JOURNAL OF PALLIATIVE MEDICINE
Volume 8, Number 3, 2005

Is the Palliative Performance Scale a Useful Predictor of Mortality in a Heterogeneous Hospice Population?

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ABSTRACT

Background: **Hospices provide care to patients with a wide range of prognoses, and must develop care plans that anticipate each patient's likely illness trajectory. However, the tools available to guide prognostication and care planning in this population have limited data to support their use. For instance, one of the most widely-used prognostic tools, the Palliative Performance Scale (PPS), has been studied primarily in inpatient settings and in patients with cancer. Its prognostic value in a heterogeneous US hospice population is unknown.**

Objective: **The goal of this study was to evaluate the prognostic value of the PPS as a predictor of mortality in a heterogeneous hospice population, and to determine whether it performs equally well across diagnoses and sites of care.**

Design: **Prospective cohort study using existing medical records.**

Setting/Subjects: **This study was conducted at a large community hospice program, and included all patients enrolled in hospice during the study period.**

Measurements: **Each patient's PPS score was recorded at the time of enrollment and patients were followed until death or discharge from hospice.**

Results: **A total of 466 patients enrolled in hospice during the study period. The PPS score was a strong independent predictor of mortality (log rank test of Kaplan Meier survival curves $p < 0.001$). Six-month mortality rates for 3 PPS categories were 96% (for PPS scores 10–20), 89% (for PPS scores 30–40), and 81% (for PPS scores ≥50). Evaluation of interaction terms in Cox proportional hazards models demonstrated a stronger association between PPS score and mortality among nursing home residents and patients with non-cancer diagnoses. Analysis of the area under receiver operating characteristic curves demonstrated strong predictive value overall, with somewhat greater accuracy for nursing home residents and patients with non-cancer diagnoses.**

Conclusion: **The PPS performs well as a predictor of prognosis in a heterogeneous hospice population, and performs particularly well for nursing home residents and for patients with non-cancer diagnoses. The PPS should be useful in confirming hospice eligibility for reimbursement purposes and in guiding plans for hospice care.**

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INTRODUCTION

Although most patients who enroll in hospice die very soon, their survival is also highly variable. For instance, the national median length of hospice service is approximately 21 days, and one-third of patients enroll in the last week of life.[1] However, some patients survive for several months after enrollment and a few (approximately 5%) live for more than 6 months.[1] This variability makes it very challenging for referring physicians to predict prognosis accurately.[2] In addition, it is often very difficult for hospice providers to develop care plans that accurately anticipate their patients' trajectories of decline and death.

Several simple rating scales have been developed to allow clinicians to predict prognosis using readily available clinical data. Some of these, like the Eastern Cooperative Oncology Group Performance Status (ECOG-PS) have been developed and validated primarily cancer patients.[3–5] Others, such as the Karnofsky Performance Scale, have been used in other populations, but have scale categories that make them less suitable for a hospice population (e.g. "need for hospitalization").[6] The most promising prognostic scale for use with hospice patients is the Palliative Performance Scale (PPS).[7] A modification of the Karnofsky, the PPS has been found to have good construct validity and interrater reliability and appears to be a good predictor of mortality for patients in palliative care units.[8,9]

Anecdotal data suggest that the PPS is becoming a widely used screening tool for hospice admission for many large hospice organizations. However, published reports of the PPS's prognostic accuracy come from palliative care inpatient populations, and these data are drawn mostly from cancer patients.[7–9] The PPS has not been adequately evaluated as a predictor of prognosis in home-dwelling patients, nursing home residents, and patients with noncancer diagnoses. It is particularly important to evaluate the PPS's predictive value in these hospice patients because approximately 80% of hospice care in the United States is delivered in these settings and at least half of U.S. hospice patients are admitted with non-cancer diagnoses.[1]

There are at least two ways in which the PPS could improve the care of hospice patients, if it is found to have acceptable predictive ability. First, more accurate prognostic estimates would help hospice staff to develop care plans that anticipate imminent death, ensuring that resources are mobilized quickly for these patients. Second, more accurate prognostic estimates could help hospices to justify the appropriateness of admissions to fiscal intermediaries that review the appropriateness of hospice admissions.

