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Research article

Palliative Performance Scale and Survival Among Advanced Cancer Inpatients: A Retrospective Cohort Study

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Abstract

Background: Prognosis discussions are essential for advance care planning in cancer patients, yet uncertainty may delay them, leading to aggressive end-of-life care. The Palliative Performance Scale (PPS) was widely applied to estimate survival in palliative care.This study examined the relationship between PPS and survival in advanced cancer inpatients in Thailand and identified survival-associated factors.

Methods: A retrospective cohort study included advanced cancer inpatients who received consultation from the Palliative Care Unit at Chulabhorn Hospital from January 2016 to December 2021, with follow-up until June 2023. PPS, Edmonton Symptom Assessment System (ESAS), and distress thermometer (DT) were used. Kaplan-Meier survival analysis assessed associations with PPS, ESAS, DT, gender, age, and cancer type. The log-rank test was applied to compare survival between groups for each variable. A Cox proportional hazards model was utilized to identify significant predictors.

Results: Among 1054 patients (50.57% female, mean age 62.28 ± 13.65 years), PPS significantly correlated with survival. Median survival (days) by PPS scores of 10, 20, 30, 40, 50, 60, 70, and ≥80% were 2, 4, 17, 28, 44, 49, 105, and 623, respectively. Overall median survival was 30 days (95% CI: 27 - 34). Cancer type, severe drowsiness, and moderate to severe shortness of breath significantly impacted survival. Hematologic cancer had lower mortality than hepatobiliary and pancreas cancers (HR 0.44; 95% CI: 0.32 - 0.60). Severe drowsiness (HR 1.65; 95% CI: 1.31 - 2.06) and moderate to severe shortness of breath (HR 1.45 - 1.88) increased mortality risk.

Conclusions: PPS, cancer type, severe drowsiness, and shortness of breath are key prognostic factors in advanced cancer inpatients, aiding palliative care planning.

Keywords: Cancer, Palliative Care, Palliative Performance Scale (PPS), Prognostication, Survival

Introduction

Prognostic awareness is crucial for cancer patients, guiding clinical decision-making and advance care planning (ACP). Although more than half of patients prefer physicians to initiate ACP discussions[1], prognostic uncertainty often delays these conversations until the final months of life.[2-4] Without sufficient time for reflection, patients may develop unrealistic expectations, resulting in more aggressive end-of-life care.[4]

Survival prediction methods encompass clinician prediction of survival (CPS), physical and vital signs,

symptomsand prognostic models.[5] While CPS is the most frequently used method, it tends to overestimate survival with only 20 - 30% accuracy, even among palliative care specialists.[6,7] The Palliative Performance Scale (PPS), derived from the Karnofsky Performance Scale, enhances CPS[6] by evaluating five functional parameters: ambulation, activity level, self-care, food/fluid intake, and consciousness. Scored in 10-point increments from 0% (death) to 100% (full function)[8], the Thai version of PPS is validated and widely utilized with in Thailand.[9]

While the Palliative Performance Scale (PPS) reflects patients' functional and physical status, the Edmonton Symptom Assessment System (ESAS) captures multidimensional symptom burden[10], and the Distress Thermometer (DT) measures emotional distress.[11] Integrating these three measures provides a comprehensive view of patients' physical, psychological, and functional decline, allowing for a more accurate estimation of survival and timely palliative care planning.

Previous studies have indicated that higher PPS levels correlate with longer survival.[12-16] Other potential survival factors, such as age, gender, and diagnosis, remain debated.[13,14] One study linked survival to age and gender but not diagnosis[13], while another indicated that diagnosis is predictive but not age or gender.[14] Symptoms such as drowsiness, shortness of breath, fatigue, and poor appetite, along with biochemical markers (e.g., albumin, CRP/albumin ratio), have also been associated with survival.[5,17-20] In Thailand, studies have identified initial PPS, gender, and hospital location as survival predictors[12,21], but none have examined ESAS or DT scores, which are widely used in clinical practice. This study aims to investigate the median survival time of advanced cancer patients across each PPS level in an inpatient setting and to identify factors associated with survival.

Method

Participants and Setting

This retrospective cohort study was conducted at Chulabhorn Hospital. Ethical approval was granted by the Human Research Ethics Committee of Chulabhorn Research Institute (IRB No. 085/2564) on July 23, 2021. Due to the retrospective nature of the research, specific informed consent from participants was waived. However, as part of routine clinical care in our palliative care unit, all participants (or their proxies, if the participants were unable to give consent) provided informed consent for telephone follow-up after hospital discharge.

