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Association between palliative care and end-of-Life care for patients with hematological malignancies

A population-based study

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Abstract

To date, few studies have examined the end-of-life (EOL) care for patients with hematological malignancies (HMs). We evaluated the effects of palliative care on the quality of EOL care and health care costs for adult patients with HMs in the final month of life.

We conducted a population-based study and analyzed data from Taiwan's Longitudinal Health Insurance Database, which contains claims information for patient medical records, health care costs, and insurance system exit dates (our proxy for death) between 2000 and 2011.

A total of 724 adult patients who died of HMs were investigated. Of these patients, 43 (5.9%) had received only inpatient palliative care (i-Pal group), and 19 (2.6%) received home palliative care (h-Pal group). The mean health care costs during the final month of life were not significantly different between the non-Pal and Pal groups (p=0.315) and between the non-Pal, i-Pal, and h-Pal groups (p=0.293) either. By the multivariate regression model, the i-Pal group had lower risks of chemotherapy, ICU admission, and receipt of CPR, but higher risks of at least two hospitalizations and dying in hospital after adjustments. The h-Pal group had the similar trends as the i-Pal group but lower risk of dying in hospital after adjustments.

Patients with HMs who had received palliative care could benefit from less aggressive EOL cancer care in the final month of life. However, 8.6% patients with HMs received palliative care. The related factors of more hospitalizations and dying in hospital warrant further investigation.

Abbreviations: AUC = area under the receiver operating characteristic curve, CCI = Charlson comorbidity index, CIC = catastrophic illness certificate, CKD = chronic kidney disease, CPR = cardiopulmonary resuscitation, DNR = do not resuscitate, EOL = end-of-life, ER = emergency room, ICU = intensive care unit, NHI = National Health Insurance, NHIRD = National Health Insurance Research Database, QI = quality indicator.

Keywords: end-of-life care, hematological malignancy, palliative care

1. Introduction

The incidence of hematological malignancies (HMs) in Taiwan is markedly lower than that in Western countries, but it had a drastically increasing trend in recent decades.[1] In Taiwan, the percentage of HMs among all cancer deaths was 4.53% and HMs were the seventh most common cause of cancer-related deaths in 2012.[2] Despite advancements in diagnosis and treatment, mortality due to HMs is not decreased. A previous study reported that the mean number of symptoms and level of distress were comparable to those patients with metastatic non-hematological malignancy.[3] In addition, patients with HMs were often treated with intensive antineoplastic regimens until the last days of life.[4] Under some medical conditions such as infections, cytopenias, and coagulopathies, patients with HMs needed frequent hospitalizations, invasive investigations, monitoring and therapies.[5,6] A cohort study reported that patients with HMs received more inappropriate care during end-of-life (EOL) care.[7] Continued efforts are needed to improve the provision of quality EOL care for patients with HMs.

Palliative care is an interdisciplinary approach to symptom management, psychological support, and treatment decision-making for patients with serious illnesses and their family members. More evidence highlights that patients with cancer could benefit greatly from palliative care, which can reduce

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symptom burden,[8] improve quality of life and mood,[9,10] increase the likelihood of survival,[10,11] and improve outcomes for caregivers as well as for patients.[12,13] In addition, the palliative care services may assist hematologists in the management of their patients' suffering and quality of life during the timing of increased symptom burden for patients with HMs.[3] In Taiwan, there are no residential facilities to provide hospice care. "Palliative care" encompasses much more than just EOL or hospice care.[13] In the current study, palliative care included hospital-based inpatient care, outpatient services, and home care.

Six QIs of EOL cancer care have been developed and are outlined as follows: undergoing chemotherapy during the last 2 weeks of life, having more than 1 emergency room (ER) visits in the final month of life, being admitted to a hospital at least twice in the final month of life, receiving intensive care unit (ICU) care in the final month of life, receiving cardiopulmonary resuscitation (CPR) in the final month of life, and dying in a hospital.[14,15] These QIs have been adopted in the United States,[16] Canada,[17] and Taiwan[18] and are considered as aggressive EOL cancer care. All indicators are considered to indicate poor quality care. More aggressive EOL care is considered inappropriate for the terminally ill patients.[17] Inappropriate EOL care was examined by a composite score adapted from Tang et al.[19] Therefore, measuring the score is crucial for evaluating the quality of palliative care programs. In this study, we used Taiwan's National Health Insurance Research Database (NHIRD) to evaluate the impact of palliative care on QIs of EOL cancer care and health care costs for patients with HMs in the final month of life.