Therefore, the goals of this study were to examine the prognostic accuracy of PPS in a U.S. hospice population and to determine whether its accuracy is affected by diagnosis or site of care.

METHODS

Sample and recruitment

This study was conducted at the Hospice of Lancaster County (Lancaster, Pennsylvania) over a 12-month period spanning 2003–2004. This not-for-profit hospice has a daily census of approximately 400 patients and provides care in patients' homes, nursing homes, hospital acute care settings, and a freestanding inpatient hospice unit. All first-time hospice admissions were eligible.

Data collection

For all patients, a PPS score was recorded at the time of enrollment by a trained hospice intake nurse as part of the routine intake process. This score was recorded only once. The PPS was originally developed for a hospice population, and measures five domains: (1) ambulation, (2) activity and evidence of disease, (3) independence in self-care, (4) oral intake, and (5) level of consciousness.[7] Each domain is arrayed on a scale from 10 (bedbound) to 100 (full ambulation). A score of 0, corresponding to death, anchors the lower end of the scale. Raters evaluate domains in the order described above, and so the first domains contribute most to the composite score. Raters then generate a global score that reflects the best composite of the five domains. Although interrater reliability was not reported in the initial validation study, our own pilot testing ($n = 30$) demonstrated good interrater reliability (quadratically weighted kappa = 0.67; $p < .001$). A revised version of the PPS has recently become available, which includes minor differences in the scores assigned to some levels of a domain.[10] However, it is similar in most respects to the original, which was used in this study.

Hospice staff reviewed medical records and extracted demographic data and admitting diagnosis. To maximize the usefulness of these data to hospice care plans that are developed at admission, site of care was defined at the time of enrollment. Thus a patient would be defined as living at home even if, at some point during his hospice stay, he spent time in other sites. Hospice staff then reviewed patient records weekly to identify deaths and discharges from hospice. This study was approved by the University of Pennsylvania Institutional Review Board.

Data analysis

Summary statistics were generated to describe the distribution of PPS scores in the study sample and in the subgroups of interest. Next, mortality rates were calculated for three PPS score categories: 10–20, 30–40, and ≥50, which represent approximately equal divisions of the PPS scores in this sample.

We first tested the relationship between PPS score and mortality with Kaplan–Meier survival curves. Next, we plotted survival data to determine that the proportional hazards assumption was valid.[11,12] Next, to examine the PPS's performance in the subgroups of interest (e.g., groups defined by site of care and diagnosis), we evaluated the significance of interaction terms (PPS × diagnosis; PPS × site of care) in Cox proportional hazard models. When interaction terms were significant, we then compared the PPS's predictive value in each subgroup (e.g., cancer vs. noncancer) by calculating its ability to predict death at 1, 3, 7, 30, and 90 days after enrollment. For these analyses, predictive accuracy was measured by calculating the area under the receiver operating characteristic (ROC) curve.[13]

Table 1. Patient Characteristics (n = 466)

Age: mean	78
Sex: male (%)	213 (46)
Ethnicity: white (%)	442 (95)
PPS score: mean (range)	38 (10–70)
Marital status: n (%)	
Married or living with partner	219 (47)
Widowed	194 (42)
Single or divorced	51 (11)
Missing	2 (0)
Site of care: n (%)[a]	
Community	305 (65)
Nursing home or assisted living	161 (34)
Primary diagnosis: n (%)[a]	
Cancer	214 (46)
Cardiac disease	70 (15)
Dementia	44 (9)
Debility (failure to thrive)	34 (7)
Pulmonary disease	25 (5)
Stroke	24 (5)
Renal failure or disease	16 (3)
Other neurological disease (excludes dementia)	11 (2)
Other or not specified	28 (6)

[a]Percents may not add to 100 because of rounding.