The study included all adult inpatients (≥ 18 years) with advanced cancer, defined as an incurable malignancy in which cancer-directed treatment may be administered for disease control or symptom palliation, or care focused solely on symptom management without active cancer-directed therapy[22], who received a Palliative Care Unit consultation between January 1, 2016 and December 31, 2021. Only the first visit was considered, excluding data from subsequent readmissions. Consultation criteria included a distress thermometer score of ≥ 4, need for symptom management, end-of-life care support, management of psychosocial problems, negotiation of advanced care plans, provision of medical equipment for home care, and evaluation of caregiver suitability for home care. The palliative care setting receives consultations from physicians for both outpatient and inpatient services.

Data Collection

At the initial consultation, palliative care nurses collected demographic and clinical data - including age, gender, diagnosis, PPS, ESAS scores, and DT scores - using paper questionnaires completed with in 24 hours of the consultation. For patients with a PPS of 10%, caregivers provided ESAS psychological ratings. Data were entered into the electronic medical record system and reviewed during weekly multidisciplinary team meetings for treatment planning.

Patients were followed weekly until discharge and subsequently monitored by family medicine doctors or palliative care nurses via telephone or home visits. Mortality data were collected until June 11, 2023. Patients alive at the end of the study were contacted on that date. Data extraction was conducted using the palliative care team's Excel program, with post-entry checks for extreme values verified against source documents.

Data Analysis

Statistical analyses were performed using STATA version 18. Descriptive statistics, including percentages, means, medians, and standard deviations, were calculated. Kaplan-Meier survival analysis was used to assess overall survival time and survival times based on initial PPS, initial ESAS score, initial DT score, gender, age, and cancer type. The log-rank test was applied to compare survival between groups for each variable. A Cox proportional hazards model was utilized to identify factors associated with survival, with covariates previously reported as relevant to survival (age, gender, cancer type, PPS, ESAS score, and DT score), along with variables having a p-value < 0.05 in univariate analysis, included in the multivariate analysis. Additionally, multicollinearity among the independent variables in the multivariable model was assessed using the Variance Inflation Factor (VIF), with a value of less than 5 indicating the absence of significant multicollinearity.

Results

There were 1054 participants included in the analysis. One hundred sixty-five patients were censored as they survived beyond the last observation date.

Patient characteristics

Table 1 shows patient characteristics. A total of 1054 patients were included in the study, with the majority being female (50.57%). The mean age of the patients was 62.28 years (SD 13.65). The three most common cancers among patients consulted by the palliative care unit were lung, hepatobiliary and pancreatic, and colorectal cancers. Most patients had a PPS of 30% (26.38%). Most patients experienced none to little pain (66.41%), nausea (93.36%), depression (81.40%), anxiety (63.85%), drowsiness (69.83%), loss of appetite (70.97%), and shortness of breath (57.87%) but moderate fatigue (38.71%). Additionally, 53.98% reported good well-being, and 56.64% had a DT score ≥4. The full dataset can be found in Supplementary 1.

Table 1 Patient characteristics (n=1054)

	n (%) = 1054
Gender	
Female	533 (50.57)
Age (years)	
Mean (SD)	62.28 (13.65)
Age group	
<45	109 (10.34)
45 - 64	458 (43.45)
65 - 74	303 (28.75)
75 - 84	137 (13.00)
≥85	47 (4.46)
Cancer type	
Lung	226 (21.44)
Hepatobiliary and pancreatic	188 (17.84)
Colorectal	125 (11.86)
Gynecologic	116 (11.01)
Breast	92 (8.73)

	n (%) = 1054
Head and Neck	84 (7.97)
Hematologic	68 (6.45)
Others	155 (14.70)
PPS	
PPS 10%	32 (3.04)
PPS 20%	47 (4.46)
PPS 30%	278 (26.38)
PPS 40%	247 (23.43)
PPS 50%	212 (20.11)
PPS 60%	151 (14.33)
PPS 70%	49 (4.65)
PPS ≥80%	38 (3.61)
ESAS	
Pain score	
No/little (0 - 3)	700 (66.41)
Fatigue score	
Moderate (4 - 6)	408 (38.71)
Nausea score	
No/little (0 - 3)	984 (93.36)
Depression score	
No/little (0 - 3)	858 (81.40)
Anxiety score	
No/little (0 - 3)	673 (63.85)
Drowsiness score	
No/little (0 - 3)	736 (69.83)
Loss of appetite score	
No/little (0 - 3)	748 (70.97)
Well-being score	
Good (0 - 3)	569 (53.98)
Shortness of breath score	
No/little (0 - 3)	610 (57.87)
Distress Thermometer Score	
≥4	597 (56.64)

PPS and Survival Time

Figure 1 shows the survival probabilities for each PPS level. Compared to those with PPS 10%, those with PPS between 30% and ≥80% had significantly lower mortality rates. The median survival times for those with PPS of 10, 20, 30, 40, 50, 60, 70, and ≥80 were 2 (1 - 6) days, 4 (3 - 6) days, 17 (13 - 22) days, 28 (22 - 34) days, 44 (32 - 57) days, 49 (34 - 61) days, 105 (76 - 293) days, and 623 (270-.) days, respectively (Table 2).

