

Can Hospices Predict which Patients Will Die within Six Months?

Pamela S. Harris, MD, FAAPMR,¹ Tapati Stalam, BA,² Kevin A. Ache, DO,³ Joan E. Harrold, MD, MPH,⁴ Teresa Craig, CPA,⁵ Joan Teno, MD, MS,⁶ Eugenia Smither, RN, BS, CHC, CHE, CHP,⁷ Meredith Dougherty, MS⁸ and David Casarett, MD, MA⁸

Abstract

Objective: To determine whether it is possible to predict, at the time of hospice enrollment, which patients will die within 6 months.

Design: Electronic health record-based retrospective cohort study.

Setting: Patients admitted to 10 hospices in the CHOICE network (Coalition of Hospices Organized to Investigate Comparative Effectiveness).

Participants: Hospice patients.

Main outcome measures: Mortality at 6 months following hospice admission.

Results: Among 126,620 patients admitted to 10 hospices, 118,532 (93.6%) died within 6 months. In a multivariable logistic regression model, five characteristics were independent predictors of 6-month mortality. For instance, patients younger than 65 years were less likely to die within 6 months (odds ratio [OR] 0.64; 95% confidence interval [CI] 0.45–0.91; $p=0.014$). Conversely, male patients were more likely to die within 6 months (OR 1.47; 95% CI 1.05–2.02; $p=0.036$). After adjusting for other variables in this model, there were several subgroups with a low probability of 6-month probability (e.g., stroke and Palliative Performance Scale [PPS] score=50; adjusted probability of 6-month mortality=39.4%; 95% CI: 13.9%–72.5%). However, 95% confidence intervals of these 6-month mortality predictions extended above 50%.

Conclusions: Hospices might use several variables to identify patients with a relatively low risk for 6-month mortality and who therefore may become ineligible to continue hospice services if they fail to show significant disease progression.

Introduction

SINCE THE ESTABLISHMENT of the Medicare Hospice Benefit in 1982, use of hospice for end-of-life care has grown steadily. The number of patients served by hospices increased from 1,300,000 in 2006 to 1,650,000 in 2012. The National Hospice and Palliative Care Organization estimates that 44.6% of patients who died in 2011 received hospice care.¹

Most patients enroll in hospice very close to the time of death. For instance, approximately half will die within 3 weeks and 35.7% of patients die within 1 week. Moreover,

among all patients, the percentage referred to hospice for just 3 days or less doubled over the past decade to 9.8% from 4.6%.²

However, a significant minority of patients (12%–15%) survive 6 months or more.^{3,4} Little is known about this population and how these patients differ from those with a more abrupt decline. Nor is it known whether hospices might be able to accurately predict which patients are likely to survive longer than 6 months.

These questions are important because Medicare eligibility criteria require patients to have a life expectancy of 6

¹Kansas City Hospice and Palliative Care, Kansas City, Missouri.

²Albany Medical College, Albany, New York.

³Suncoast Hospice, Clearwater, Florida.

⁴Hospice of Lancaster County, Lancaster, Pennsylvania.

⁵Consultant, Dunedin, Florida.

⁶Brown University School of Public Health, Providence, Rhode Island.

⁷Hospice of the Bluegrass, Lexington, Kentucky.

⁸Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania.

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months or less if their disease takes its natural course. Hospices must carefully evaluate each patient's prognosis, and the patient's physician must certify that the patient meets this criterion. However, if physicians and hospices can predict which patients are likely to have a long survival, they can more intensely monitor those patients regarding disease progression. They can also better prepare patients and families for discharge if needed. Therefore, the goal of this study was to define the characteristics of hospice patients that are associated with a survival of more than 6 months.

Methods

Patient data were extracted from the electronic medical records of 10 hospices in the CHOICE network (Coalition of Hospices Organized to Investigate Comparative Effectiveness).⁵ CHOICE is a research-focused network of hospices that all use Suncoast Solutions Electronic Health Record (EHR) software and that have agreed to share their data for research purposes. CHOICE projects are defined and approved by a steering committee comprising leaders from all hospices in the network. Participating hospice range in size from 400–1700 patients per day and are located in New Mexico, California, Florida, Pennsylvania, Wisconsin, Michigan, Ohio, Texas (2 hospices), and Kansas/Missouri. All are not-for-profit.