RESULTS

Medical records were examined for 468 consecutive enrollment visits. Of these, PPS scores were recorded for 466, who comprise the study sample. All patients' hospice course could be followed for at least 5 months after enrollment. At the time of the last chart review, 422 study patients had died (90.6%), 38 were still alive (8.1%), and 6 had been discharged (1.3%).

Most characteristics of these patients (described in Table 1) are typical of hospices nationwide.[1] Although the proportion of minorities (5%) is lower than national figures (18%),[1] it is representative of this hospice's service area. The mean PPS of the sample was 38 (standard deviation = 13.5; range 10–70). Because there were so few patients with PPS scores of 60 or 70 and no patients with a score ≥80, scores of 60 and 70 were combined and evaluated as a single group. Crude mortality rates (not accounting for censoring or incomplete follow-up) were examined for PPS scores of 10–20, 30–40, and 50–70 (Table 2).

To examine the PPS's ability to predict early versus late deaths, ROC curve areas were plotted for survival at five times (1, 3, 7, 30, and 90 days after enrollment). These results (Fig. 1) suggest that the PPS is most accurate in predicting early deaths (≤1 week). The PPS became less accurate in predicting later deaths and was only somewhat better than chance at predicting deaths at 90 days.

Next, survival was examined using time to event analysis to account for censoring of observations due to discharge or variable periods of follow-up. In Kaplan–Meier survival curves the PPS was strongly predictive of mortality (log-rank test $p < .001$) (Fig. 2). Using these curves, patients admitted with a PPS score of 40 or 50 had an 80% mortality at 6 months. For patients with PPS scores of 60 or 70, 6-month mortality was only somewhat lower (73%). Therefore, at least in

Table 2. Mortality Rates Stratified by PPS Score

		PPS 10–20				*PPS 30–40*				*PPS 50–70*			
Death on or before:		*7 days*	*30 days*	*90 days*	*180 days*	*7 days*	*30 days*	*90 days*	*180 days*	*7 days*	*30 days*	*90 days*	*180 days*
Mortality (all patients)		*72%*	*91%*	*96%*	*96%*	*22%*	*58%*	*80%*	*89%*	*6%*	*33%*	*69%*	*81%*
Site of care	Nursing home	79%	92%	95%	95%	17%	57%	77%	88%	6%	35%	71%	76%
	Community	64%	90%	97%	100%	24%	58%	82%	90%	7%	24%	59%	82%
Diagnosis	Cancer	50%	62%	100%	100%	20%	60%	88%	95%	5%	36%	75%	84%
	Noncancer	74%	94%	96%	97%	23%	57%	76%	85%	9%	27%	56%	75%

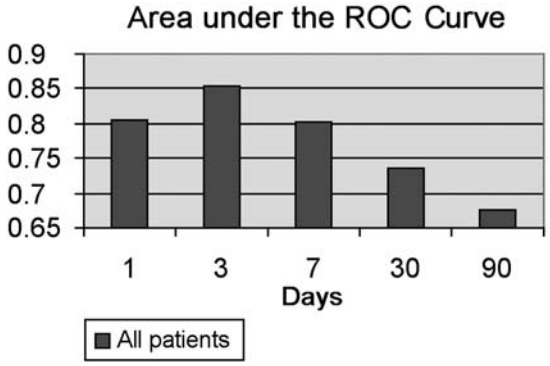

FIG. 1. Prognostic accuracy.

this population, a PPS score of 70 or less at the time of hospice enrollment was associated with a very poor prognosis.

Univariate Cox proportional hazards modeling demonstrated a significant effect of PPS score on survival (hazard ratio = 0.96; $p < .001$). None of the other patient characteristics described in Table 1 was associated with survival in either univariate or multivariable proportional hazards models. Significant interaction terms were identified between PPS score and diagnosis (cancer vs. noncancer) and site (nursing home vs. community), indicating that these characteristics influence the relationship between PPS score and survival. Stratified analysis of the PPS's prognostic value in these subgroups is described next.

