 (19.3%) of these patients received hospice care. The rate of hospice service use increased from 14.9% to 21.5% over 8 years. From 2004 to 2011, the mean health-care cost per day in the last month of life increased 8.2% (from US\$93 ± \$108 in 2004 to US\$101 ± \$110 in 2011; $P = 0001$). We compared three groups of patients who received hospice care for more than 1 month (long-H group), received hospice care for 30 days or less (short-H group), and did not receive hospice care (non-H group). Compared to non-H group, long-H group had a significantly lower mean health-care cost per day during their last month of life (US\$85.7 ± 57.3 vs. US\$102.4 ± 120) ($P < 0001$). Furthermore, compared to short-H and non-H groups, patients in the long-H group had lower probabilities of receiving chemotherapy and visiting the emergency department more than once. They also incurred lower health-care costs (US\$77.1 ± 58.1 vs. US\$92.2 ± 56.0 for short-H group and US\$102.4 ± 120 for non-H group) ($P < 0001$). **Conclusion:** Health-care costs in the last month of life are increasing over time in Taiwan. Nonetheless, health-care costs for patients receiving hospice care can be as much as 16.3% lower than patients not receiving hospice care. Patients receiving hospice care for more than 30 days also had lower health-care costs than those receiving care for <30 days.

KEYWORDS: Cancer, Health-care costs, Hospice, Last month of life

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INTRODUCTION

Cancer is a leading cause of death worldwide and accounted for 8.2 million deaths in 2012 [1]. Despite improvements in diagnostic practices and treatments for cancers, the cancer mortality rate has not been arrested [2]. In Taiwan, 43,665 (28.4%) patients died of cancer in 2012 [3]; similar data have been reported in Canada (29.9%) and the United States (23.3%) [4,5]. Because of this high mortality rate, we must consider near end-of-life (EOL) care a crucial part of the entire cancer treatment program.

The direct health-care costs of treating cancers have markedly increased worldwide [6]. They have also increased

in Taiwan: hospitalization costs increased by 172% from 1999 (US\$3 227 790) to 2007 (US\$5 524 095) [7]. National health expenditures also increased from US\$21.68 billion in 2004 to US\$27.86 billion in 2011. Health care also accounted for approximately 6.5% of Taiwan's gross domestic product in 2011 [8]. These increases have caused financial difficulties for patients and their families and


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impose a considerable burden on Taiwan's health insurance system.

The hospice movement started in 1983, and in 1990, the first hospice was set up in Taiwan [9]. Models of hospice care in Taiwan include inpatient hospice care, hospice team home care, and hospice-shared care [10]. In 1996, the Department of Health (DOH) declared that providing palliative care during EOL, including compliance with a do-not-resuscitate (DNR) order, is appropriate and legally justified. In 1996, the National Health Insurance (NHI) program started to cover hospice home care in its funding program. In 2000, the NHI started subsidizing hospice inpatient care through a per capita and per diem program. By 2004, hospice care was being provided passively in the form of inpatient and home hospice care for patients with advanced cancer. However, hospice care was an underutilized resource, and the coverage rate of hospice care for patients with advanced cancer was 15.4% in 2004 [11]. To improve the rate of coverage, the DOH, in 2004, started a pilot study on providing hospice-shared care. Hospice-shared care was defined as the use of hospice palliative care teams to provide consultation and service to patients with advanced cancer; specifically, to patients admitted to Taiwan's nonhospice care wards since 2005. Thereafter, the coverage rate of hospice care for patients with advanced cancer increased to 44.80% in 2013 [12].

Hospice care aims to provide the highest possible quality of life for patients with a terminal illness. A systemic review paper reported that relative to conventional care, palliative care costs less [13]. In Taiwan, patients with catastrophic illnesses (e.g., cancer) do not make extra payments for health-care services such as outpatient visits, emergency department (ED) visits, and inpatient services; instead, Taiwan's NHI program covers the expense. The price of hospice care in Taiwan is fixed at US\$142 per day for inpatient hospice care and US\$42–48 per home visit and is paid for by the NHI program. A study observed that the median length of stay after hospice enrollment for patients with terminal cancer was 16 days [14]. In this study, we determined the effect of hospice care on health-care costs for patients with advanced cancer during their last month of life.