2. Methods

2.1. Data source

Taiwan's National Health Insurance (NHI) program was implemented in March 1995; it is a single-payer program that covered as many as 99.9% of Taiwan's residents in 2012.[20] Taiwan's NHI has the unique characteristics of universal insurance coverage, comprehensive services (including medications, home care, even Chinese herbal medicine therapy) provided, and a single-payer system with the government as sole insurer. Patients have free access to any health care system and provider they choose. Health care systems are reimbursed for services provided, and copayment is waived for patients with examined catastrophic illness certificate (CIC), including malignancy. In the present study, patient data were linked to Taiwan's 2000 Longitudinal Health Insurance Database (LHID2000), a subset of the NHIRD. The LHID2000 contains all original claims data for 1 million individuals randomly sampled from the 2000 NHIRD Registry. All patients who had a diagnosis of hematological malignancies with matching CIC between January 1, 2000 and December 31, 2011 were included in our study. We followed patients with HMs until December 2012 by using the LHID2000. Claims data included medical records (inpatient care, outpatient records, and home care) of patients who had and had not received palliative care. Patients under 20 years old and those who had died within 1 month after HM diagnosis were excluded. The International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes (200–208) and A codes (A140, A141, and A149) were used to define HMs. To increase the validity of diagnoses of diabetes or hypertension, we defined patients with these conditions as those with 3 reported diagnoses of diabetes or three instances of hypertension in their medical claims data based on the ICD-9-CM or A codes for these disease entities.[21,22]

2.2. Variables

Patient characteristics included age, sex, age at death, median (range) survival in years after HM diagnosis, chemotherapy (the chemotherapy was assumed whenever there was an order for a reimbursement code of oral or intravenous chemotherapy during the period of study), geographic location,[23] level of urbanization, and whether diagnosis was made at a teaching hospital (Table 1). Comorbid conditions listed in the Charlson comorbidity index (CCI) and common comorbidities (e.g., diabetes, hypertension, stroke, and chronic kidney disease) were identified based on ICD-9-CM codes.[24]

2.3. Variable definitions

Inpatient palliative, home palliative, palliative, and nonpalliative care groups: We searched the claim data for the reimbursement codes of inpatient palliative care and home palliative care. Among the claim data, patients with the codes for inpatient palliative care and without the codes for home palliative care were classified as inpatient palliative (i-Pal) group. If patients were with the codes for home palliative care, they were classified as home palliative (h-Pal) group. Accordingly, these inpatient palliative units also served as the back-up system for patients receiving home palliative care when they experienced exacerbating symptoms that required further readmission to the palliative unit or whose families needed respite care from caregiving. Patients of i-Pal group and h-Pal group were combined into the Pal groups. Patients with HMs who had not received palliative care were categorized as non-palliative group (non-Pal group).

2.3.1. Charlson comorbidity index (CCI). We calculated CCI scores by examining ICD-9-CM-based diagnoses and procedure codes recorded using the Deyo method. We subsequently applied calculated indices to inpatient and outpatient claims reported by Klabundle et al.[25,26]

2.3.2. Health care costs. We calculated each patient's health care costs by summing the inpatient service and outpatient service costs listed in his or her claims records. We converted these costs based on the average U.S. Dollar to New Taiwan Dollar exchange rate in 2006 (US$1.00 = NT$32.53).

2.3.3. Socioeconomic status (SES). According to the procedures described in a previous study,[27] the income categories are generally representative of the 5 income groups in Taiwan in 2005.[28] In this study, we classified socioeconomic status (SES) as three groups: the low SES group comprised patients earning less than US$922 (NT$30,000) per month, the moderate SES group comprised patients earning between US$922 and US$3074 (NT $30,000–100,000) per month, and the high SES group comprised patients earning more than US$3074 (NT$100,000) per month.

2.3.4. Aggressive EOL care and composite scores. Aggressiveness of EOL care was examined using a composite measure adapted from Earle et al.[14] The following 6 QIs of EOL cancer care in the final month of life were employed: chemotherapy within the final 2 weeks of life; more than one ER visit, more than 1 hospitalization, ICU admission, and CPR during the final

Table 1

Demographic characteristics of patients with hematological malignancies by palliative utilization.