CHOICE obtains data from a data warehouse (Solutions Intelligence) that participating hospices use for tracking, quality measurement, and benchmarking. Warehouse data reside on a secure server that is managed by Suncoast Solutions. Extracted data are then stripped of identifiers in order to create a Health Insurance Portability and Accountability Act (HIPAA)-compliant limited dataset that is transferred as an encrypted file to the University of Pennsylvania for analysis.

Patients were included if they were admitted to a participating hospice between January 1, 2008 and May 15, 2012. We first extracted a dataset containing basic demographic variables (age, gender, race) and diagnoses (admitting diagnosis and up to three additional diagnoses). Debility or general decline was an allowable terminal diagnosis during the timeframe of this study and was included as a separate diagnostic category.

Coding also included site of care at the time of enrollment (home, long-term care facility, hospital, hospice inpatient unit). We also extracted clinical data elements that were markers of the severity of the illness and the complexity of care (e.g., presence of pain, use of oxygen, presence of intravenous access). We extracted Palliative Performance Scale (PPS) scores for each patient. The PPS is an 11-point scale (scored 0–100 in 10-point increments) in which higher numbers indicate better function.⁶ Like the Karnofsky Performance Scale, the PPS assesses functional status. However, unlike the Karnofsky scale, which focuses on ambulation and self-care, the PPS assesses five domains: (1) ambulation (range, bed-bound to full); (2) activity (unable to work to normal); (3) self-care (completely dependent to completely independent); (4) intake (mouth care only to full diet); and (5) level of consciousness (drowsy or coma to fully alert). Scoring proceeds in this order, so that the first categories (e.g., ambulation, activity) are given the greatest weights. We initially described the PPS score as a continuous variable. In subsequent analysis, for ease of interpretation in calculating predicted survivals we grouped PPS scores into 5 categories

(10–20, 30, 40, 50, ≥ 60) based on previous studies of prognosis in hospice patients.^{7,8}

In examining mortality, we divided the sample into those who died prior to 6 months and those who were still alive at 6 months. When patients were discharged because they no longer met hospice prognostic eligibility criteria, we treated them as if they lived for 6 months. Patients who were discharged for other reasons (e.g., voluntary withdrawal or transfer to a facility with which the hospice does not have a contract) were excluded.

To identify potential predictors of 6-month mortality, we examined each patient characteristic in Table 1 in univariate logistic regression models. For these and all subsequent models, we used bootstrapped confidence intervals with 50 replications, and robust standard errors clustered by hospice. We then considered all potential predictors ($p < 0.25$) in a forward stepwise logistic regression model. We retained characteristics in the final model if they were independent predictors of 6-month mortality. Finally, we used that model to estimate the predicted 6-month mortality of patients in the sample, stratified by diagnosis and PPS score, and adjusted for the other characteristics in the model.

In estimating power, we anticipated a sample of at least 118,000 patients and a 6-month mortality rate of 86%. This would provide adequate power ($1 - \beta = 0.93$; $\alpha = 0.05$) to detect a 1.3% difference in mortality (15% versus 16.3%), even if a characteristic were present in 5% of the population.

Stata statistical software (Stata MP2 version 11.0; Stata-Corp, College Station, TX) was used for all analysis. The University of Pennsylvania Institutional Review Board provided approval for use of secondary data.

Results

A total of 126,620 patients were admitted to 10 hospices between June 1, 2008 and June 30, 2012. Of these, 8088 patients (6.4%) left hospice voluntarily within 180 days and were excluded. Of the remaining 118,532 patients, 1274 (1.1%) were discharged from hospice in the first 6 months of care because their prognosis was believed to exceed 6 months. An additional 14,607 (12.3%) of patients were alive at 6 months. We counted both groups of patients in the sample as surviving for 6 months ($n = 15,878$, 13.4%), leaving 102,654 (86.6%) who were coded as having died within 6 months. The mean and median lengths of stay for all patients in the sample (alive and dead) were 63 days and 18 days, respectively. The characteristics of the 118,532 patients in the sample are described in Table 1.