Our previous study demonstrated that hospice care was associated with better EOL care in patients with advanced cancer [15]. However, the health-care costs in the last month of life for patients with advanced cancer have been understudied. This population-based longitudinal cohort study, thus, examined the health-care costs in the last month of life for patients with advanced cancer. We evaluated trends in health-care costs during an 8-year period (2004–2011) and assessed their association with hospice services. We also compared the aggressiveness of cancer care between patients receiving and not receiving hospice care services.

MATERIALS AND METHODS

Study design and cohort selection

Taiwanese patients with all types of cancers who died between January 1, 2004, and December 31, 2011 were enrolled in our study. Because patients exit the insurance

system upon death, insurance system exit dates were our proxy for the occurrence of death. We excluded patients who died within 30 days of a cancer diagnosis ($n = 613$) because these patients would have had limited opportunity to receive hospice care. We also excluded those who were younger than 20 years of age at their time of death ($n = 20$), had no insurance claims in their last year of life ($n = 514$), or had inaccurate records missing data as well as 95 who were of unknown gender and 129 who had their death dated earlier than their diagnosis.

Data source and identification

In this nationwide population-based cohort study, data obtained from Taiwan's NHI Research Database (NHIRD) were analyzed. Established in March 1995, the NHI program is a single-payer health insurance system that covered up to 99.9% of Taiwan's residents in 2012. The NHI program also has contracts with 97% of medical providers nationwide [16]. We used Taiwan's 2000 Longitudinal Health Insurance Database (LHID2000), which is a subset of the NHIRD containing all original claims data from 1 million patients randomly sampled from the NHIRD in 2000. All patients were linked to the LHID2000 to obtain the hospital care and visit data collected from 1996 to 2012. To verify diagnostic accuracy, Taiwan's Bureau of NHI randomly interviews patients as well as reviews the charts of 1 per 100 ambulatory and 1 per 20 inpatient claims [17].

Cancers were diagnosed according to the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 140.x–239.x. In this study, the cancer diagnoses of patients were confirmed by matching it with their catastrophic illness certificate (CIC). Cancer decedents were identified using an official record of deaths during the study period (2004–2011). Patient comorbidity was determined using the Charlson comorbidity index (CCI), which is computed by examining a patient's ICD-9-CM diagnosis and procedure codes recorded in the year before diagnosis. We used the Deyo method for computations, and the method was applied to inpatient and outpatient claims, following Klabunde *et al.* [18–20].

Variable definitions

Hospice and nonhospice care groups

Patients with advanced cancer were classified into a hospice care group (H group) if their medical records indicated that they had received hospice care (whether inpatient or home hospice care). The H group was further divided into a short-H group comprised patients who received hospice care for 30 days or less and a long-H group comprised patients who received hospice care for more than 30 days. Patients with advanced cancer who had not received hospice care were classified into a nonhospice (non-H) group.

Health-care costs

We calculated each patient's health-care costs by adding the incurred costs of inpatient and outpatient services indicated in their claims records. Originally given in New Taiwan dollars, we expressed the costs in US dollars according to a 2006 exchange rate of US\$1.00 = NT\$32.53 [7].

Socioeconomic status of patients

Socioeconomic status (SES) is a crucial factor in health-care utilization [21,22]. Patients were classified into three subgroups, as previously described in Taiwanese studies [23,24]: low SES patients listed in the claims data are those earning below NT\$20 000 (US\$571) per month, moderate SES patients are those earning between NT\$20 000 and 40 000 (US\$571-1141) per month, and high SES patients are those earning more than NT\$40 000 (US\$1141) per month.

Aggressiveness of end-of-life cancer care

This study considered five indicators of the quality of EOL cancer care during a patient's last month of life: (1) receiving chemotherapy, (2) visiting the ED more than once, (3) being admitted to a hospital for more than 14 days, (4) receiving care in an intensive care unit (ICU), and (5) receiving cardiopulmonary resuscitation (CPR) during their final month of life [25-27]. More aggressive EOL care is considered inappropriate for terminally ill patients. Each indicator indicates a poor quality of care.

Urbanization

Urbanization levels were extracted from the postal codes in the claims data. For our analysis, urbanization levels were divided into urban, suburban, and rural categories.

Hospital characteristics

Whether a patient's treatment facility during the last month of life was a teaching hospital or not was coded. Taiwan's NHI reimbursements for hospice care are fixed for various levels of hospital accreditation.

The study protocol was approved by the Research Ethics Committee of the Buddhist Dalin Tzu Chi Hospital, Taiwan (No. B10301001). Because NHIRD files contain only deidentified secondary data, the review board waived the requirement of informed consent.

