Original Article

Use of the Palliative Performance Scale (PPS) for End-of-Life Prognostication in a Palliative Medicine Consultation Service

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Abstract

This study examines the use of the Palliative Performance Scale (PPS) in end-of-life prognostication within a regional palliative care program in a Canadian province. The analysis was done on a prospective cohort of 513 patients assessed by a palliative care consult team as part of an initial community/hospital-based consult. The variables used were initial PPS score, age, gender, diagnosis, cancer type, and survival time. The findings revealed initial PPS to be a significant predictor of survival, along with age, diagnosis, cancer type and site, but not gender. The survival curves were distinct for PPS 10%, 20%, and 30% individually, and for 40%–60% and ≥70% as bands. This is consistent with earlier findings of the ambiguity and difficulty when assessing patients at higher PPS levels because of the subjective nature of the tool. We advocate the use of median survival and survival rates based on a local cohort where feasible, when reporting individual survival estimates. J Pain Symptom Manage 2009;37:965–972.

Key Words

Palliative Performance Scale, palliative care, end of life, prognostication, survival prediction, survival estimates

Introduction

"*How long do I have to live, doc?*" is a question often raised by patients in the end-stage of a life-threatening illness.[1] Knowing how long one will live allows the individual to bring closure to personal/family matters, and the prognostic information helps clinicians plan for appropriate care options that respect the will of the patient and family. Moreover, such information may ease the transition from active

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medical therapies to palliative-oriented therapies. Yet end-of-life (EOL) prognostication remains a challenge even for experienced clinicians because of the complex interplay of individual, family, and health system-related factors. In a review of clinicians' survival predictions, Glare et al.[2] reported that clinicians were generally overoptimistic in survival estimation; their predictions were correct to within one week in only 25% of the cases and were overestimated by at least four weeks in 27%. There is evidence that the inclusion of performance status and clinical symptoms can improve clinicians' survival estimates. In their review of prognostic factors, Chow et al.[3] found performance status to be strongly correlated with survival, followed by anorexia, weight loss, and dysphagia found in "terminal syndrome."

Recent studies have reported the use of the Palliative Performance Scale (PPS) as a prognostic tool to estimate the survival of patients with a life-threatening illness.[4–9] The PPS provides a functional assessment of one's ambulation, activity level, and evidence of disease, self-care, oral intake, and level of consciousness. The PPS has 11 categories, from PPS 0% to PPS 100% in 10% increment's. A patient at PPS 0% is dead, whereas at PPS 100% is mobile and healthy. In their 2006 study, Lau et al.[10] examined the use of PPS to estimate the survival of terminally ill patients in an inpatient palliative care unit in a Canadian province, and clarified its instruction set as PPS version 2 (PPSv2). The study found admission PPSv2 was a significant predictor of survival for palliative care patients, along with gender and age but not diagnosis. In addition, PPS 10% through PPS 40% all had distinct survival curves, and male patients had consistently lower survival rates than females regardless of PPS. These findings were different from other published studies that assumed the presence of three distinct PPS survival groups, with diagnosis and non-cancer illnesses as the significant covariates.[5,7–9] These differences were probably because of the small sample sizes and characteristics of the patients and settings.

This article describes our findings on the use of PPS in EOL prognostication within the context of a regional palliative care program in Toronto, Canada. We repeated the survival analysis using the initial PPS from patients in this program with the same methods as in the Lau et al.[10] study. We examined the significance of PPS and other covariates in survival time models and developed ways to report survival results. We conclude by discussing the implications of our findings and suggestions to expand the use of PPS in EOL prognostication in a regional context.

Methods

Design and Sample

This PPS analysis was based on a data set from an earlier prospective observational cohort study that examined the burden of wounds in advanced illness by a palliative care research group at the William Osler Health Centre in Toronto, Canada.[11] The prospective cohort consisted of all patients referred to a regional palliative care program between May 1, 2005 and June 30, 2006 who gave consent to have their data included in the study. This regional palliative care program comprises a community consultation service, a palliative care inpatient unit, and associated hospital-based palliative consultation service. The community and hospital components serve a population of 750,000 within northwest metropolitan Toronto.