SITE OF CARE: PROGNOSTIC VALUE OF THE PPS IN NURSING HOME RESIDENTS AND COMMUNITY-DWELLING PATIENTS

In this sample, nursing home residents had higher PPS scores than did community-dwelling patients (mean 40 vs. 34; rank sum test: $p < .001$) and were older (mean 85 years vs. 75 years, rank sum test: $p < .001$). Nursing home residents were also more likely to be female (χ^2 test: $p < .001$, 68% vs. 47%), white (χ^2 test: $p = .006$, 99% vs. 93%), and less likely to be married (χ^2 test: $p < .001$, 28% vs. 60%). Nursing home residents were also less likely to have a hospice admitting diagnosis of cancer (χ^2 test: $p < .001$, 21% vs. 57%).

For PPS scores of 10–20, nursing home residents had somewhat higher 7-day mortality rates (79% vs. 64%), but had equivalent rates at 30, 90, and 180 days (Table 2). For patients with scores of ≥30, there was no clear difference in PPS-associated mortality between nursing home residents and community-dwelling patients. The predictive accuracy of the PPS in these two groups is described graphically in Fig. 3. Overall, the PPS offers somewhat better predictive accuracy for nursing home residents than it does for community-dwelling patients.

DIAGNOSIS: PROGNOSTIC VALUE OF THE PPS IN PATIENTS WITH CANCER AND NONCANCER DIAGNOSES

Patients with an admitting diagnosis of cancer had higher PPS scores than did patients with other diagnoses (mean 45 vs. 32; rank sum test: $p < .001$). Cancer patients were also younger than patients with noncancer diagnoses (mean age 73 vs. 83; rank sum test: $p < .001$) and more likely to be married (54% vs. 41%; χ^2 test: $p = .004$). They were also more likely to reside in the community (72% vs. 33%; χ^2 test: $p < .001$).

For a given PPS value, patients with noncancer diagnoses had higher mortality rates at 7 days and 30 days compared with cancer patients, but lower mortality rates at 90 and 180 days (Table 2). The predictive accuracy of the PPS in these two groups is described graphically in Fig. 4. Although the PPS appears to offer slightly better accuracy in predicting early deaths in cancer patients, its predictive accuracy overall is better for patients with noncancer diagnoses.

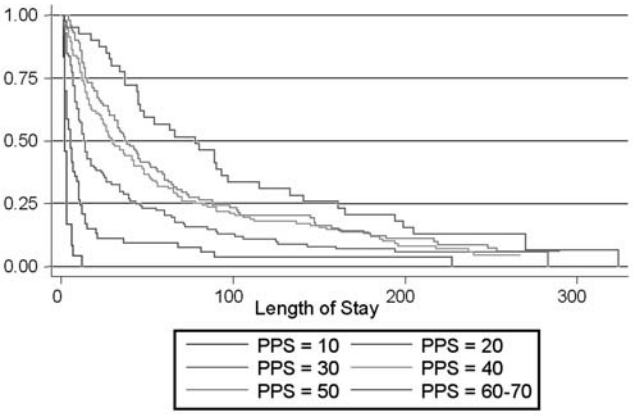

FIG. 2. Kaplan–Meier survival curves by PPS score.

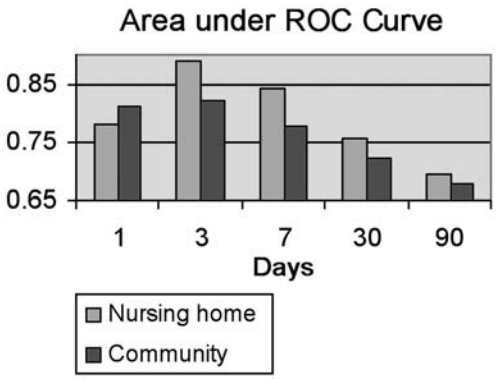

FIG. 3. Accuracy of prediction of mortality by site of care.