Statistical analysis

Group characteristics are described in terms of frequency (percentages) and their mean \pm standard deviation. Categorical variables were analyzed using the Chi-square and Fisher's exact tests. Continuous variables were analyzed using the *t*, Wilcoxon rank-sum, or analysis of variance (ANOVA) tests, as appropriate. The Kaplan-Meier method was used for survival data analyses. Trends in health-care costs during a patient's last month of life for the different groups between 2004 and 2011 were analyzed using ANOVA, and the results were plotted. We also performed multivariable generalized linear regressions for the outcomes of interest – health-care costs and aggressiveness of EOL cancer care.

All statistical analyses were conducted using the R statistical software (version 3.2.3, R Foundation for Statistical Computing, Vienna, Austria). A two-sided $P \leq 0.05$ was considered statistically significant.

RESULTS

Baseline characteristics

A total of 11 104 patients who died of cancer between 2004 and 2011 were enrolled in this study. Figure 1 depicts

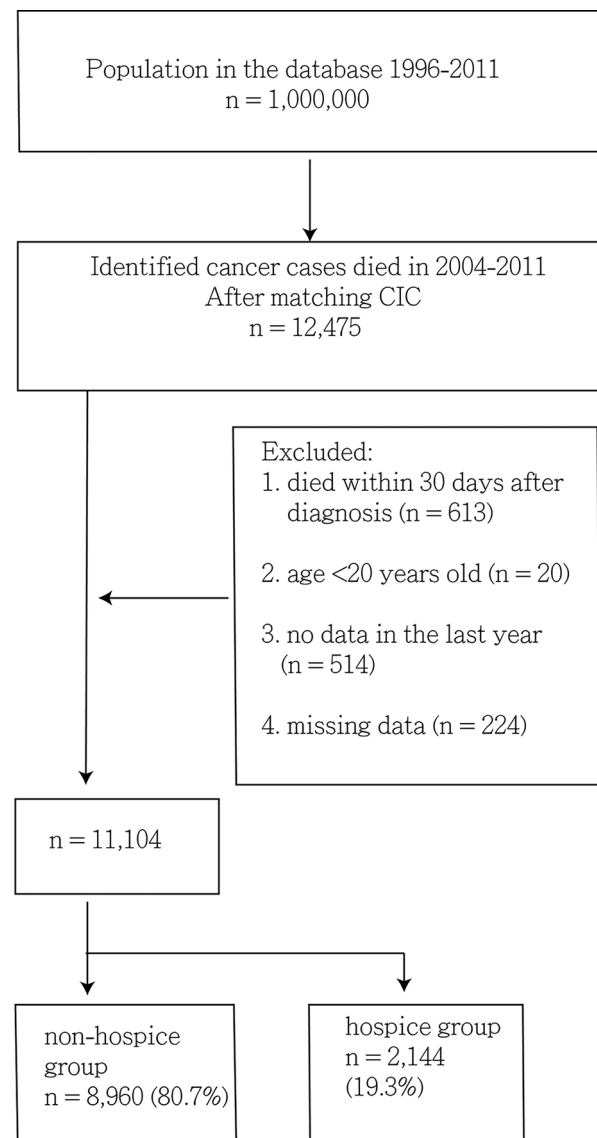


Figure 1: Study flowchart. ICD-9-CM: International Classification of Diseases, ninth revision, Clinical Modification, CIC: Catastrophic illness certificate

a flowchart illustrating how our study was conducted. The study cohort had 2144 (19.3%) patients with advanced cancer who had received hospice care. Table 1 presents a comparison of the baseline demographic data and clinical characteristics between the H and non-H groups. Most cancer decedents were male (64.8%), had a low SES (66.6%), lived in an urban area (52.1%), and had a mean CCI of 4.34 ± 4.00 . Decedents with cancers occurring at sites such as the breasts and pancreas were relatively more likely to receive hospice care, and decedents with cancers occurring at sites such as the liver, prostate, and blood were relatively less likely to receive hospice care. The mean CCI of the H group was higher than that of the non-H group (4.71 ± 4.34 vs. 4.25 ± 3.91 , $P = 0.038$). In teaching hospitals, fewer patients received hospice care than did not ($P = 0.003$). Similar results were obtained after stratifying the H group into the short-H and long-H groups.