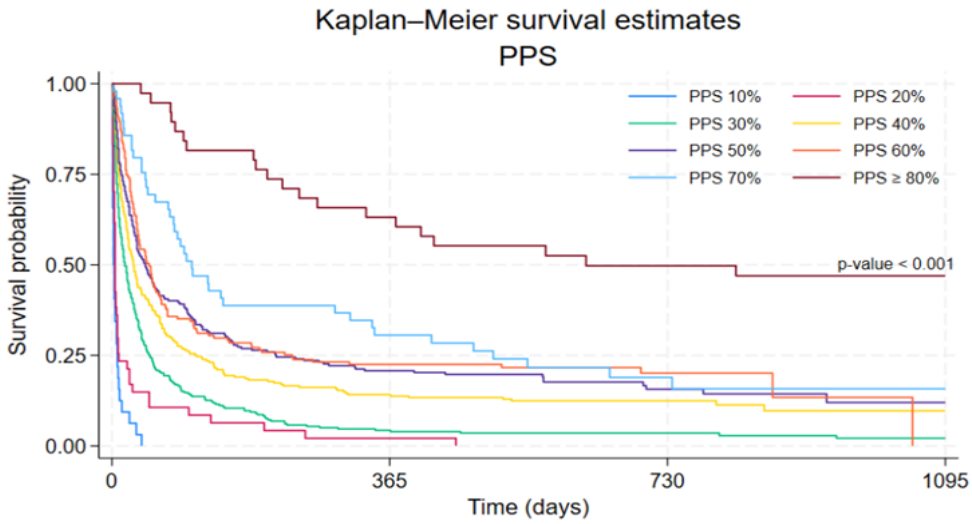

Figure 1 Kaplan-Meier survival curves by initial Palliative Performance Scale

Table 2 Median Survival Time in days grouped by initial PPS level

PPS (%)	Median survival time, days (95% CI)	Total case
10	2 (1 - 6)	32
20	4 (3 - 6)	47
30	17 (13 - 22)	278
40	28 (22 - 34)	247
50	44 (32 - 57)	212
60	49 (34 - 61)	151
70	105 (76 - 293)	49
≥80	623 (270-.)	38
overall	30 (27 - 34)	1054

Overall Survival Patterns

Table 3 presents median survival times by cancer type, initial PPS, ESAS drowsiness, and ESAS shortness of breath scores. Overall median survival was 30 days (95% CI: 27 - 34). A log-rank test compared survival between groups for each variable, and a Cox proportional hazards model identified factors associated with survival, adjusting for gender, age, cancer type, initial PPS, ESAS score, and DT score. The respective p-values for the log-rank test (univariate analysis) and the Cox proportional hazards model (multivariate analysis) are presented within Table 3, directly under the corresponding variable and hazard ratio columns for immediate interpretation. Reference groups in the Cox model included males, age group ≥85, hepatobiliary and pancreatic cancer, PPS 10%, and minimal symptom burden. Full data are available in Supplementary 2.

Table 3 Hazard ratios (HR) and 95% confidence intervals (CI) for median survival by cancer type, initial PPS, ESAS drowsiness, and shortness of breath scores.