All patients enrolled in the original prospective cohort study were examined within 24 hours of the initial referral by a member of the regional palliative care consult team. These referrals originated from community primary care physicians, community hospital oncologists, surgeons, internists, and tertiary care oncologists who provide care in the region. Anonymized patient demographics and clinical assessment data were recorded by members of the consult team who were also the researchers in the original wounds-burden study. The cohort was tracked for one year after our study end-date on their survival status. We extracted a relevant data set collected from the original cohort for the PPS analysis. We obtained ethics approval for this PPS analysis from the University of Victoria Ethics Review Board in fall 2005 (protocol no. 2005-96c).

Data Analysis

In this PPS study, we repeated the survival analysis with the same variables used in the Lau et al.[10] study, which were age, gender,

diagnosis, initial PPS, and survival time in days. Because these patients were first seen by the consult team at home or in the hospital, we included the first consult site where the initial PPS was recorded. For age, we used the categories of <45, 45–64, 65–74, 75–84, and 85+ years. For diagnosis, we grouped the cases as cancer and non-cancer, with cancer cases further grouped by type into lung, colorectal, breast (female), prostate, and others, based on the categories in the 2005 Canadian Cancer Statistics Report from the Canadian Cancer Society. Survival time was defined as the difference between the death date and assessment date on which the initial PPS was obtained. For patients whose death date was unknown, survival times were censored at the last known consult date.[12,13] The censoring indicator is used in all analyses of survival times. All data were entered by the palliative care consult team into a Microsoft Access database created by one of its members on an accrual basis.

The analyses consisted of frequency distributions of the variables in the data set; survival time in days by age, gender, diagnosis, site, and PPS; and Kaplan-Meier (KM) survival curves by age, gender, diagnosis, site, and PPS. A multivariable Cox proportional hazards model was fitted using all of the covariates, yielding hazard ratios by age group, gender, diagnosis, site, and PPS; and survival rates in days by PPS. The proportionality assumption was tested using cox.zph in R[14] with a critical value adjusted for multiple comparisons, 0.05 divided by 18, or 0.003. Log-rank tests were computed for each adjacent pair of PPS survival curves (e.g., PPS 10% and PPS 20%) to examine if they were statistically different from each other. The analyses were conducted in the same manner as in the Lau et al. study, except for the inclusion of the "first consult site" as an additional variable, and the use of a survival table by days instead of mortality rates over time. All data analysis was performed using the statistical software packages SPSS version 15 (SPSS Inc., Chicago, IL) and R 2.5.1 (www.r-project.com).

Results

Patient Characteristics

The characteristics of this cohort at the time of their first assessment by the palliative care consult team during the study period are shown in Table 1. Of the 670 patients in the original cohort, 157 were excluded from the final analysis—151 of these patients had invalid PPS (values that were not multiples of 10, for example, PPS 11%, 27%) and six patients had their PPS recorded >24 hours after the first consult. These exclusions led to a final cohort of 513 patients with a median age of 77 years, of which 257 (50.1%) were female and 256 (49.9%) male. The diagnosis included 347 (67.6%) cancer and 166 (32.4%) non-cancer cases. The cancer cases were grouped according to the common types of cancer in Canada, which were 81 (23.4%) lung, 48 (13.8%) colorectal, 24 (6.9%) breast, 13 (3.7%) prostate, and 181 (52.2%) others. For the first consult site, 322 (62.8%) of these patients were assessed in the hospital by the consult team, with the remaining 191 (37.2%) at home.

Table 1
Patient Characteristics

Variable	Frequency	Percent
No. of patients considered for final analysis	513	
Female	257	50.1
Male	256	49.9
No. of patients per age group (years; from first consult date)		
<45	15	2.9
45–64	74	14.4
65–74	119	23.2
75–84	194	37.8
85+	111	21.7
Mean age	74.91 (S.E. 0.563)	
Median age	77	
No. of patients with primary diagnosis		
Cancer	347	67.6
Non-cancer	166	32.4
No. of patients with most common cancer types[a]		
Breast	24	6.9
Colorectal	48	13.8
Lung	81	23.4
Prostate	13	3.7
Other cancer	181	52.2
No. of patients from each site of first consultation		
Home	191	37.2
Hospital	322	62.8
Exclusion criteria		
No. of patients—initial count	670	
Incorrect PPS scores	151	
PPS > 24 hours of first consult	6	
Total excluded	157	

[a]Based on data from the Canadian Cancer Society/National Cancer Institute of Canada. Canadian Cancer Statistics 2005. Toronto, Canada, 2005.