In univariate analysis (Table 1), patients admitted to hospice in a hospice unit or hospital were more likely to die within 6 months (odds ratio [OR] 4.31; 95% confidence interval [CI] 4.07–4.57; $p < 0.001$). Conversely, patients with a diagnosis of dementia (OR 0.14; 95% CI 0.13–0.15; $p < 0.001$) or debility (OR 0.18; 95% CI 0.17–0.19; $p < 0.001$) were less likely to die within 6 months. Additionally, 6-month mortality was also associated with lower (worse) PPS scores. For instance, compared to patients with a PPS score of 10 or 20, those with a PPS score of 30 had a significantly lower probability of 6-month mortality (OR 0.23; 95% CI 0.21–0.24; $p = 0.001$). Patients with a PPS score ≥ 60 had the lowest probability of 6-month mortality (OR 0.12; 95% CI 0.11–0.13; $p < 0.001$).

TABLE 1. CHARACTERISTICS AND OUTCOMES OF HOSPICE PATIENTS (N=118,532)

<i>Patient characteristics (n=118,532)</i>	<i>Patients who died within 6 months</i>	<i>Odds ratio (95% confidence interval)</i>	<i>p value</i>
Age			
≥ 65 (97,068)	82,425 (84.9%)		
< 65 (21,464)	20,229 (94.2%)	0.34 (0.32–0.36)	< 0.001
Gender			
Women (64,588)	54,965 (85.1%)		
Men (53,944)	47,689 (88.4%)	1.33 (1.29–1.38)	< 0.001
Hospice			
0 (6487)	5,653 (87.1%)	—	—
1 (12,446)	11,276 (90.6%)	1.42 (1.29–1.56)	< 0.001
2 (5095)	4,397 (86.3%)	0.93 (0.83–1.04)	0.184
3 (11,840)	11,025 (93.1%)	2.00 (1.80–2.21)	< 0.001
4 (11,118)	9,799 (88.1%)	1.10 (1.00–1.20)	0.052
5 (29,863)	24,754 (82.9%)	0.71 (0.66–0.77)	< 0.001
6 (9085)	7,005 (77.1%)	0.50 (0.46–0.54)	< 0.001
7 (7520)	6,745 (89.7%)	1.28 (1.16–1.42)	< 0.001
8 (2409)	2,182 (90.6%)	1.41 (1.21–1.66)	< 0.001
9 (22,669)	19,818 (87.4%)	1.03 (0.94–1.11)	0.550
Race			
Non-white (8,604)	6593 (76.6%)	—	—
White (107,960)	87,721 (81.3%)	1.46 (1.38–1.56)	< 0.001
Missing (10,056)	8340 (82.9%)	—	—
Location at admission			
Home (57,967)	48,591 (83.8%)	—	—
Nursing home or hospice (26,473)	21,431 (81.0%)	0.82 (0.79–0.85)	< 0.001
Hospital/inpatient unit (34,092)	32,632 (95.7%)	4.31 (4.07–4.57)	< 0.001
Primary diagnoses			
Cancer (45,601)	43,301 (95.0%)	—	—
Debility (13,466)	10,336 (76.8%)	0.18 (0.17–0.19)	< 0.001
Cardiovascular disease (16,522)	13,326 (80.7%)	0.22 (0.21–0.23)	< 0.001
Dementia (11,931)	8605 (72.1%)	0.14 (0.13–0.15)	< 0.001
Pulmonary (8037)	6703 (83.4%)	0.27 (0.25–0.29)	< 0.001
Stroke (5559)	4422 (79.5%)	0.21 (0.19–0.22)	< 0.001
Other (17,416)	15,961 (91.6%)	0.58 (0.54–0.62)	< 0.001
Married (80,831)	68,262 (84.5%)	—	—
Unmarried (37,701)	34,392 (91.2%)	1.91 (1.84–1.99)	< 0.001
No catheter (85,069)	73,752 (86.7%)	—	—
Foley catheter (33,463)	28,902 (86.4%)	0.97 (0.94–1.01)	0.137
No oxygen (73,289)	63,985 (87.3%)	—	—
Oxygen (45,243)	38,669 (85.5%)	0.86 (0.83–0.88)	< 0.001
No advance directive (84,151)	74,693 (88.8%)	—	—
Advance directive (34,381)	27,961 (81.3%)	0.55 (0.53–0.57)	< 0.001
No DNR order (49,637)	43,130 (86.9%)	—	—
DNR (68,895)	59,524 (86.4%)	0.96 (0.93–0.99)	0.014
No ulcer (109,182)	96,003 (87.9%)	—	—
Pressure ulcer (9350)	6651 (71.1%)	0.34 (0.32–0.36)	< 0.001
No enteral tube (108,980)	94,444 (86.7%)	—	—
Gastrostomy or jejunostomy tube (9,552)	8210 (86.0%)	0.94 (0.89–1.00)	0.050
PPS Score			
< 30 (26,005)	25,190 (96.9%)	—	—
30 (22,227)	19,437 (87.4%)	0.23 (0.21–0.24)	< 0.001
40 (24,792)	19,878 (80.2%)	0.13 (0.12–0.14)	< 0.001
50 (19,900)	15,355 (77.2%)	0.11 (0.10–0.12)	< 0.001
≥ 60 (5,731)	4484 (78.2%)	0.12 (0.11–0.13)	< 0.001
Missing (19,877)	18,310 (92.1%)	—	—