	Median survival time, days (95% CI)	Univariate		Multivariate	
		HR (95% CI)	P-value	HR (95% CI)	P-value
Overall	30 (27 - 34)				
Cancer type			<0.001		<0.001
Hepatobiliary and pancreatic	18 (13 - 23)	reference			
Lung	24 (19 - 35)	0.87 (0.71 - 1.07)	0.179	0.80 (0.65 - 0.98)	0.034
Colorectal	23 (16 - 38)	0.83 (0.66 - 1.06)	0.136	0.74 (0.58 - 0.94)	0.015
Gynecologic	28 (22 - 42)	0.76 (0.60 - 0.97)	0.029	0.80 (0.62 - 1.03)	0.082
Breast	48 (27 - 128)	0.58 (0.44 - 0.76)	<0.001	0.57 (0.43 - 0.75)	<0.001
Head and Neck	75 (39 - 119)	0.50 (0.38 - 0.67)	<0.001	0.65 (0.49 - 0.87)	0.004
Hematologic	91 (47 - 148)	0.46 (0.33 - 0.63)	<0.001	0.44 (0.32 - 0.60)	<0.001
Others	34 (24 - 45)	0.78 (0.62 - 0.98)	0.032	0.80 (0.63 - 1.01)	0.057
PPS			<0.001		<0.001
PPS 10%	2 (1 - 6)	reference			
PPS 20%	4 (3 - 6)	0.44 (0.28 - 0.70)	<0.001	0.47 (0.29 - 0.77)	0.002
PPS 30%	17 (13 - 22)	0.22 (0.15 - 0.32)	<0.001	0.33 (0.22 - 0.50)	<0.001
PPS 40%	28 (22 - 34)	0.15 (0.10 - 0.22)	<0.001	0.24 (0.16 - 0.36)	<0.001
PPS 50%	44 (32 - 57)	0.12 (0.08 - 0.17)	<0.001	0.19 (0.12 - 0.29)	<0.001
PPS 60%	49 (34 - 61	0.11 (0.07 - 0.16)	<0.001	0.18 (0.12 - 0.28)	<0.001
PPS 70%	105 (76 - 293)	0.08 (0.05 - 0.13)	<0.001	0.14 (0.08 - 0.23)	<0.001
PPS ≥80%	623 (270-.)	0.03 (0.02 - 0.06)	<0.001	0.07 (0.04 - 0.12)	<0.001
ESAS Drowsiness score			<0.001		<0.001
No/little (0-3)	42 (34 - 49)	reference			
Moderate (4-6)	17 (11 - 24)	1.60 (1.35 - 1.89)	<0.001	1.18 (0.98 - 1.43)	0.077
Severe (7-10)	6 (5 - 8)	2.89 (2.38 - 3.50)	<0.001	1.65 (1.31 - 2.06)	<0.001
Shortness of breath score			<0.001		<0.001
No/little (0-3)	48 (39 - 57)	reference			
Moderate (4-6)	21 (14 - 28)	1.77 (1.52 - 2.07)	<0.001	1.45 (1.22 - 1.71)	<0.001
Severe (7-10)	8 (7 - 11)	2.52 (2.13 - 2.99)	<0.001	1.88 (1.53 - 2.31)	<0.001

Univariate analysis identified cancer type, initial PPS, ESAS fatigue, drowsiness, loss of appetite, well-being, and shortness of breath scores as significant predictors of survival (log-rank $P < 0.05$). Therefore, these seven covariates were included in the multivariate analysis. The final model illustrates that cancer type, initial PPS, ESAS drowsiness score, and ESAS shortness of breath score significantly impacted overall survival (log-rank $P < 0.05$ for each variable). In the final multivariable model, all included variables demonstrated low multi collinearity, with Variance Inflation Factor (VIF) values all below 1.5, confirming the stability and independence of the predictors (detailed VIF values are provided in Supplementary 3).

Covariates and Survival Time

Figure 2 shows the survival probabilities for each cancer type. Patients with hepatobiliary and pancreatic cancer had the shortest median survival at 18 (13 - 23) days. Those with lung, colorectal, breast, head and neck, and hematologic cancers had significantly lower mortality than hepatobiliary and pancreatic cancer patients, with adjusted HR of 0.80 (95% CI: 0.65 - 0.98), 0.74 (0.58 - 0.94), 0.57 (0.43 - 0.75), 0.65 (0.49 - 0.87), 0.44 (0.32 - 0.60), respectively (Table 3).