Overall Survival Patterns

The mean, median, and range of the survival time of the cohort by age, gender, diagnosis, site, and initial PPS are shown in Table 2. The overall survival time accounting for the 47 censored patients had a median of 24 days (95% confidence interval [CI] 19, 29), a mean of 71 days (95% CI 61, 81) and a range of <1−624 days. The diagnosis, cancer type, site, and initial PPS had significant effects on overall survival (log-rank $P < 0.001$, for each variable). Age was also significant but to a lesser extent (log-rank $P = 0.006$), whereas gender was insignificant (log-rank $P = 0.793$).

The KM survival curves stratified by initial PPS are shown in Fig. 1. The log-rank test for the equality of survival curves was highly significant at $P < 0.001$, suggesting that there were significant differences among the curves over the PPS categories. Furthermore, pair-wise log-rank tests for adjacent pairs of PPS showed that patients at PPS 10% vs. 20% had significantly different survival curves (log-rank test $P < 0.001$), as did the patients at PPS 20% vs. 30% ($P < 0.001$), and those at PPS 30% vs. 40% ($P = 0.002$). Although the survival curves for patients at PPS 60% vs. PPS 70% were also statistically different from each other ($P = 0.015$), those at PPS 40% vs. 50%, PPS 50% vs. 60%, and PPS 70% vs. 80% were not statistically different (log-rank tests $P = 0.975$, $P = 0.066$, and $P = 0.812$).

Survival by PPS and Covariates

The Cox proportional hazards model was used to examine the relationship between the hazard ratio of death, adjusted for age, gender, diagnosis, site, and initial PPS. Sixteen of the 18 *P*-values for the tests of proportionality were above 0.05, the other two were 0.05

Table 2
Survival Times by Age, Gender, Diagnosis, Site, and PPS

	Survival Time (In Days)					
Variable	Mean (95% CI)	Median (95% CI)	Range	No. of Patients	Percent	Log Rank *P*-value
Overall	71 (61, 81)	24 (19, 29)	<1−624	513	100	
Age group (years)						0.006
<45	47 (23, 71)	19 (0, 49)	1−127	15	2.9	
45−64	102 (69, 135)	47 (26, 68)	<1−624	74	14.4	
65−74	67 (49, 84)	29 (16, 42)	1−169	119	23.2	
75−84	75 (56, 94)	24 (17, 31)	<1−607	194	37.8	
85+	47 (31, 63)	13 (6, 20)	<1−367	111	21.7	
Gender						0.793
Female	73 (58, 88)	22 (16, 28)	<1−607	257	50.1	
Male	69 (55, 83)	28 (21, 35)	<1−624	256	49.9	
Primary diagnosis						<0.001
Cancer	83 (70, 97)	37 (29, 45)	1−624	347	67.6	
Non-cancer	44 (29, 60)	11 (7, 15)	<1−493	166	32.4	
Common cancer types						<0.001
Breast	143 (85, 200)	84 (30, 138)	4−513	24	6.9	
Colorectal	85 (55, 116)	59 (38, 80)	2−559	48	13.8	
Lung	59 (40,77)	29 (19,39)	1−369	81	23.4	
Prostate	146 (62, 229)	53 (0, 119)	18−424	13	3.7	
Other cancer	81 (61, 100)	32 (20, 44)	1−624	181	52.2	
Site of first consultation						<0.001
Home	110 (90, 130)	61 (49, 73)	1−624	191	37.2	
Hospital	46 (36, 56)	14 (11, 17)	<1−559	322	62.8	
Initial PPS						<0.001
PPS 10%	5 (1, 9)	2 (1, 3)	<1−22	27	5.3	
PPS 20%	14 (8, 21)	6 (4, 8)	<1−123	71	13.8	
PPS 30%	32 (23, 41)	12 (9, 15)	1−249	118	23.0	
PPS 40%	65 (36, 95)	31 (15, 47)	1−493	56	10.9	
PPS 50%	58 (43, 72)	35 (29, 41)	2−320	88	17.2	
PPS 60%	104 (61, 147)	50 (33, 67)	7−624	56	10.9	
PPS 70%	168 (133, 203)	110 (77, 143)	3−607	81	15.8	
PPS 80%	151 (92, 210)	71 (0, 196)	33−424	16	3.1	

CI = confidence interval.