Variables	Total	Non-Pal group No. (%)	Pal group No. (%)	*P* value	Non-Pal group No. (%)	i-Pal group No. (%)	h-Pal group No. (%)	*P* value
Total	724	662 (91.4%)	62 (8.6%)		662 (91.4%)	43 (5.9%)	19 (2.6%)	
Disease types				.156				.299
Leukemia	292 (40.3%)	272 (41.1%)	21 (33.9%)		272 (41.1%)	16 (37.2%)	5 (26.3%)	
Lymphoma	316 (43.6%)	285 (43.1%)	30 (48.4%)		285 (43.1%)	20 (46.5%)	10 (52.6%)	
Multiple myeloma	116 (16.0%)	105 (15.8%)	11 (17.8%)		105 (15.8%)	7 (16.3%)	4 (21.1%)	
Gender				.226				.390
Female	304 (42.0%)	273 (41.2%)	31 (50.0%)		273 (41.2%)	22 (51.2%)	9 (47.4%)	
Male	420 (58.0%)	389 (58.8%)	31 (50.0%)		389 (58.8%)	21 (48.8%)	10 (52.6%)	
Age, years	69.4 (20.1-97.4)	68.8 (20.1-97.4)	76.1 (23.5-92.1)	<.001	68.8 (20.1-97.4)	76.2 (23.5-92.1)	75.9 (30.4-84.9)	<.001
Age at diagnosis, years	68.2 (16.1-97.2)	67.3 (16.1-97.2)	75.2 (21.0-91.4)	<.001	67.3 (16.1-97.2)	74.4 (21.0-91.4)	75.5 (25.0-84.4)	<.001
Survival,* years	0.74 (0.08-9.94)	0.75 (0.08-9.94)	0.67 (0.09-5.85)	.377	0.75 (0.08-9.94)	0.71 (0.09-5.86)	0.63 (0.10-5.32)	.600
CCI	2 (2-16)	2 (2-16)	2 (2-6)	.758	2 (2-16)	2 (2-6)	2 (2-6)	.948
Diabetes	101 (14.0%)	87 (13.1%)	14 (22.6%)	.053	87 (13.1%)	9 (20.9%)	5 (26.3%)	.085
Hypertension	126 (17.4%)	114 (17.2%)	12 (19.4%)	.726	114 (17.2%)	7 (16.3%)	5 (26.3%)	.546
Stroke	92 (12.7%)	82 (12.4%)	10 (16.1%)	.423	82 (12.4%)	8 (18.6%)	2 (10.5%)	.453
CKD	45 (6.2%)	41 (6.2%)	4 (6.5%)	.789	41 (6.2%)	3 (7.0%)	1 (5.3%)	.904
Hemodialysis history	53 (7.3%)	51 (7.7%)	2 (3.2%)	.304	51 (7.7%)	1 (2.3%)	1 (5.3%)	.459
Socioeconomic status								
HSS	42 (5.8%)	39 (5.9%)	3 (4.8%)	1	39 (5.9%)	2 (4.7%)	1 (5.3%)	1
MSS	160 (22.1%)	156 (23.6%)	4 (6.5%)	.001	156 (23.6%)	2 (4.7%)	2 (10.5%)	.003
LSS	522 (72.1%)	467 (70.5%)	55 (88.7%)	.002	467 (70.5%)	39 (90.7%)	16 (84.2%)	.005
Urbanization								
Urban	378 (52.2%)	337 (50.9%)	41 (66.1%)	.024	337 (50.9%)	28 (65.1%)	13 (68.4%)	.076
Suburban	247 (34.1%)	230 (34.7%)	17 (27.4%)	.265	230 (34.7%)	12 (27.9%)	5 (26.3%)	.583
Rural	99 (13.7%)	95 (14.4%)	4 (6.5%)	.119	95 (14.4%)	3 (7.0%)	1 (5.3%)	.300
Teaching hospital at diagnosis	450 (62.2%)	418 (63.1%)	32 (51.6%)	.077	418 (63.1%)	24 (55.8%)	8 (42.1%)	.125

Pal group, i-Pal group, h-Pal group, non-Pal group: patients with hematological malignancies were categorized into the palliative group (Pal group) if patients received palliative care before death, and the non-palliative group (non-Pal group) if patients without palliative care before death. Pal group further categorized into the inpatient palliative group (i-Pal group) if patients received inpatient palliative, and the home palliative group (h-Pal group) if patients received home palliative care.

CCI = Charlson co-morbidity index, CKD = chronic kidney disease, HSS = high socioeconomic status, LSS = low socioeconomic status, MSS = moderate socioeconomic status.

All continuous variables were descripted with median and range.

* By Kaplan–Meier method, median probability (range). *P* value was tested by log-rank test.

month of life; and dying in hospital. Instead of using this measure to determine the occurrence for any of the above 6 indicators, we scored 1 point per indicator per person. Composite scores ranged from 0 to 6, with a higher score indicating more aggressive EOL care, as adapted from Tang et al.[19] In these recent years, aggressive EOL care was considered as inappropriate EOL cancer care.

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

2.4. Statistical analysis

All statistical analyses were performed using R version 3.0.2 (R Foundation for Statistical Computing, Vienna, Austria). A two-sided *P* value of ≤.05 was considered statistically significant. The distributional properties of continuous variables and categorical variables were expressed as the median (range) or frequency (percentage). Survival was defined as the time from HMs diagnosis until death. The Kaplan–Meier estimator was used to measure the survival probabilities of patients after HMs diagnosis and tested using the log-rank test.[29] Normality was examined using the Shapiro–Wilk test. In the univariate analysis, Wilcoxon rank-sum test, Kruskal-Wallis rank sum test, chi-squared test, and Fisher's exact test were conducted to examine differences in the distributions of continuous variables and categorical variables between 2 or 3 groups. We assessed patients' demographic and clinical characteristics, including age, sex, CCI score, geographic area of residence, and treatment modality (Tables 1 and 2).