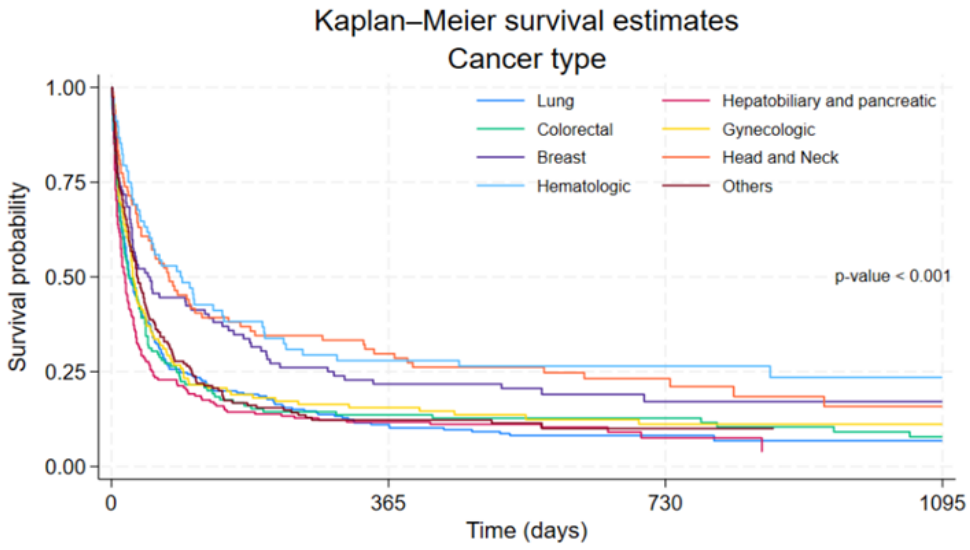

Figure 2 Kaplan-Meier survival curves by cancer type

Figure 3 and 4 illustrate survival probabilities for ESAS drowsiness and shortness of breath scores. Median survival for severe drowsiness was 6 (5 - 8) days, with significantly higher mortality (adjusted HR: 1.65, 95% CI: 1.31 - 2.06). Median survival for severe shortness of breath was 8 (7 - 11) days, with adjusted HRs of 1.45 (1.22 - 1.71) for moderate and 1.88 (1.53 - 2.31) for severe shortness of breath (Table 3).

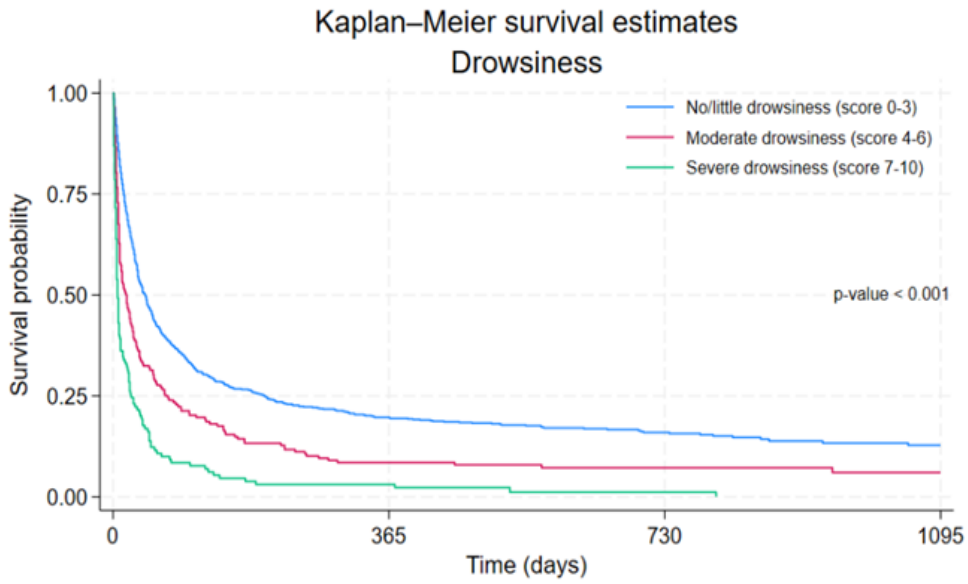

Figure 3 Kaplan-Meier survival curves by ESAS drowsiness score

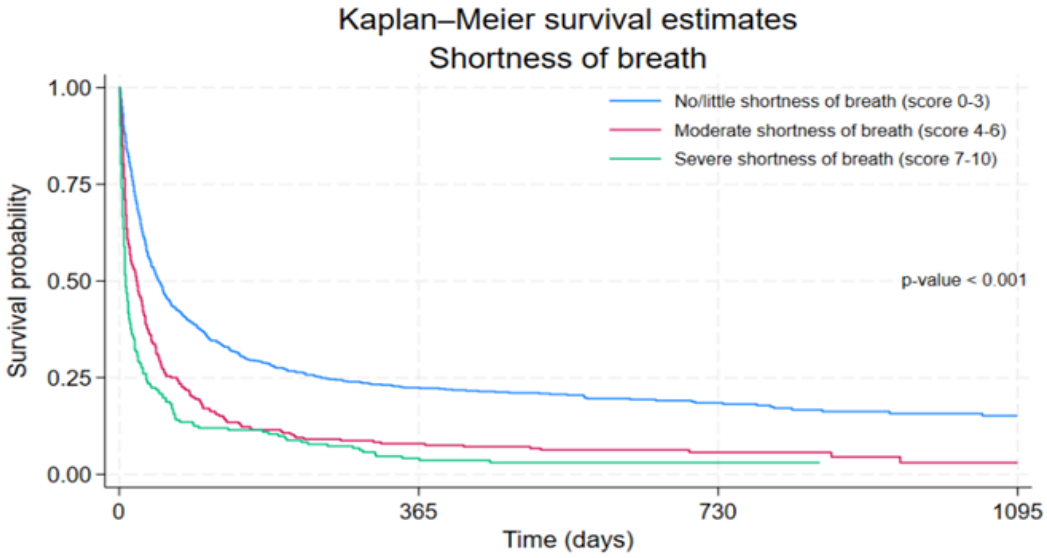

Figure 4 Kaplan-Meier survival curves by ESAS shortness of breath score

Discussion

This study demonstrates a significant association between initial PPS and survival time, with higher PPS levels linked to longer survival. Median survival times indicate that patients with PPS 10 - 20% survived for days, PPS 30 - 40% for months, and PPS ≥80% for over 1.5 years. These findings align with previous research[12,15-16,21] but differ from those of Jeff Myers et al. who reported that outpatients with PPS ≥60% had a survival exceeding three months[23], likely due to differences in patient settings.