Table 1: Baseline demographic and clinical characteristics of cancer decedents in Taiwan between 2004 and 2011

Variables	Total (%)	Non-H group (%)	H group (%)	P	Non-H group (%)	Short-H group (%)	Long-H group (%)	P
n	11,104	8960 (80.7)	2144 (19.3)		8960 (80.7)	1226 (11.0)	918 (8.3)	
Mean age, years	67.18±14.07	67.17±14.11	67.21±13.92	0.884	67.17±14.11	67.14±13.31	67.27±14.69	0.861
Female (%)	3908 (35.2)	3041 (33.9)	867 (40.4)	<0.001	3041 (33.9)	435 (35.5)	432 (47.1)	<0.001
Survival years, after diagnosis*	1.05 (1.14, 2.44)	1.02 (0.39, 2.42)	1.15 (0.50, 2.50)	0.309	1.02 (0.39, 2.42)	1.01 (0.41, 2.39)	1.32 (0.62, 2.72)	<0.001
Cancer type								
Lung	2348 (21.1)	1878 (21.0)	470 (21.9)	0.331	1878 (21.0)	258 (21.0)	212 (23.15)	0.318
Liver	2325 (20.9)	1918 (21.4)	407 (19.0)	0.013	1918 (21.4)	297 (24.2)	110 (12.0)	<0.001
Colorectal	1398 (12.6)	1108 (12.4)	290 (13.5)	0.147	1108 (12.4)	168 (13.7)	122 (13.3)	0.323
Head and neck	1030 (9.3)	847 (9.5)	183 (8.5)	0.199	847 (9.5)	102 (8.3)	81 (8.8)	0.401
Stomach	682 (6.1)	538 (6.0)	144 (6.7)	0.229	538 (6.0)	84 (6.9)	60 (6.5)	0.424
Breast	422 (3.8)	320 (3.6)	102 (4.8)	0.012	320 (3.6)	50 (4.1)	52 (5.7)	0.008
Esophagus	375 (3.4)	311 (3.5)	64 (3.0)	0.287	311 (3.5)	36 (2.9)	28 (3.1)	0.569
Prostate	383 (3.4)	332 (3.7)	51 (2.4)	0.002	332 (3.7)	19 (1.5)	32 (3.5)	<0.001
Pancreas	332 (3.0)	243 (2.7)	89 (4.2)	0.001	243 (2.7)	44 (3.6)	4.5 (4.9)	0.001
Hematologic	307 (2.8)	283 (3.2)	24 (1.1)	<0.001	283 (3.2)	14 (1.1)	10 (1.1)	<0.001
Cervix	191 (1.7)	159 (1.8)	32 (1.5)	0.406	159 (1.8)	11 (0.9)	21 (2.3)	0.025
Others	1311 (11.8)	1023 (11.4)	288 (13.4)	0.010	1023 (11.4)	143 (11.7)	145 (15.8)	0.001
Mean CCI, per point	4.34±4.00	4.25±3.91	4.71±4.34	0.038	4.25±3.91	4.59±4.34	4.87±4.34	<0.001
SES								
LES	7397 (66.6)	5978 (66.7)	1419 (66.2)	0.646	5978 (66.7)	819 (66.8)	600 (65.4)	0.695
MES	3054 (27.5)	2463 (27.5)	591 (27.6)	0.957	2463 (27.5)	332 (27.1)	259 (28.2)	0.842
HES	653 (5.9)	519 (5.8)	134 (6.2)	0.414	519 (5.8)	75 (6.1)	59 (6.4)	0.656
Urbanization level								
Urban	5787 (52.1)	4592 (51.3)	1195 (55.9)	<0.001	4592 (51.3)	680 (55.5)	515 (56.3)	0.001
Suburban	3805 (34.3)	3160 (35.3)	645 (30.2)	<0.001	3160 (35.3)	364 (29.7)	281 (30.7)	<0.001
Rural	1506 (13.6)	1207 (13.5)	299 (14.0)	0.550	1207 (13.5)	181 (14.8)	118 (12.9)	0.385
Teaching hospitals	6124 (56.7)	4990 (57.4)	1134 (53.7)	0.003	4990 (57.4)	637 (52.9)	497 (54.9)	0.067

H group: Advanced cancer patients who ever receiving hospice care (H group) and who did not (non-H group). H group was further divided into short-H group (received hospice care were 30 days or less), and long-H group (received hospice care were <30 days). *Median (first quartile, third quartile) by Kaplan-Meier estimate. CCI: Charlson comorbidity index, SES: Socioeconomic status, LES: Low socioeconomic status, MES: Moderate socioeconomic status, HES: High socioeconomic status

Figure 2 depicts the Kaplan–Meier estimates of survival curves for the H and non-H groups. The median survival probability, expressed in years after diagnosis, of the H group was 1.15 years, which was not significantly longer than that of the non-H group (1.02 years, $P = 0.309$).