A multivariate analysis was conducted by fitting multiple logistic regression models with the stepwise variable selection procedure to determine vital predictors of QIs during the final month of life. Generalized additive models were fitted to detect the potential nonlinear effects of continuous covariates and determine appropriate cutoff points for discretizing continuous covariates if necessary, during stepwise variable selection.

We assessed the goodness of fit of the final logistic regression model based on the estimated area under the receiver operating characteristic curve (AUC) (also called the "*c*-statistic"). In practice, a *c*-statistic value (c = 0–1) of ≥0.7 suggests an acceptable level of discriminatory power. Statistical tools for regression diagnostics, including multicollinearity checking, were applied to ascertain any problems associated with the regression model or data.

Table 2

The comparison of the inappropriate cancer care and health care costs in the last month of life between Pal-group, i-Pal group, h-Pal group, and non-Pal group during 2000 to 2011.

Variables	Total No. (%)	Non-Pal group No. (%)	Pal group No. (%)	*P* value	Non-Pal group No. (%)	i-Pal group No. (%)	h-Pal group No. (%)	*P* value
Number of subjects (%)	724	662 (91.4%)	62 (8.6%)		662 (91.4%)	43 (5.9%)	19 (2.6%)	
Chemotherapy* in last 2 wk	236 (32.6%)	233 (35.2%)	3 (4.8%)	<.001	233 (35.2%)	2 (4.7%)	1 (5.3%)	<.001
≥2 ER visits†	365 (50.4%)	330 (49.8%)	35 (56.5%)	.354	330 (49.8%)	23 (53.5%)	12 (63.2%)	.492
≥2 Hospitalizations†	129 (17.8%)	109 (16.5%)	20 (32.3%)	.005	109 (16.5%)	13 (30.2%)	7 (36.8%)	.008
ICU admission†	196 (27.1%)	193 (29.2%)	3 (4.8%)	<.001	193 (29.2%)	1 (2.3%)	2 (10.5%)	<.001
CPR†	267 (36.9%)	261 (39.4%)	6 (9.7%)	<.001	261 (39.4%)	4 (9.3%)	2 (10.5%)	<.001
Dying in hospital†	403 (55.7%)	360 (54.4%)	43 (69.4%)	.024	360 (54.4%)	34 (79.1%)	9 (47.4%)	.004
Inappropriate end-of-life care score				.013				.314
0	95 (13.1%)	89 (13.4%)	6 (9.7%)	.554	89 (13.4%)	3 (7.0%)	3 (15.8%)	.440
1	158 (21.8%)	138 (20.8%)	20 (32.3%)	.052	138 (20.8%)	15 (34.9%)	5 (26.3%)	.079
2	169 (23.3%)	149 (22.5%)	20 (32.3%)	.086	149 (22.5%)	14 (32.6%)	6 (31.6%)	.207
3	156 (21.5%)	142 (21.5%)	14 (22.6%)	.872	142 (21.5%)	10 (23.3%)	4 (21.1%)	.966
4	110 (15.2%)	108 (16.3%)	2 (3.2%)	.003	108 (16.3%)	1 (2.3%)	1 (5.3%)	.012
5	24 (3.3%)	24 (3.6%)	0	.254	24 (3.6%)	0	0	.557
6	12 (1.7%)	12 (1.8%)	0	.613	12 (1.8%)	0	0	1
Sum of score	2 (0-6)	2 (0-6)	2 (0-4)	.018	2 (0-6)	2 (0–4)	2 (0–4)	.049
Cost (US $)	3792 (0-43783)	3900 (0-43783)	3096 (0-13762)	.315	3900 (0-43783)	3368 (0-13762)	2681 (0-4738)	.293
Hospital stay in the last month of life (days)	19 (0-30)	18.5 (0-30)	20 (0-30)	.112	18.5 (0-30)	22 (0-30)	17 (0-30)	.079

Pal group, i-Pal group, h-Pal group, non-Pal group: patients with hematological malignancies were categorized into the palliative group (Pal group) if patients received palliative care before death, and the non-palliative group (non-Pal group) if patients without palliative care before death. Pal group further categorized into the inpatient palliative group (i-Pal group) if patients received inpatient palliative, and the home palliative group (h-Pal group) if patients received home palliative care.

All continuous variables were descripted with median and range.

* Receiving chemotherapy within 14 d before death.

† These quality indicators were within the last month of life.

CPR = cardiopulmonary resuscitation, ER = emergency room, ICU = intensive care unit.

3. Results

A total of 724 patients with HMs aged ≥20 years who died in 2000–2011 were analyzed. A total of 62 patients (8.6%) had received palliative care (Pal group) and 662 had not (non- Pal group). Among the Pal group, 43 (69.4%) had received only inpatient palliative care (i-Pal group), and 19 (30.6%) received home palliative care (h-Pal group). The median duration from the day of receiving palliative care until death was 40.3 (range: 0-369) days in the Pal group, with 15 patients (24.2%) receiving palliative care for less than 7 days, 22 patients (35.5%) receiving palliative care for more than 30 days, 7 patients (11.3%) receiving palliative care for more than 3 months, and 4 patients (6.5%) receiving palliative care for more than 6 months after enrollment. The study flowchart was shown in Figure 1.