In addition to PPS, this study identifies cancer type, ESAS drowsiness, and ESAS shortness of breath as factors associated with survival. Other variables, including age, gender, and additional ESAS and DT scores, did not show statistically significant associations.

These findings are consistent with prior studies reporting associations between cancer type and survival[14] while showing no significant predictive value for distress scores.[24,25] Furthermore, our results align with those of Lori Spoozak et al. and Hsien Seow et al., demonstrating that drowsiness and shortness of breath worsen as patients near death.[18,19] Similarly, our findings are consistent with the research by Masanori Mori et al. The authors identified decreased consciousness as an early sign of impending death, while Cheyne-Stokes breathing and mandibular movement were observed to occur in the final days.[5] Thus, severe ESAS drowsiness and moderate to severe shortness of breath may serve as survival predictors in advanced cancer patients.

However, our findings contrast with those of Lau et al., who reported associations between age, gender, and survival while finding no link between cancer type and survival.[13] This discrepancy may be due to differences in sample size and study settings. Additionally, our results differ from those of Charlotte Goodrose-Flores et al. who found that poor appetite and severe fatigue increased mortality risk.[17] This variation may be attributed to differences in participant selection and exclusion criteria, particularly the exclusion of patients with a life expectancy under three months.[17]

Based on these findings, we suggest that integrating PPS and ESAS into routine inpatient care for advanced cancer could offer significant clinical benefits. First, identifying factors associated with increased mortality empowers nursing and medical teams to play a proactive role in symptom interpretation and the prioritization of high-risk patients, ensuring more timely access to palliative care. Second, integrating these tools into clinical protocols allows for the continuous monitoring of performance status and symptom burden, which facilitates multidisciplinary communication and nursing-led assessments, ensuring a more coordinated care plan. Third, recognizing early prognostic indicators provides a natural entry point for ACP discussions, which is essential for ensuring quality end-of-life care for patients and their families. Finally, these findings can contribute to medical education and inform national healthcare policy-such as optimizing selection criteria for hospice care, a resource that remains limited in Thailand.

This study has several limitations. First, it lacks data on biochemical markers (e.g., albumin, CRP/albumin ratio) and the duration of palliative care, which are associated with survival in cancer patients.[17,26] Second, changes in PPS after the initial assessment were not recorded, despite evidence that a PPS decline of ≥10% predicts increased mortality.[27] Third, we did not account for comorbidities or ongoing cancer treatment, which may act as confounders. However, initial PPS, cancer type, ESAS drowsiness scores, and ESAS shortness of breath scores remain valuable for prognosis communication and ACP decision-making. Fourth, the absence of a standardized recording system, aside from cross-referencing extreme values, may introduce bias. Lastly, data collection was limited to a single site (Chulabhorn Hospital) and advanced cancer patients. Future multi-site studies should include broader patient populations, incorporate biomarkers and co-morbidities, and refine data extraction to minimize bias.

This study's strength lies in its inclusion of multiple prognostic factors from real-world palliative care. Additionally, PPS data were collected across a broad patient range, not limited to the end-of-life period, providing a comprehensive view of survival at each PPS level. This enhances external validity and broadens the findings' applicability in palliative cancer care.

Conclusion

Initial PPS, cancer type, severe ESAS drowsiness, and moderate to severe shortness of breath are significant predictors of mortality in inpatients with advanced cancer. These findings underscore the importance of integrating PPS and ESAS into standardized clinical assessment frameworks, such as daily ward rounds, to enhance nursing-led prognostication. Beyond clinical practice, these tools provide a valuable basis for palliative care education and nursing research, while informing policy development for resource allocation in Thailand. Utilizing these variables facilitates timely prognostic communication and proactive Advance

Care Planning, ultimately ensuring quality end-of-life care.