Aggressiveness of end-of-life cancer care during the last month of life

In this study, because aggressive cancer care is expensive, we compared the aggressiveness of EOL cancer care between hospice and nonhospice patients. Table 2 depicts the aggressiveness of EOL cancer care during a patient’s last month of life within the study period in Taiwan. CPR (24.6%) was the most frequently received form of aggressive cancer care, followed by chemotherapy (18.1%), ICU care (18.1%), more than one ED visit (17.8%), and a mean hospital stay of 14.5 ± 11.5 days in the last month of life for all cancer decedents. Among cancer decedents, receiving hospice care was associated with a significantly reduced proportion of patients who received CPR (4.6%), chemotherapy (10.0%), and ICU admission (3.9%) compared with patients who did not receive hospice care (29.4%, 20.0%, and 21.5%, respectively, $P < 0.001$). The mean hospital stay in the last month of life for the H group (17.6 ± 10.4 days) was higher than that for the non-H

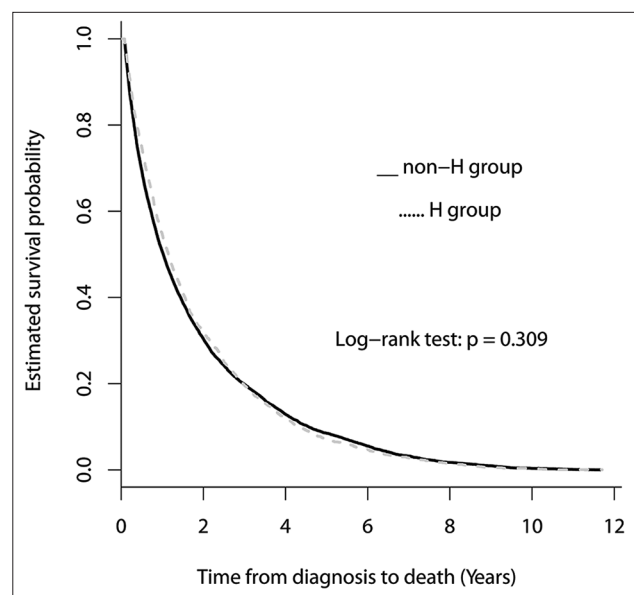


Figure 2: Kaplan–Meier estimates of survival curves for patients who did (H group) and did not receive (non-H group) hospice care

group (13.8 ± 11.7 days, $P < 0.001$). Compared with the other two groups, the long-H group had a lower proportion

of patients receiving chemotherapy and visiting the ED more than once [Table 2].

Trends of hospice care and mean health-care cost in the last month of life between 2004 and 2011

As illustrated in Table 3, the rate of hospice service use increased from 14.9% to 21.5% in the study period. The mean health-care cost per day during the last month of life increased significantly from US\$ 93.3 ± \$108.1 in 2004 to US\$100.9 ± \$110.4 in 2011 (ANOVA, *P* = 0.001); the cost for the H group was significantly lower than that for the non-H group (US\$85.7 ± \$57.3 vs. US\$102.4 ± \$120, *P* < 0.001). The mean health-care cost per day for patients with cancer in the last month of life was US\$99.2 ± 110.9, and the cost for the H group was significantly lower than that of the non-H group [US\$85.7 ± \$57.3 vs. US\$102.4 ± \$120, *P* < 0.001; Table 3].

Figure 3 depicts the trends of health-care costs for Taiwanese cancer decedents of different groups during the last month of life between 2004 and 2011. The mean cost of the long-H group was much lower than that of the other two groups. We also performed multivariable generalized linear regressions for the outcomes of

interest, health-care costs, and aggressiveness of EOL cancer care in the last month of life. Compared with the short-H group and non-H group, the long-H group had a lower mean cost per day