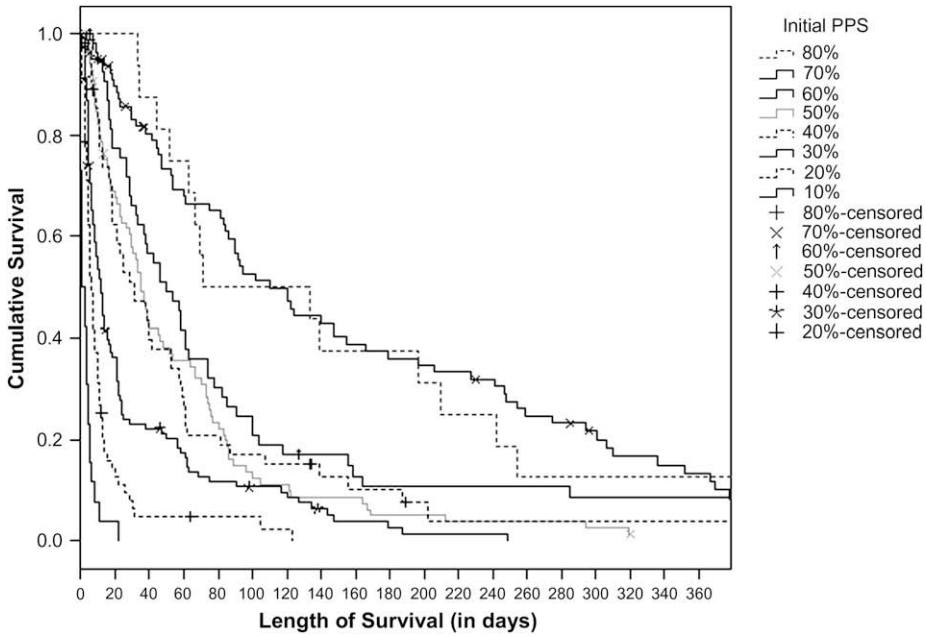

Fig. 1. Kaplan-Meier survival curves by initial PPS.

(PPS 20%) and 0.02 (PPS 10%). We do not consider these to be statistically significant, given our critical level of 0.003, adjusted for multiple comparisons. The reference groups for comparison in the Cox model were male, age 85+, non-cancer diagnosis, first consult site at home, and initial PPS 10%. The results shown in Table 3 reveal that diagnosis and initial PPS were significantly related to hazard for death. For diagnosis, higher hazard ratios were attributed to lung cancer and other cancer patients, suggesting a shorter survival time than those with non-cancer ($P < 0.001$ and $P = 0.001$, respectively). There was no significant difference in hazard ratios between non-cancer patients and those with prostate, colorectal, or breast cancer ($P = 0.504$, $P = 0.114$, and $P = 0.186$, respectively). For PPS, all of the initial PPS categories from PPS 20% to PPS 80% had significantly lower hazards than those with initial PPS 10% ($P < 0.001$) where their 95% CI for the relative hazards were less than one. There is a strong ordering effect across the PPS categories, but with overlapping 95% CIs for the hazard ratios at PPS 40% and above, suggesting difficulty in distinguishing the effects among higher PPS levels. In this model, no significant differences in hazard ratios were found among age, site, and gender ($P = 0.149$, $P = 0.151$, and $P = 0.951$).

Survival Rates Over Time

We constructed a life expectancy table from the KM survival curves to show the respective survival rates for each PPS category (see Table 4). Also included are the number of patients for each PPS category on which the rates are based. From this table, one can see at PPS 10%, that only 13% of patients are expected to survive seven days or longer, 5% to survive 14 days, but none would survive 30 days. In contrast, at PPS 30% one can expect 63% of patients to survive seven days or longer, 42% to survive 14 days, and 23% to survive 30 days. The survival rates continued to improve at higher PPS categories. For instance, we can expect 98% of the patients with an initial PPS 60% to survive seven days and 91% to survive 14 days. At 30 days, we can expect 65% of these patients to be still alive.