DNR, do not resuscitate; PPS, Palliative Performance Scale.

TABLE 2. INDEPENDENT PREDICTORS OF SIX-MONTH MORTALITY FOLLOWING HOSPICE ADMISSION

	<i>Odds ratio</i>	<i>95% confidence interval</i>	<i>p value</i>
Age: <65 years old	0.64	0.45–0.91	0.014
Male	1.47	1.05–2.02	0.036
Location at admission			
Nursing home or hospice	1.09	0.63–1.88	0.769
Hospital or inpatient unit	2.19	1.76–2.65	0.004
PPS score			
<30	—	—	—
30	0.22	0.09–0.55	0.001
40	0.10	0.03–0.34	<0.001
50	0.07	0.02–0.18	<0.001
>60	0.04	0.01–0.14	<0.001
Diagnosis			
Cancer	—	—	—
Debility	0.12	0.07–0.20	<0.001
Cardiovascular disease	0.16	0.10–0.25	<0.001
Dementia	0.07	0.03–0.16	<0.001
Pulmonary disease	0.22	0.19–0.26	<0.001
Stroke	0.05	0.02–0.15	<0.001
Other	0.39	0.28–0.53	<0.001

PPS, Palliative Performance Scale.

In a multivariable model, there were five characteristics that were independent predictors of 6-month mortality (Table 2). For example, patients younger than 65 years were less likely to die within 6 months (OR 0.64; 95% CI 0.45–0.91; $p=0.014$). Conversely, male patients were more likely to die within 6 months (OR 1.47; 95% CI 1.05–2.02; $p=0.036$). Patients admitted to hospice from a hospital or inpatient hospice unit were also more likely to die within 6 months (OR 2.19; 95% CI 1.76–2.65; $p=0.004$). Similarly, patients with lower PPS scores were also more likely to die than those with higher PPS scores (Table 2).

Using this multivariable model, and adjusting for all variables in Table 2, we calculated 6-month mortality rates, stratified by admitting diagnosis and PPS score. These results are shown in Table 3. The probability of 6-month mortality ranged from 32.6% to 99.5%. The patients who were least likely to die within 6 months were those who had been admitted to hospice after a stroke and who had PPS scores

of ≥ 40 . Patients most likely to die within 6 months were those with cancer admitted with PPS scores below 30.

For patients with an admitting diagnosis of cancer, the probability of dying within 6 months was high across all PPS scores. In fact, even among patients with cancer with a PPS score ≥ 60 , the predicted 6-month mortality rate was 89.1%. In contrast, patients with dementia and debility who had high PPS scores were much less likely to die within 6 months (36.6% and 47.4%, respectively.) The lowest probability of 6-month mortality was observed in patients with stroke and PPS scores of 60 or greater (32.6%). Even at a PPS score of 40, patients with stroke had only a 48.4% probability of death within 6 months).