The median age at diagnosis of the patients in the Pal group was older than that of the patients in the non-Pal group (76.1 vs 68.4 years; $P < .001$). Compared with the non-Pal group, the Pal group had significantly higher proportions of patients with low SES ($P = .002$) and those living in urban areas ($P = .024$). Trend was still similar after separating the Pal group into the i-Pal and h-Pal groups (Table 1). Kaplan–Meier survival analysis revealed that the median probability of survival after diagnosis did not differ between the 2 groups (0.75 and 0.67, respectively; $P = .377$; Fig. 2), even the 3 groups ($P = .585$). Six QIs of EOL cancer care and health care costs in the final month of life were compared between the Pal and non-Pal groups (Table 2). The median composite scores were not significantly different between Pal and non-Pal groups (2 vs 2, $P = .758$). Compared with the non-Pal group, the Pal group had lower proportions of patients receiving chemotherapy in the final 2 weeks of life (4.8% vs 35.2%; $P < .001$), those requiring ICU admission (4.8% vs 29.2%; $P < .001$), and those requiring CPR (9.7% vs 39.4%; $P < .001$). However, compared with the non-Pal group, the Pal group had significantly higher proportions of patients requiring more than 1 hospitalization (32.3% vs 16.5%; $P = .005$) and those who died in hospital (69.4% vs 54.4%; $P = .024$). No difference in patients requiring more than 1 ER visit was observed (56.5% vs 49.8%; $P = .354$). The median health care cost per person during the final month of life between the Pal group and the non-Pal group were not significantly different (US$3096 [0-13762] vs US$3900 [0-43783], $P = .315$). Similar results were found after separating the Pal group into i-Pal group and h-Pal group.

The significant factors related to the aforementioned 6 QIs of EOL care were explored through multivariate logistic regression (Table 3). The factors listed in Tables 1 and 2 were entered into these models. The i-Pal group had lower risk of receiving chemotherapy in the last 2 weeks (OR, 0.11; 95% CI, 0.02–0.63; $P = .013$), admitting to ICU (OR, 0.03; 95% CI, 0.004–0.30; $P = .002$), receiving CPR (OR, 0.13; 95% CI, 0.04–0.40; $P < .001$), but had higher risk of at least 2 hospitalization (OR, 2.44; 95% CI, 1.11–5.39; $P = .027$), higher risk of dying in hospital (OR, 2.49; 95% CI, 1.07–5.77; $P = .034$). The h-Pal group had the same trends as the i-Pal group but lower trend of dying in hospital (OR, 0.79; 95% CI, 0.25–2.54; $P = .698$). All AUCs were also calculated.

4. Discussion

The novel finding in this study was that patients with HMs receiving palliative care had less inappropriate EOL cancer care in the final month of life. The contributing factors might be

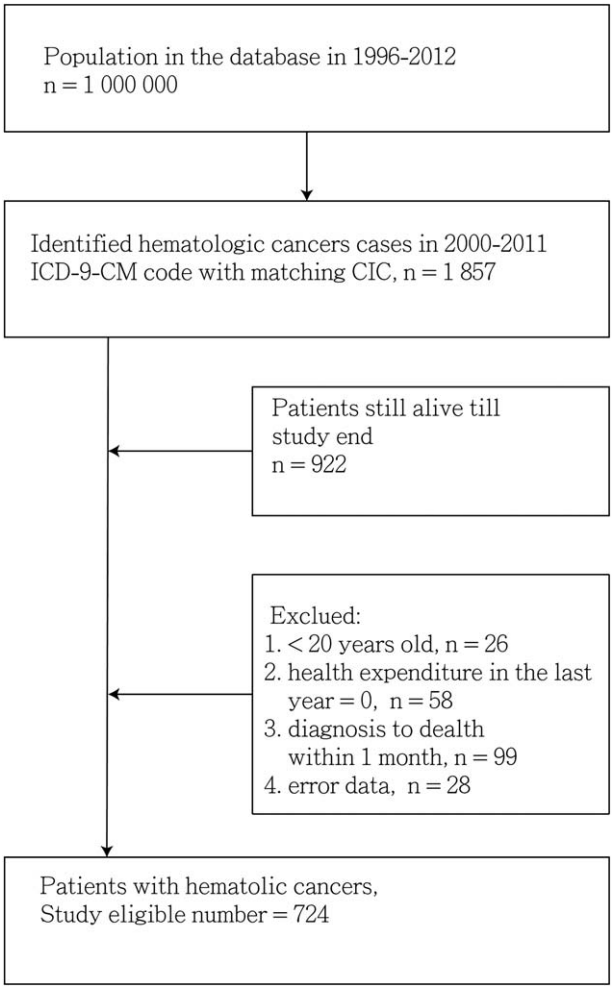

Figure 1. Study flowchart. CIC = catastrophic illness certificate, ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification.