Discussion

How Well Can PPS Predict Survival?

In this study, initial PPS of referred patients were obtained at the time of first assessment at home or in the hospital by a regional palliative

Table 3
Hazard Ratios for Age, Diagnosis, Gender, Site and PPS

Variable	Hazard Ratio	95% CI for Hazard Ratio		*P*-value
		Lower	Upper	
Age group (vs. 85+ years)				0.149
<45	0.980	0.555	1.732	0.945
45–64	0.864	0.618	1.210	0.395
65–74	1.171	0.875	1.569	0.288
75–84	0.858	0.659	1.116	0.252
Gender (vs. male)	1.007	0.819	1.237	0.951
Diagnosis–cancer type (vs. non-cancer)				<0.001
Breast	1.393	0.852	2.279	0.186
Colorectal	1.361	0.929	1.993	0.114
Lung	1.955	1.405	2.720	<0.001
Prostate	1.595	1.221	2.084	0.001
Other cancer	1.270	0.630	2.560	0.504
First consult site hospital (vs. home)	1.183	0.940	1.489	0.151
Initial PPS (vs. PPS 10%)				<0.001
PPS 20%	0.402	0.253	0.637	<0.001
PPS 30%	0.204	0.132	0.316	<0.001
PPS 40%	0.099	0.060	0.165	<0.001
PPS 50%	0.099	0.061	0.161	<0.001
PPS 60%	0.062	0.036	0.107	<0.001
PPS 70%	0.039	0.023	0.067	<0.001
PPS 80%	0.046	0.022	0.092	<0.001

care consult team. Analyses reaffirmed that PPS is a significant predictor of survival for patients with a life-threatening illness. The results revealed the survival curves for PPS 10%, PPS 20%, and PPS 30% are distinct from each other, with a strong ordering effect for increasing survival times at higher PPS categories. However, there is no significant difference between the survival curves for PPS 40%, 50%, and 60%. These findings are similar to those reported by Head et al.,[8] although Lau et al.[10] showed significance at lower levels and also between PPS 40%–50%, and may reflect variations in sample size and/or difficulty in assigning mid-range PPS scores.

The PPS is predicated on subjective judgment of various parameters of the instrument. For instance, ambulation is reduced in each increment and self-care varies from "occasional assistance" needed at PPS 60% to "mainly assistance" at PPS 40%. Another is "oral intake" where some patients may be receiving intravenous and/or hyperalimenation (nasogastric, percutaneous endoscopic gastrostomy, or total parenteral nutrition), while others are managed "nothing by mouth" or "as tolerated" according to advance directives and preferences of the patient and substitute decision makers. Instructions for use of PPS from its original authors were further clarified as PPSv2 (see www.victoriahospice.org and Lau et al.[10]). PPSv2 has replaced PPS and should be used in future research. Although these provide guidance in determining the appropriate score, PPSv2 remains a subjective best-fit judgment, as do most functional performance tools.

The presence of the 151 "invalid" PPS cases further exemplifies the problem of mid-range PPS scores. Follow-up discussion with the clinician who provided the data set led to some insight on how these invalid scores were obtained. Because several clinicians assessing PPS in the same patient on a given day came up with different PPS ratings, an "average" was calculated and used in care planning. Only these pooled averages were entered into the database and thus had to be excluded from the study as an incorrect method for calculation. Based on this disclosure, we advocate that, when two or more clinicians assess

Table 4
Survival Rate (%) in Days

PPS Score	Survival Rate (%) in Days[a]											Total Cases
	1	3	5	7	14	30	45	60	90	180	365	
PPS 80%	100	100	100	100	100	100	81	75	46	35	10	16
PPS 70%	100	97	96	95	94	82	76	68	57	36	12	81
PPS 60%	100	100	100	98	91	65	52	41	25	10	7	56
PPS 50%	100	97	94	91	76	57	41	33	14	4	0	88
PPS 40%	98	97	96	88	73	50	36	27	16	8	1	56
PPS 30%	97	87	71	63	42	23	22	17	11	2	0	118
PPS 20%	92	72	53	42	19	8	6	5	4	0	0	71
PPS 10%	52	33	19	13	5	0	0	0	0	0	0	27