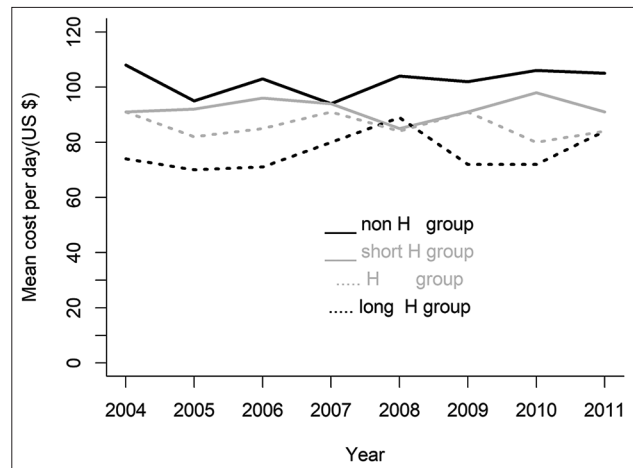


Figure 3: Trends of health-care costs for cancer decedents of different groups during the last month of life in Taiwan between 2004 and 2011

Table 2: The comparison of the aggressiveness of cancer care in the last month of life between H-group, non-H group, short-H group, and long-H group during 2004-2011

Variables	Total	Non-H group	H group	<i>P</i>	Non-H group	Short-H group	Long-H group	<i>P</i>
<i>n</i>	11 104	8960 (80.7%)	2144 (19.3%)		8960 (80.7%)	1226 (11.0)	918 (8.3)	
Chemotherapy	2005 (18.1)	1790 (20.0)	215 (10.0)	<0.001	1790 (20.0)	158 (12.9)	57 (6.2)	<0.001
more than one ED visits	1982 (17.8)	1598 (17.8)	384 (17.9)	0.925	1598 (17.8)	279 (22.8)	105 (11.4)	<0.001
Hospital stay (days)*	14.5±11.5	13.8±11.7	17.6±10.4	<0.001	13.8±11.7	17.0±9.4	18.5±11.5	<0.001
ICU admission	2008 (18.1)	1925 (21.5)	83 (3.9)	<0.001	1925 (21.5)	39 (3.2)	44 (4.8)	<0.001
CPR	2737 (24.6)	2638 (29.4)	99 (4.6)	<0.001	2638 (29.4)	43 (3.5)	56 (6.1)	<0.001

H group: Advanced cancer patients who ever receiving hospice care (H group) and who did not (non-H group). H group was further divided into short-H group (received hospice care were 30 days or less) and long-H group (received hospice care were more than 30 days). *Mean±SD. ED: Emergency department, ICU: Intensive care unit, CPR: Cardiopulmonary resuscitation, SD: Standard deviation

Table 3: The mean health-care costs per day for patients with cancer in the last month of life between H-group, non-H group, short-H group, and long-H group during 2004-2011

Variables	Total	Years									<i>P</i>
		2004	2005	2006	2007	2008	2009	2010	2011		
<i>n</i>	11104	1151	1170	1285	1364	1426	1544	1578	1586		
Hospice care (H group), <i>n</i> (%)	2144 (19.3)	172 (14.9)	195 (16.7)	233 (18.1)	262 (19.2)	299 (21.0)	321 (20.8)	321 (20.3)	341 (21.5)	<0.001	
Short-H group, <i>n</i> (%)	1226 (11.0)	97 (8.4)	127 (10.9)	135 (10.5)	147 (10.8)	168 (11.8)	175 (11.3)	186 (11.8)	191 (12.0)	0.003	
Long-H group, <i>n</i> (%)	918 (8.3)	75 (6.5)	68 (5.8)	98 (7.6)	115 (8.4)	131 (9.2)	146 (9.5)	135 (8.6)	150 (9.5)	<0.001	
Total cost (US \$), mean±SD	99.2±110.9	93.3±108.1	93.1±100	95.6±101.3	97.3±105.1	103.1±110.7	103.9±120.9	102.6±122.4	100.9±110.4	0.001	
Cost (US \$) for H group, mean±SD	85.7±57.3	78.5±61.4	83.9±51.8	86.9±59.6	86.3±57.8	92.4±58.4	84.2±53.1	81.6±54.5	88.6±61.4	0.384	
Cost (US \$) for non-H group, mean±SD	102.4±120	95.9±114.1	94.9±107	97.5±108.3	99.9±113.4	106.0±120.7	109.1±132.6	107.9±133.9	104.3±120.2	0.001	
<i>P</i> *	<0.001	0.273	0.055	0.076	0.080	0.020	0.923	0.812	0.133		
Cost (US \$), Short-H group, mean±SD	92.2±56.0	82.8±47.0	85.6±49.6	89.0±52.3	96.1±59.7	95.7±57.3	92.7±51.9	88.2±56.0	100.8±63.7	0.022	
Cost (US \$), Long-H group, mean±SD	77.1±58.1	72.8±76.1	80.9±56.1	84.1±69.6	73.7±52.9	88.2±59.7	73.9±52.8	72.5±49.7	73.1±54.8	0.298	
Cost (US \$) for non-H group, mean±SD	102.4±120	95.9±114.1	94.9±107	97.5±108.3	99.9±113.4	106.0±120.7	109.1±132.6	107.9±133.9	104.3±120.2	0.001	
<i>P</i> **	<0.001	0.042	0.157	0.139	0.018	0.049	<0.001	<0.001	0.003		