associated with a significant decrease in the proportions of patients receiving chemotherapy during the final 2 weeks of life, those admitted to the ICU in the final month of life, and those receiving CPR in the final month of life. In addition, 35.5% patients of the Pal group survived for more than 30 days after receiving palliative care. Another novel finding of the present study was that the median probability of survival after diagnosis was not compromised in patients who received palliative care. However, palliative care use for patients with HMs was 8.6%, and patients receiving palliative care were more likely to be hospitalized or die in hospital.

Patients with HMs had more conditions, such as antineoplastic regimens, infections, cytopenias, and coagulopathies during the end of life, and these patients need more frequent ER visits and hospitalizations. However, the palliative care teams may assist hematologists in the management of their patients' suffering and quality of life during the timing of increased symptoms burden.[3] In Taiwan, palliative care programs include both inpatient and home care models and have been available since 1990 for patients with serious illnesses without an absolute limitation of predicted survival duration.[30] Palliative care is covered by NHI, adopted palliative chemotherapy or radiotherapy, and included inpatient and home services. Thus, patients requiring inpatient palliative care were admitted to hospitals in Taiwan. Although most EOL quality measures were met by hematological oncologists, the quality of indicators, such as at least 2 hospitalizations and dying in hospital was not decreased in this model. We suggest that the QI of hospitalization during EOL care could be modified to days of hospital stay in the final month of life. In this study, we found that days of hospital stay in the final month of life did not differ between the Pal and non-Pal groups. One of the reasons of more hospital stays might be patients with HMs and those with solid tumors had significant symptom burden at the time of referral for palliative care, and patients with HMs exhibited more substantial drowsiness and tiredness than did those with solid tumors.[31] Previous study reported that patients receiving home-based palliative care was associated with a significant reduction of dying in a hospital.[32] In this study, we further separated the palliative group into h-Pal group and i-Pal group. We found that the h-Pal group had the similar trends as i-Pal group, but had lower trend of dying in hospital after adjustments. It might be due to the small sample size for h-Pal group to reach significant. In this study, we also found the median survival for patients with HMs was 0.74 years, which was different from previous report. The 5-year survival rate was 51.1% for patients with chronic lymphocytic lymphoma during 1990 to 2004, in Taiwan.[33] On account that those patients with HMs being alive at the end of this study were excluded, the selection bias might exist.

Another issue in care of patients with HMs is how to increase the proportion of patients with HMs who receive palliative care. Although the patients with HMs in this study who received palliative care benefited from it during EOL care, we found that palliative care use was 8.6% among patients with HMs. A cohort study reported that 8.0% of the patients with HMs had received inpatient palliative care in the United States.[7] A previous study reported that 19.9% patients with lung cancer received inpatient palliative care in Taiwan.[34] An integrative systemic review study reported that palliative care for patients with HMs is often limited to the EOL phase with late referral to palliative care.[35] Previous studies have reported that HMs were associated with inappropriate cancer-directed care during EOL care and under-use of palliative care.[16,36,37] Possible reasons for lesser use of care on palliative wards are

(1) patients maintaining strong relationships with their oncologists and not wishing their care to become fragmented,
(2) lower severity of symptoms among patient with HMs, and
(3) oncologists tending toward optimism in their prognostication for patients with advanced cancers.[38]

Identification of when the EOL period begins in patients with HMs is crucial for hematological oncologists. In a previous study conducted as a series of focus groups with hematological oncologists, researchers reported that the factors influencing initiation of EOL care for patients with HMs were age, comorbidities, and performance status; the researchers also found that disease-directed treatments were causing a significant decline in patient quality of life.[39] Other barriers included hematologic oncologists' attitudes and beliefs toward EOL care and patients' and their family members' preferences.[40]

There are limited data regarding the quality of EOL care for patients with HMs. Previous study reported that translating evidence into action improve chronic illness care.[41] The successful approaches included provider-oriented components, such as continuing education or physician feedback, information systems changes, and patient-oriented interventions.[41] We could