Finally, because there was substantial variation in 6-month mortality among hospices, we examined adjusted differences. We used the multivariable model described above (Table 2) to calculate adjusted 6-month mortality rates for each hospice. After adjusting for all patient characteristics in Table 2, there was still significant variation in 6-month mortality rates (range, 82.3%–90.1%).

Discussion

Although most patients die very soon after hospice enrollment, there is a small minority of patients who have an extended survival. These patients may live 6 months or more, and create pressures for hospices to prepare patients and families for potential discharge if they no longer meet eligibility criteria. This study provides three principal results that hospices and referring physicians could use to guide the care of hospice patients who may have an extended prognosis.

First, we found that 13.4% of patients survived more than 6 months after hospice admission. This figure is consistent with the results of previous studies.^{3,4} The most recent figures reported for Medicare hospice participants found 11.8% of patients in 2010 and 11.4% of patients in 2011 survived more than 6 months.¹ Even with implementation of provider face-to-face recertification visits for patients entering their third benefit period or beyond, the percentage of patients surviving past 6 months has remained stable. Indeed, one recent study found that recertification rates of patients actually increased following implementation of the face-to-face requirement.⁹

Second, there appear to be patients who have a relatively low 6-month mortality. For instance, patients with debility or dementia and PPS score ≥ 60 have an overall 6-month mortality rate that is less than 50%. Similarly, patients with

TABLE 3. ADJUSTED PROBABILITY OF DEATH WITHIN SIX MONTHS (95% CONFIDENCE INTERVAL)^a

<i>Diagnosis</i>	<i>Palliative Performance Scale score</i>				
	<i><30</i>	<i>30</i>	<i>40</i>	<i>50</i>	<i>≥60</i>
Cancer	99.6 (98.9–100)	98.3 (97.0–99.1)	95.5 (91.9–97.5)	92.8 (87.5–95.9)	89.1 (86.0–91.7)
Debility	96.3 (90.4–98.6)	83.6 (73.2–90.5)	67.1 (54.6–77.6)	57.6 (42.7–71.2)	47.4 (34.2–61.0)
Cardiovascular disease	97.6 (93.6–99.2)	89.8 (82.9–94.1)	74.2 (55.3–87.0)	65.3 (47.5–79.6)	51.8 (34.5–68.6)
Dementia	93.2 (76.7–98.3)	73.6 (56.6–85.7)	54.9 (44.9–64.5)	51.4 (31.8–70.6)	36.6 (20.9–55.9)
Pulmonary disease	98.4 (94.9–99.5)	92.4 (88.0–95.3)	79.9 (72.2–85.8)	71.6 (62.4–79.3)	63.8 (58.2–69.1)
Stroke	92.8 (84.5–96.8)	67.4 (44.1–84.5)	48.4 (18.4–79.5)	39.4 (13.9–72.5)	32.6 (12.6–61.8)
Other	99.1 (97.3–99.7)	95.0 (91.3–97.2)	88.3 (79.6–93.6)	81.9 (70.9–89.4)	79.2 (72.1–84.8)

^aProbabilities of 6-month mortality adjusted for age (<65 vs. ≥ 65), gender, and site of care at the time of hospice enrollment (home, nursing home, hospital).

diagnosis of stroke and PPS scores as low as 40 also have an overall mortality rate of less than 50%. Therefore, hospices should consider the possibility of discharge in care planning if patients in these groups are not showing expected progression of disease.

Third, the 95% confidence intervals of predicted 6-month mortality rates all included probabilities above 50%. That is, even among those groups with low 6-month mortality rates, the possibility exists that a patient will die within 6 months. Therefore, caution should be used in interpreting these data, and these results should not be used to exclude patients or groups from hospice care.