P* for health-care costs comparison between the H group and the non-H group, *P* for health-care cost comparison between the short H group, long H group, and the non-H group. H group was further divided into short-H group (received hospice care were 30 days or less) and long-H group (received hospice care were more than 30 days). SD: Standard deviation

(estimate = -25.87, $P < 0.001$, using linear regression) and lower probabilities of both receiving chemotherapy (odds ratio [OR]: 0.26, 95% confidence interval [CI]: 0.20–0.34) and visiting the ED more than once (>1 ; OR: 0.58, 95% CI: 0.47–0.72), but a higher number of admission days (estimate = 4.70, $P < 0.001$, by linear regression). Both the long-H group and short-H groups had lower probabilities of receiving ICU and receiving CPR than the non-H group [Table 4].

DISCUSSION

The mean health-care cost per day for cancer decedents in their last month of life has significantly increased over time. The magnitude of increase was approximately 16.3% higher for nonhospice patients than for hospice patients. Patients receiving hospice care for more than 30 days have a lower mean cost per day and lower probabilities of receiving chemotherapy and visiting the ED more than once (>1) than those receiving hospice care for <30 days and those not receiving hospice care. The long-H group, however, had more admission days than the other two groups. This might be because, compared with hospice patients, nonhospice patients with advanced cancer were more likely to receive aggressive cancer care, including chemotherapy, ICU admission, and CPR, during their last month of life.

A previous Taiwanese study reported that nominal growth in health-care expenditures was 4.49%, caused primarily by health-care inflation (2.43%) and an aging population (1.68%) [28]. In Taiwan, patients with advanced cancer receive care for their illnesses and related conditions. They do not pay any out-of-pocket fees for their medical care, including inpatient, outpatient, ER, and other costs. However, Taiwan's NHI reimbursements for hospice care were fixed at US\$142 per day for inpatient hospice care and US\$42–48 per home visit before 2015. In the current study, we observed that the mean health-care cost per day in a patient's last month of life increased 8.2% from 2004 to 2011.

The quality of EOL care for patients with advanced cancer was investigated in our previous study. We demonstrated that hospice care provided better EOL care for patients with advanced cancer [15]. Compared to patients not receiving hospice care, a lower proportion of hospice patients receive ICU care, CPR, and chemotherapy. However, despite an equal proportion of hospice and nonhospice patients visiting the ED more than once, hospice patients are more likely to

be hospitalized more than once and to die under hospital care. Thus, hospice care can be a good model for EOL care for patients with advanced cancer in Taiwan. It provides better quality EOL care and lowers health-care costs.

EOL care for patients with cancer constitutes a high proportion of health-care costs. According to the estimates from the United States, 25% of health-care costs are related to care expenses for patients in their last year of life [29]. Chastek *et al.* reported that costs were highest for patients with cancer in their last month of life [30]. In this study, we determined that the mean health-care cost per day during a patient's last month of life significantly increased during 2004–2011. We observed that the mean health-care cost per day in the H group was significantly lower than that in the non-H group; similar findings have been previously reported [13,31–33]. We also observed that the cost was lowest in the long-H group than the other two groups.

Hospice care aims to relieve the pain and suffering of patients with terminal illnesses. Moreover, hospice care is an established model for treating advanced cancer. A review reported that patients who received hospice care exhibited superior symptom control and were more satisfied with their care than those who did not receive hospice care [34]. However, studies are in conflict with regard to the effect of hospice care on EOL cancer care [2,35–39]. Some studies have indicated that hospice care might attenuate the aggressiveness of cancer care during EOL care [35,37]. Another study reported that Taiwanese patients with cancer receiving hospital-based hospice care were significantly less likely to be intubated or to use mechanical ventilators. Nonetheless, no benefits were reported for other aggressive cancer care strategies [36].