[a]Shaded cells represent approximately 50% survival rates at given PPS level.

different PPS scores on a patient, a discussion should occur to determine a best fit rather than averaging the percentages. Of interest is that, when we repeated the analyses combining these 151 in-between cases by rounding up/down the PPS with the 513 cases, there were no differences in the results. But to ensure data accuracy in this study, these cases were not included in the final analysis.

Which Are the Significant Covariates?

Aside from PPS, univariate log-rank analysis found that age group, diagnosis, cancer type, and site to be significant covariates in predicting survival. The Cox model showed no difference in hazard ratios among breast, lung, and prostate cancer patients vs. non-cancer patients. These results are different from the Head et al. study,[8] which showed that dementia/debility and lung disease patients had longer survival than cancer patients, and from the Lau et al. study[10] where male patients had shorter survival than female patients but with statistically similar hazards across cancer and non-cancer status. Such differences are likely due to small sample sizes, and variations in patient characteristics and care settings. We speculate that non-cancer patients had worse prognoses than those with cancer (median survival 11 vs. 37 days) because they were referred to palliative care consult at a very advanced stage.

The survival curves by PPS in this study (see Fig. 1) revealed a widening "tailing effect" similar to the Lau et al. study at PPS 20% and PPS 10%. This tailing effect suggests the presence of other factors beyond functional status and the covariates examined that had prolonged the survival of these patients. Possible factors may include symptoms/signs, tumor type, comorbidities, psychosocial status, treatment decisions to stop/start/not start, biologic makeup, and the environment.[15,16] Further investigation into the influence of these and other factors on survival is needed, especially in patients at PPS 10% and PPS 20%.

Meaningful Reporting of Survival Estimates

A recurring issue in predicting survival of terminally ill patients is the lack of clarity in the time frame used. For instance, it is not uncommon for clinicians to estimate that a patient may have one to four weeks to live given the type of illness. Yet it is not clear whether this estimate represents the actual time the person would live, the best/worst case scenario possible, or the average survival time of similar patients.[17] A further confusion is in the reporting of different forms of survival estimates. One example is the Palliative Prognostic Score with its 30-day survival probabilities.[18] Another is the Lung Cancer Prediction Model with survival times in days at 50% and 90% mortality rates.[19] We believe that the use of median survival and survival rates by PPS can offer a consistent basis for reporting survival estimates. The use of local survival profiles, if available, is desirable when estimating survival because one can account for variations within the local patient population and care setting.

The median survival times by PPS (see Table 2) for which 50% of the patients are expected to survive could be used by clinicians to formulate survival estimates on their own patients if they had similar characteristics to this data sample. Also, the survival rates by PPS (see Table 4) in the form of a life expectancy table could provide a temporal view of the time intervals for which certain percentages of the patients are expected to survive. Yet this article demonstrates the need for calibration within each palliative program. One cannot assume that the data obtained for this cohort, especially where some cases were excluded because of PPS scoring error, would provide the same survival predictions in another setting; it would only be if the patient demographics and the palliative service (here palliative medical consultation) were similar to this cohort. Calibration implies that parameters in this cohort have shown predictive value but unless the inception cohort (similar in time of entry, e.g., early- vs. late-stage illness) is similar, then the tables cannot be readily extrapolated to another setting.

Study Limitations

There were several limitations in this study. First, the small sample size, such as low case counts for PPS 10% and PPS 80%, could influence the results. Second, the presence of "in-between" PPS scores in the original data set which, although excluded in this analysis, could cast doubts on the credibility of the study. Third, the large number of cases grouped under "Other Cancer" for this analysis to be

comparable to the Lau et al.[10] study leave unanswered questions on the exact nature of these cases. This underscores the need for multisite, large population analyses where both cancer and non-cancer categories are subdivided into individual diseases rather than broad groupings. Lastly, there is the need to validate the accuracy of the reported survival estimates using an independent cohort. Readers are cautioned to exercise their clinical judgment when applying these findings to their own patients and settings.