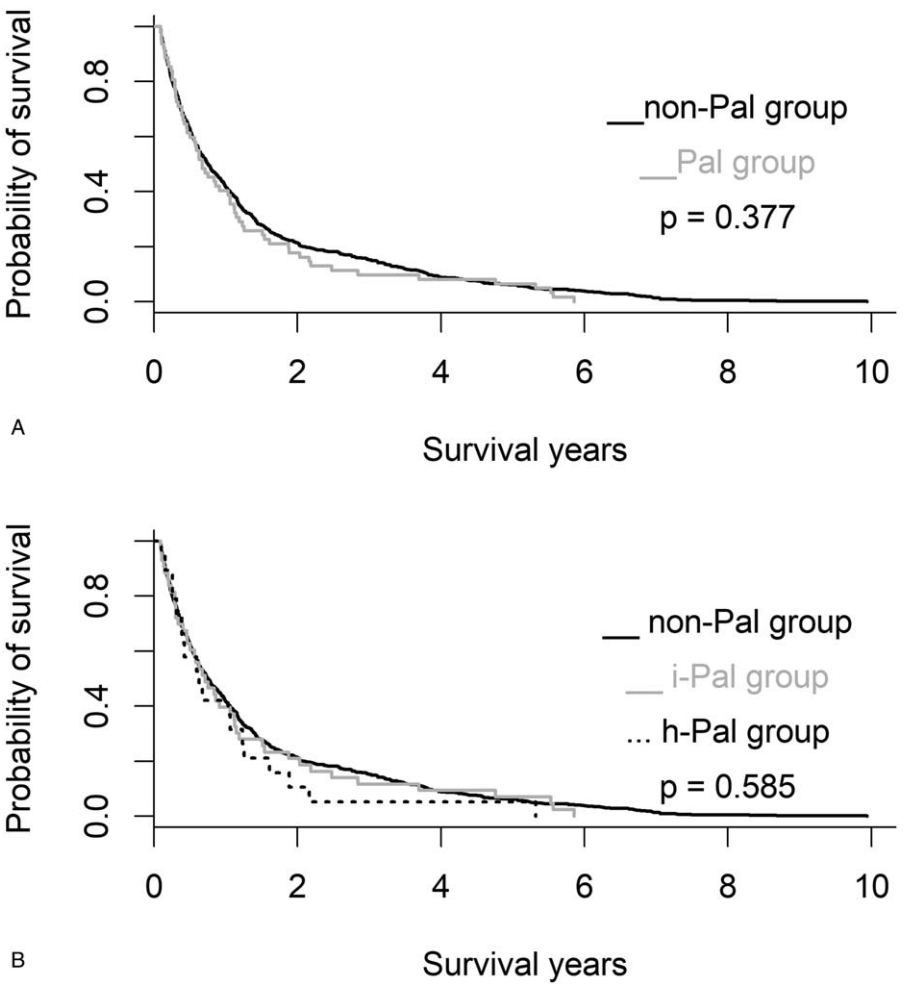

Figure 2. (A) Kaplan–Meier estimates of survival curves for the Pal and non-Pal groups. The median survival probabilities in years after diagnosis were 0.75 years for the Pal group and 0.67 years for the non-Pal group ($P = .377$). (B) Kaplan–Meier estimates of survival curves for the i-Pal, h-Pal, and non-Pal groups.

learn from this model of improving chronic illness care. A potential method for increasing palliative care use is the timing of integrating palliative care. In 2012, the American Society of Clinical Oncology offered a guideline update on the integration of palliative care into standard oncologic care.[42] The guideline update recommended that inpatients and outpatients with advanced cancers should receive dedicated palliative care as early as possible in the disease course alongside standard oncologic care.[43] One study reported that patients with HMs had considerable physical and psychological symptom burden and the most appropriate time to introduce palliative care might be during increased symptom burden.[3] Prospective studies evaluating earlier implementation of palliative care with standard care of HMs are warranted. Another potential method was to reinforce the criteria (the indicators of EOL cancer care) that the health care team should follow to define the final decisions to continue or discontinue treatment in the EOL cancer care. Further studies should also look into patient reported quality of life outcomes.

4.1. Limitations

HMs were defined as incurable diseases at presentation or relapsed/refractory status.[7] The information about the staging of HMs was not obtained in the claimed data, and it is a major limitation in current study. We classified HMs as leukemia, lymphoma, and multiple myeloma. The numbers of these 3 subgroups would be too small to analyze. Additionally, this was another major limitation in current study. This study had other limitations. First, our cohort being restricted to adult patients might have limited the generalizability of our findings to people younger than 20 years of age. Second, misclassification bias may have occurred because of the inaccuracy of some of the variables used, including calculations of comorbidity scores. Third, the patients included in this study were not randomized to Pal (i-Pal, h-Pal), and non-Pal groups for comparison, and it might have selection bias. Fourth, the risk factors related to each QI (e.g., clinical symptoms and signs, patients' or family members' preferences, physician recommendations, and do-not-resuscitate designations) were not recorded in the administrative database. Patients' and family members' preferences may have influenced some outcomes. Fifth, the care of HMs has been improved over time. Alongside, the claimed data which had been used in the current study might have limitations of out-of-date care. Previous studies reported that clinical trials in HMs have been growing rapidly since 2010. Sixth, we used the insurance system exit dates as our proxy for death. The proxy date might be a couple of days later than the real death date, as it sparsely occurred. In addition,

Table 3

The significant factors for the quality indicators by multivariate logistic regression for patients with advanced hematological malignancies.