We observed that during 2004–2011, hospice patients with advanced cancer were less likely to receive aggressive cancer care, including chemotherapy, ICU admission, and CPR, during their last month of life. Patients who had received these forms of aggressive cancer care incurred higher health-care costs than those who did not. A previous study reported that receiving aggressive cancer care is not always associated with favorable outcomes or a higher quality of life near a patient's EOL [40]. Therefore, during the last month of life, hospice patients incurred lower health-care costs and had a higher quality of life compared with nonhospice patients; a previous study reported similar results [41].

The hospice movement started in 1983, and the first hospice was set up in 1990 in Taiwan [10]. On June 7, 2000,

Table 4: The multivariable generalized linear regressions for the outcome of interest (health-care costs and aggressiveness of end-of-life cancer care) in the last month of life during 2004-2011

	Mean cost per day*	Chemotherapy**	ED, more than one visits (>1)**	Admission days*	ICU**	CPR**
Years, 2004 as reference	1.68 (<0.001)	1.09 (1.07-1.12) (<0.001)	1.05 (1.03-1.08) (<0.001)	-0.004 (0.941)	1.00 (0.98-1.03) (0.692)	0.98 (0.96-1.00) (0.063)
Short-H versus non-H group	-10.64 (0.002)	0.58 (0.49-0.69) (<0.001)	1.34 (1.16-1.55) (<0.001)	3.22 (<0.001)	0.12 (0.09-0.17) (<0.001)	0.09 (0.06-0.12) (<0.001)
Long-H versus non-H group	-25.87 (<0.001)	0.26 (0.20-0.34) (<0.001)	0.58 (0.47-0.72) (<0.001)	4.70 (<0.001)	0.18 (0.14-0.25) (<0.001)	0.16 (0.12-0.21) (<0.001)

*Linear regression, the data were expressed as estimate (P), **Logistic regression, the data were expressed as odds ratio (95% confidential interval) (P). ED: Emergency department, ICU: Intensive care unit, CPR: Cardiopulmonary resuscitation

the government passed the Natural Death Act (Hospice Palliative Care Act), allowing advanced medical directives to forgo CPR and legalizing palliative hospice care for patients with terminal illnesses [42]. Thus, either patients with advanced cancer or their families would typically sign a DNR form before receiving hospice care. This might explain why a significantly lower proportion of hospice patients received ICU care, CPR, and chemotherapy compared with nonhospice patients in Taiwan.

In this study, we observed that compared to nonhospice patients during the last month of life, hospice patients had longer hospital stays despite visiting the ED less. These results differ from a previous study by Dudgeon *et al.*, which determined that the palliative care program reduced hospitalization and ED visits [38]. An explanation might be that although home hospice services had been provided in Taiwan, patients requiring hospice services might have received inpatient hospice care instead.

We offer the following suggestions. First, for patients with advanced cancer, provide additional programs for home hospice care in future to reduce the rate of ED visits and hospitalization in their last month of life. Second, physicians ought to be more realistic in predicting their patients' chances of surviving advanced cancer. As physicians tend to overestimate these chances, they may not realize when EOL is approaching [43]. Third, provide education on anticipating and coping with crises for patients and their families in the last month of life. Policy-advisers and policy-makers have been studying the policies and experiences of other countries, gleaning highly relevant knowledge of EOL cancer care that could support educational efforts.

Limitations

This study has some limitations. First, measures that backtrack from the time of death are retrospective, and real-time prospective decisions are required. Second, there might be misclassification bias because of the accuracy of some of our variables such as the comorbidity score. Third, our patients were not randomized into the H and non-H groups for comparison. Fourth, risk factors related to the aggressiveness of cancer care (such as clinical symptoms and signs, patient and family preferences, and DNR designation) were not recorded in the claims database. Fifth, patients receiving hospice care for <1 month were also classified into the H group. The lower occurrence of aggressive cancer care might have caused us to underestimate the H group's health-care costs. Sixth, patients with catastrophic illness certifications did not pay any out-of-pocket expenses for any care for their illnesses and related conditions received in Taiwan. Determining the amount of out-of-pocket expenses for a patient with advanced cancer is, thus, an important issue for further investigation. Seventh, information about these expenses were not obtained from claims data. Finally, future studies should also compare costs of care between the major cancers.

CONCLUSION

In Taiwan, the health-care costs in a patient's last month of life continue to increase. However, on average, patients

receiving hospice care services have approximately 16.3% lower health-care costs than patients not receiving hospice care. Patients receiving hospice care for more than 30 days incurred lower costs than those receiving hospice care for <30 days. We, therefore, suggest hospice promotion to reduce health-care costs and give patients better quality care during EOL.

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Conflicts of interest

There are no conflicts of interest.

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