Conclusion

Initial PPS obtained through first consult at home or in hospital is a significant predictor of survival for patients with a life-threatening illness. As such, PPS can be a useful prognostic tool in a broader regional care setting beyond the palliative care inpatient unit. However, the covariates found as significant in this study differ somewhat from those in earlier publications and illustrate the impacts of variations between regional program data and factors such as small sample sizes, patient characteristics, and care settings. We advocate the consistent use of median survival and survival rates from a local patient cohort where feasible as the basis for formulating and reporting survival estimates on individual patients.

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References

1. Kirk P, Kirk I, Kristjanson LJ. What do patients receiving palliative care for cancer and their families want to be told? A Canadian and Australian qualitative study. Br Med J 2004;328:1343–1350.

2. Glare P, Virik K, Jones M, et al. A systematic review of physicians' survival predictions in terminally ill cancer patients. Br Med J 2004;327:195–205.

3. Chow E, Harth T, Hruby G, et al. How accurate are physicians' clinical predictions of survival and the available prognostic tools in estimating survival times in terminally ill cancer patients? A systematic review. Clin Oncol 2001;13(3):209–218.

4. Anderson F, Downing MG, Hill J, Casorso L, Lerch N. Palliative Performance Scale (PPS): a new tool. J Palliat Care 1996;12(1):5–11.

5. Morita T, Tsunoda J, Inoue S, Chihara S. Validity of the Palliative Performance Scale from a survival perspective. J Pain Symptom Manage 1999;18(1):2–3.

6. Virik K, Glare P. Validation of the Palliative Performance Scale for inpatients admitted to a palliative care unit in Sydney, Australia. J Pain Symptom Manage 2002;23(6):455–456.

7. Harrold J, Rickerson E, Carroll JT, et al. Is the Palliative Performance Scale a useful predictor of mortality in a heterogeneous hospice population? J Palliat Med 2005;8(3):503–509.

8. Head B, Ritchie CS, Smoot TM. Prognostication in hospice care: can the Palliative Performance Scale help? J Palliat Med 2005;8(3):492–502.

9. Olajide O, Hanson L, Usher B, et al. Validation of the Palliative Performance Scale in the acute tertiary care hospital setting. J Palliat Med 2007;10(1): 111–117.

10. Lau F, Downing M, Lesperance M, Shaw J, Kuziemsky C. Use of Palliative Performance Scale in end-of-life prognostication. J Palliat Med 2006; 9(5):1066–1075.

11. Maida V, Corbo M, Dolzhykow M, et al. Wounds in advanced illness: a prevalence and incidence study based on a prospective case series. Int Wound J 2008;5(2):305–314.

12. Lawless J. Statistical models and methods for lifetime data, 2nd ed. New York: Wiley, 2003.

13. Kalbfleisch JD, Prentice R. Statistical analysis of failure time data, 2nd ed. New York: Wiley, 2002.

14. Grambsch P, Therneau T. Proportional hazards tests and diagnostics based on weighted residuals. Biometrika 1994;81:515–526.

15. Glare P. Clinical predictors of survival in advanced cancer. J Support Oncol 2005;3(5): 331–339. Available at www.SupportiveOncology.net. Accessed August 5, 2008.

16. Vigano A, Dorgan M, Buckingham J, Bruera E, Suarez-Almazor ME. Survival prediction in terminal cancer patients: a systematic review of the medical literature. Palliat Med 2000;14:363–374.

17. Glare P, Christakis N. Predicting survival in patients with advanced disease. In: Doyle D, Hanks G, Cherny N, Calman K, eds. Oxford textbook of palliative medicine, 3rd ed. Oxford: Oxford University Press, 2005: 29–42.

18. Maltoni M, Nanni O, Pirovano M, et al. Successful validation of the Palliative Prognostic Score in terminally ill cancer patients. J Pain Symptom Manage 1999;17(4):240–247.

19. Schonwetter RS, Robinson BE, Ramirez G. Prognostic factors for survival in terminal lung cancer patients. J Gen Intern Med 1994;9:356–371.