Variable	Chemotherapy*	≥2 ER visits†	≥2 Hospitalizations†	ICU†	CPR†	Dying in hospital
Age > 65 yr old	0.52 (0.37–0.74) (<0.001)	1.24 (0.90–1.72) (0.187)	1.21 (0.79–1.84) (0.385)	0.98 (0.68–1.43) (0.935)	0.80 (0.57–1.12) (0.188)	0.85 (0.59–1.22) (0.376)
Survival year, after diagnosis‡	0.94 (0.84–1.04) (0.246)	1.04 (0.94–1.14) (0.466)	0.93 (0.82–1.05) (0.247)	0.94 (0.83–1.05) (0.260)	0.92 (0.83–1.02) (0.112)	1.10 (0.99–1.23) (0.070)
i-Pal group	0.11 (0.02–0.63) (0.013)	1.22 (0.61–2.46) (0.573)	2.44 (1.11–5.39) (0.027)	0.03 (0.004–0.30) (0.002)	0.13 (0.04–0.40) (<0.001)	2.49 (1.07–5.77) (0.034)
h-Pal group	0.27 (0.02–3.88) (0.334)	1.34 (0.44–4.05) (0.608)	5.30 (1.55–18.08) (0.008)	0.17 (0.02–1.28) (0.085)	0.20 (0.04–1.15) (0.071)	0.79 (0.25–2.54) (0.698)
Admission days	1.07 (1.05–1.08) (<0.001)	0.96 (0.94–0.97) (<0.001)	1.03 (1.01–1.05) (0.002)	1.07 (1.05–1.09) (<0.001)	1.06 (1.05–1.08) (<0.001)	1.09 (1.08–1.11) (<0.001)
Palliative care to death days	0.98 (0.92–1.04) (0.469)	1.00 (0.99–1.01) (0.620)	0.99 (0.97–1.00) (0.147)	1.01 (1.00–1.02) (0.247)	1.00 (0.99–1.01) (0.913)	1.00 (0.99–1.01) (0.794)
Hypertension	1.13 (0.71–1.80) (0.599)	2.27 (1.48–3.48) (<0.001)	1.93 (1.20–3.11) (0.007)	1.08 (0.67–1.73) (0.766)	1.04 (0.67–1.62) (0.862)	1.84 (1.16–2.92) (0.010)
Hemodialysis	0.37 (0.18–0.75) (0.006)	0.53 (0.28–0.99) (0.048)	0.45 (0.17–1.17) (0.103)	4.60 (2.42–8.71) (<0.001)	2.90 (1.52–5.49) (0.001)	0.67 (0.35–1.28) (0.225)
Stroke	1.81 (1.09–2.30) (0.021)	1.59 (0.99–2.56) (0.054)	1.19 (0.67–2.11) (0.545)	1.06 (0.62–1.82) (0.820)	1.38 (0.84–2.26) (0.198)	1.11 (0.66–1.86) (0.697)
CCI	1.00 (0.91–1.10) (0.985)	0.95 (0.87–1.03) (0.242)	0.96 (0.85–1.08) (0.465)	1.10 (1.00–1.21) (0.041)	1.04 (0.95–1.13) (0.392)	0.97 (0.89–1.07) (0.574)
Intercept	−1.37	0.01	−2.12	−2.47	−1.52	−1.32
Nagelkerke's R squared	0.244	0.138	0.076	0.235	0.219	0.310
Hosme-Lemeshow test	0.281	<0.001	<0.001	0.019	0.092	<0.001
AUC	0.758 (0.723–0.794)	0.679 (0.641–0.718)	0.656 (0.608–0.703)	0.755 (0.719–0.792)	0.739 (0.703–0.776)	0.775 (0.740–0.810)

i-Pal group, and h-Pal group: patients with hematological malignancies received palliative care were categorized into the inpatient palliative group (i-Pal group) if patients received inpatient palliative care before death, and the home palliative group (h-Pal group) if patients received home palliative care before death.

The values indicated: estimate (*P* value) (95%CI).

* Receiving chemotherapy in 14 days before death.

† These quality indicators were during the last month of life.

‡ Survival years, after diagnosis: by Kaplan–Meier method.

CCI = Charlson co-morbidity index, CKD = chronic kidney disease, CPR = cardiopulmonary resuscitation, ER = emergency room, ICU = intensive care unit.

patient-centered outcome measurements, such as quality of life, health care utilization and functional capacity were incorporated in a small number of trials.[44] Finally, only 35.5% of the patients survived for more than 30 days after receiving palliative care, and the inappropriate EOL care score might be overestimated and the health care costs might be underestimated.

5. Conclusion

Patients with HMs who receive palliative care could benefit from less inappropriate EOL cancer care in the final month of life. However, we found that palliative care was received by 8.6% of patients with HMs. The related factors of more hospitalizations and dying in hospital warrant further investigation.

Author contributions

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