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Supplementary 1

	n (%) = 1054
Gender	
Male	521 (49.43)
Female	533 (50.57)
Age (years)	
Mean (SD)	62.28 (13.65)
Age group	
<45	109 (10.34)
45 - 64	458 (43.45)
65 - 74	303 (28.75)
75 - 84	137 (13.00)
≥85	47 (4.46)
Cancer type	
Lung	226 (21.44)
Hepatobiliary and pancreatic	188 (17.84)
Colorectal	125 (11.86)
Gynecologic	116 (11.01)
Breast	92 (8.73)
Head and Neck	84 (7.97)
Hematologic	68 (6.45)
Others	155 (14.70)
PPS	
PPS 10%	32 (3.04)
PPS 20%	47 (4.46)
PPS 30%	278 (26.38)
PPS 40%	247 (23.43)
PPS 50%	212 (20.11)
PPS 60%	151 (14.33)
PPS 70%	49 (4.65)
PPS ≥80%	38 (3.61)
ESAS	
Pain score	
No/little (0 - 3)	700 (66.41)
Moderate (4 - 6)	187 (17.74)
Severe (7 - 10)	167 (15.84)

	n (%) = 1054
Fatigue score	
No/little (0 - 3)	379 (35.96)
Moderate (4 - 6)	408 (38.71)
Severe (7 - 10)	267 (25.33)
Nausea score	
No/little (0 - 3)	984 (93.36)
Moderate (4 - 6)	45 (4.27)
Severe (7 - 10)	25 (2.37)
Depression score	
No/little (0 - 3)	858 (81.40)
Moderate (4 - 6)	121 (11.48)
Severe (7 - 10)	75 (7.12)
Anxiety score	
No/little (0 - 3)	673 (63.85)
Moderate (4 - 6)	270 (25.62)
Severe (7 - 10)	111 (10.53)
Drowsiness score	
No/little (0 - 3)	736 (69.83)
Moderate (4 - 6)	188 (17.84)
Severe (7 - 10)	130 (12.33)
Loss of appetite score	
No/little (0 - 3)	748 (70.97)
Moderate (4 - 6)	196 (18.60)
Severe (7 - 10)	110 (10.44)
Well-being score	
Good (0 - 3)	569 (53.98)
Moderate (4 - 6)	297 (28.18)
Poor (7 - 10)	188 (17.84)
Shortness of breath score	
No/little (0 - 3)	610 (57.87)
Moderate (4 - 6)	252 (23.91)
Severe (7 - 10)	192 (18.22)
Distress Thermometer Score	
<4	457 (43.36)
≥4	597 (56.64)

Supplement 2

	Median survival time, days (95% CI)	Univariate		Multivariate	
		HR (95% CI)	P-value	HR (95% CI)	P-value
Overall	30 (27 - 34)				
Gender			0.169		
Male	29 (22 - 34)	reference			
Female	32 (28 - 39)	0.91 (0.80 - 1.04)	0.169		
Age group (years)			0.621		
< 45	37 (18 - 53)	1.05 (0.73 - 1.52)	0.791		
45 - 64	30 (26 - 35)	1.01 (0.73 - 1.40)	0.957		
65 - 74	29 (22 - 36)	1.13 (0.81 - 1.58)	0.468		
75 - 84	32 (22 - 43)	1.12 (0.79 - 1.60)	0.522		
≥ 85	29 (19 - 53)	reference			
Cancer type			<0.001		<0.001
Hepatobiliary and pancre atic	18 (13 - 23)	reference			
Lung	24 (19 - 35)	0.87 (0.71 - 1.07)	0.179	0.80 (0.65 - 0.98)	0.034
Colorectal	23 (16 - 38)	0.83 (0.66 - 1.06)	0.136	0.74 (0.58 - 0.94)	0.015
Gynecologic	28 (22 - 42)	0.76 (0.60 - 0.97)	0.029	0.80 (0.62 - 1.03)	0.082
Breast	48 (27 - 128)	0.58 (0.44 - 0.76)	<0.001	0.57 (0.43 - 0.75)	<0.001
Head and Neck	75 (39 - 119)	0.50 (0.38 - 0.67)	<0.001	0.65 (0.49 - 0.87)	0.004
Hematologic	91 (47 - 148)	0.46 (0.33 - 0.63)	<0.001	0.44 (0.32 - 0.60)	<0.001
Others	34 (24 - 45)	0.78 (0.62 - 0.98)	0.032	0.80 (0.63 - 1.01)	0.057
PPS			<0.001		<0.001
PPS 10%	2 (1 - 6)	reference			
PPS 20%	4 (3 - 6)	0.44 (0.28 - 0.70)	<0.001	0.47 (0.29 - 0.77)	0.002
PPS 30%	17 (13 - 22)	0.22 (0.15 - 0.32)	<0.001	0.33 (0.22 - 0.50)	<0.001
PPS 40%	28 (22 - 34)	0.15 (0.10 - 0.22)	<0.001	0.24 (0.16 - 0.36)	<0.001
PPS 50%	44 (32 - 57)	0.12 (0.08 - 0.17)	<0.001	0.19 (0.12 - 0.29)	<0.001
PPS 60%	49 (34 - 61)	0.11 (0.07 - 0.16)	<0.001	0.18 (0.12 - 0.28)	<0.001
PPS 70%	105 (76 - 293)	0.08 (0.05 - 0.13)	<0.001	0.14 (0.08 - 0.23)	<0.001
PPS ≥80%	623 (270-.)	0.03 (0.02 - 0.06)	<0.001	0.07 (0.04 - 0.12)	<0.00