DISCUSSION

Hospices face considerable pressures in providing care to patients and families very near the end of life. Care planning under these circumstances requires that hospice teams mobilize services rapidly and respond quickly to meet needs that they identify. To do this effectively, it is essential that hospices are able to identify those patients who are likely to die very soon. Although the PPS is widely used in this way, its value as a predictor of prognosis in a general hospice population has not been adequately evaluated. The results of this study offer several important insights into the use of the PPS as a prognostic tool for patients who have enrolled in hospice.

First, in this study the PPS was a valuable prognostic tool for use in patients who have enrolled in hospice. As a single-variable predictor of mortality, it appears to perform at least as well as the ECOG or Karnofsky performance status scores have been demonstrated to in cancer patients.[4,14] Moreover, it does so remarkably well in a heterogeneous hospice population.

Second, the PPS performed somewhat better as a predictor of prognosis in nursing home residents and in noncancer patients. In fact, it appears that the PPS offers even greater value as a predictor of mortality in a typical hospice population than it does for inpatients and patients with cancer, the population in which it has been primarily studied.[7–9] These findings provide further support for the use of the PPS as a prognostic tool for hospice patients, many of whom are in nursing homes or have noncancer diagnoses, or both.

Third, these findings have important implications for determinations about hospice reimbursement based on prognosis. In this population, the 6-month mortality estimate based on Kaplan–Meier plots for PPS scores of 40–50 was 80%. Even for the highest PPS scores in this sample (60–70), the 6-month mortality estimate was 73%. Therefore, for patients with a PPS score of ≤70 at the time of hospice enrollment, survival for greater than 6 months is unlikely.

This finding is particularly important because existing diagnosis-based hospice eligibility criteria[15] do not perform well.[16] Therefore, in discussions with fiscal intermediaries, hospices may find that the PPS provides useful evidence of a poor prognosis, particularly when a patient's score is very low. For instance, these results indicate that a hospice could predict with a high degree of certainty that a patient with a PPS score of 10–20 at the time of admission would be very unlikely to survive for 6 months and should be appropriate for hospice. More broadly, these results demonstrate that even patients with PPS scores of 50–70 at the time of hospice enrollment are more likely than not to die within 6 months. Thus even these relatively high functioning patients meet the general prognostic criteria for hospice enrollment.[17]

There are at least two limitations of this study that should be considered in interpreting and applying its findings to clinical care. First, this study included survival data for only one hospice. Although this hospice's population is typical of other hospices nationwide in many respects, including its typical lengths of stay, a variety of other local factors may limit the degree to which these data are applicable to other settings. These factors, and particularly patient characteristics

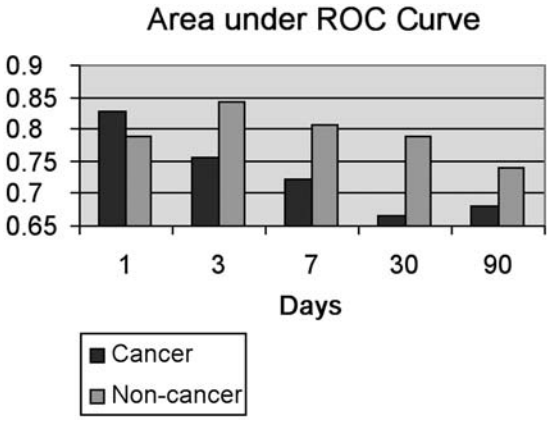

FIG. 4. Accuracy of prediction of mortality by diagnosis.

such as ethnicity, should be considered in future studies. Second, because the range of PPS scores in this population was truncated (10–70), these results do not permit an analysis of the prognostic utility of higher PPS scores. Although this is a theoretical limitation, the PPS distribution described here is similar to that reported in previous studies.[7–9] Moreover, it is unlikely that a typical hospice population would enroll significant numbers of patients with higher PPS scores. Therefore, these results should be applicable to most U.S. hospice populations.

Hospices face considerable time pressures to provide the best possible care to patients and families in the last days of life. Trends toward shorter lengths of stay suggest that these pressures are likely to increase in the future. Therefore, it will be essential to develop and refine prognostic tools, like the PPS, that can guide care planning and help to ensure that patients and families receive the services that they need during short lengths of stay in hospice.

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