Furthermore, it is important to note that even a patient who is still alive at 6 months following hospice admission may still meet hospice eligibility criteria. For instance, if a patient continues to elect a plan of comfort care and continues to have a prognosis of 6 months or less, he or she would still be eligible to receive hospice services. Nevertheless, any patient who is still alive 6 months after hospice enrollment is likely to undergo regulatory scrutiny, and hospices and referring physicians will need to provide additional documentation to justify the patient's limited prognosis for continued hospice care.

There are three limitations of this study that should be noted. First, this study was conducted in only 10 not-for-profit hospices. Therefore, the results reported here may not be generalizable to the national population of hospice patients. Nevertheless, the 6-month mortality rate in this sample was similar to that which has been reported nationally, providing confidence that these findings may be similar in other hospice programs.

Second, the prognostic models described here are necessarily limited by the data available. Therefore, hospices and referring physicians will need to continue to examine evidence of disease progression in individual patients over time. Identifying disease progression for patients with diagnoses of debility and dementia can be particularly challenging for hospices, however, as the rate of their decline in PPS tends to be slower than with other diagnoses.¹⁰ Furthermore, there are few objective markers other than ongoing weight loss or major medical complications that hospices can use to quantify disease progression. Patients with diagnoses of dementia or debility may therefore require more extensive description of their functional deficits to more fully paint a picture of a patient's decline that would justify ongoing hospice eligibility.

Third, this study focused on patient characteristics that were associated with 6-month mortality. We did not have an adequate sample of hospices to examine hospice characteristics that were associated with survival. It is possible that some hospice characteristics such as marketing practices, community relationships, or local hospice competition might also determine whether and when patients are referred to hospice. These questions should be the focus of future research.

This study highlights some of the challenges of describing clinical decline in the hospice patient population. While it is possible to identify groups of patients at higher risk of living for 6 months after hospice admission, this current model does not yet allow for prognostic determination at hospice admission of what is likely to happen to any particular patient. Therefore, better criteria need to be developed and tested regarding hospice eligibility, particularly for patients with stroke and dementia, to identify which particular patients are more likely to die within 6 months.

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Author Disclosure Statement

No competing financial interests exist.

References

1. National Hospice and Palliative Care Organization: *NHPCO's Facts and Figures: Hospice Care in America*. Alexandria, VA: 2012, p. 17.
2. Wachterman MW, Marcantonio ER, Davis RB, McCarthy EP: Association of hospice agency profit status with patient diagnosis, location of care, and length of stay. *JAMA* 2011;305:472–479.
3. Christakis NA: Timing of referral of terminally ill patients to an outpatient hospice. *J Gen Intern Med* 1994;9:314–320.
4. Christakis NA, Lamont EB: Extent and determinants of error in doctors' prognoses in terminally ill patients: Prospective cohort study. *Br Med J* 2000;320:469–472.
5. Casarett DJ, Harrold J, Oldanie B, Prince-Paul M, Teno J: Advancing the science of hospice care: Coalition of Hospices Organized to Investigate Comparative Effectiveness. *Curr Opin Support Palliat Care* 2012;6:459–464.
6. Anderson F, Downing GM, Hill J, Casorso L, Lerch N: Palliative performance scale (PPS): A new tool. *Journal of Palliative Care* 1996;12:5–11.
7. Harrold J, Rickerson E, Carroll JT, McGrath J, Morales K, Kapo J, Casarett D: Is the palliative performance scale a useful predictor of mortality in a heterogeneous hospice population? *J Palliat Med* 8:503–509, 2005.
8. Downing GM, Lesperance M, Lau F, Yang J: Survival implications of sudden functional decline as a sentinel event using the palliative performance scale. *J Palliat Med* 2010;13:549–557.
9. Harrold J, Harris P, Green D, Craig T, Casarett DJ: Effect of the Medicare face-to-face visit requirement on hospice utilization. *J Palliat Med* 2013;16:163–166.
10. Stuart B: The NHO Medical Guidelines for Non-Cancer Disease and local medical review policy: Hospice access for patients with diseases other than cancer. *Hosp J* 1999;14:139–154.

Address correspondence to:
 Pamela S. Harris, MD, FAAPMR
 Kansas City Hospice and Palliative Care
 9221 Ward Parkway, Suite 100
 Kansas City, MO 64114

E-mail: pharris@kchospice.org