	Median survival time, days (95% CI)	Univariate		Multivariate	
		HR (95% CI)	P-value	HR (95% CI)	P-value
ESAS Pain score			0.106		
No/little (0 - 3)	31 (27 - 36)	reference			
Moderate (4 - 6)	37 (30 - 50)	0.94 (0.79 - 1.12)	0.495		
Severe (7 - 10)	19 (13 - 26)	1.18 (0.99 - 1.41)	0.068		
Fatigue score			<0.001		0.262
No/little (0 - 3)	53 (42 - 73)	reference			
Moderate (4 - 6)	32 (26 - 37)	1.42 (1.22 - 1.65)	<0.001	1.07 (0.90 - 1.27)	0.439
Severe (7 - 10)	11 (8 - 16)	2.08 (1.76 - 2.46)	<0.001	1.18 (0.97 - 1.44)	0.102
Nausea score			0.363		
No/little (0 - 3)	32 (28 - 35)	reference			
Moderate (4 - 6)	20 (8 - 39)	1.20 (0.88 - 1.64)	0.250		
Severe (7 - 10)	25 (7 - 45)	1.21 (0.79 - 1.85)	0.380		
Depression score			0.743		
No/little (0 - 3)	30 (27 - 35)	reference			
Moderate (4 - 6)	35 (24 - 47)	0.99 (0.81 - 1.22)	0.956		
Severe (7 - 10)	26 (14 - 33)	1.10 (0.86 - 1.42)	0.448		
Anxiety score			0.137		
No/little (0 - 3)	28 (23 - 32)	reference			
Moderate (4 - 6)	38 (31 - 55)	0.86 (0.74 - 1.00)	0.049		
Severe (7 - 10)	28 (20 - 43)	0.99 (0.80 - 1.22)	0.920		
Drowsiness score			<0.001		<0.001
No/little (0 - 3)	42 (34 - 49)	reference			
Moderate (4 - 6)	17 (11 - 24)	1.60 (1.35 - 1.89)	<0.001	1.18 (0.98 - 1.43)	0.077
Severe (7 - 10)	6 (5 - 8)	2.89 (2.38 - 3.50)	<0.001	1.65 (1.31 - 2.06)	<0.001
Loss of appetite score			<0.001		0.084
No/little (0 - 3)	34 (29 - 42)	reference			
Moderate (4 - 6)	22 (18 - 34)	1.25 (1.06 - 1.47)	0.009	1.16 (0.96 - 1.40)	0.115
Severe (7 - 10)	24 (15 - 28)	1.44 (1.17 - 1.77)	0.001	1.24 (0.98 - 1.56)	0.067
Well-being score			0.002		0.260
Good (0 - 3)	32 (27 - 42)	reference			
Moderate (4 - 6)	33 (28 - 39)	1.06 (0.91 - 1.23)	0.474	1.15 (0.97 - 1.36)	0.104
Poor (7 - 10)	21 (14 - 28)	1.37 (1.15 - 1.63)	<0.001	1.07 (0.88 - 1.31)	0.497

	Median survival time, days (95% CI)	Univariate		Multivariate	
		HR (95% CI)	P-value	HR (95% CI)	P-value
Shortness of breath score			<0.001		<0.001
No/little (0 - 3)	48 (39 - 57)	reference			
Moderate (4 - 6)	21 (14 - 28)	1.77 (1.52 - 2.07)	<0.001	1.45 (1.22 - 1.71)	<0.001
Severe (7 - 10)	8 (7 - 11)	2.52 (2.13 - 2.99)	<0.001	1.88 (1.53 - 2.31)	<0.001
DT score			0.373		
<4	32 (25 - 39)	reference			
≥4	29 (26 - 34)	1.06 (0.93 - 1.21)	0.373		

Supplementary 3

Variable	Variance Inflation Factor
Fatigue	1.37
Drowsiness	1.33
Shortness of breath	1.29
PPS	1.25
Well-being	1.23
Loss of appetite	1.18
Cancer type	1.03