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Resource Use in the Last Year of Life Among Patients Who Died With vs. From Prostate Cancer

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Abstract

Background—Prostate cancer poses significant financial burden in the United States. However, most men with prostate cancer will die from non-cancer causes. Concerns about increased resource utilization at the end of life have not been appropriately examined in this context.

Materials and Methods—We conducted a retrospective analysis of Surveillance, Epidemiology, and End Results (SEER)-Medicare data of men who were diagnosed with and died from, as opposed to with, prostate cancer between 2000 and 2007. Within these 2 populations, we compared changes in the use of medical interventions, hospice, and overall health care costs to Medicare in the last year of life.

Results—Among 34,727 patients, those who died from prostate cancer had lower costs (\$43,572 vs \$45,830; $P < .001$), largely because of lower mean inpatient costs (\$20,769 vs \$29,851), fewer hospitalizations (1.8 vs 2.1), inpatient days (12.2 vs 15.7), intensive care unit days (1.4 vs 3.4), and skilled nursing facility days (11.7 vs 14.7; $P < .001$ for all). Outpatient and hospice costs were significantly higher among patients who died from prostate cancer, as was use of chemotherapy and androgen deprivation therapy. Patients who died from prostate cancer had roughly 12% lower costs than patients who died from other causes in adjusted analyses (fold change, 0.88; 95% CI, 0.85–0.92). The single strongest predictor of increased costs at the end of life was receipt of multiple invasive procedures (fold increase in costs, 2.39; 95% CI 2.22–2.58).

Conclusion—Patients who died from prostate cancer rather than other causes had more hospice and outpatient use, less inpatient and ICU use, and lower overall costs. Efforts to shift care toward

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outpatient settings may provide more efficient and judicious care for patients during the end of life.

Keywords

Health Care Costs; Medicare; Prostatic Neoplasms; SEER Program; Terminal Care

Introduction

Prostate cancer and end-of-life care are 2 major sources of overall costs among the United States population and both are expected to rise in coming years. End-of-life inpatient care for all Medicare beneficiaries has intensified in recent decades¹ and out-of-pocket costs have increased fourfold.² Among all men, prostate cancer is the most commonly diagnosed cancer in the United States,³ and is a leading source of overall costs for cancer care.⁴ We now know that most men who are diagnosed with prostate cancer die from other causes,⁵ however, and it is not clear how costs and end-of-life resource use compare between men who die with versus from their cancer.

The total costs of both end-of-life care and prostate cancer are high. Costs among Medicare beneficiaries in the last year of life constitute approximately one-quarter of all Medicare costs, a figure that has been stable for 20 years.⁶ Among older patients diagnosed with cancer in 2004, aggregate 5-year costs of cancer care totaled \$21 billion and were highest in the year after the initial cancer diagnosis and in the last year of life. In the initial 5 years after a cancer diagnosis, Medicare beneficiaries incur \$20,000 to \$40,000 in additional costs, compared with beneficiaries without a cancer diagnosis who were matched by sex, age, geography, and phase of care.⁴

Although costs during the earlier phases of care have been well characterized,⁷⁻¹⁰ the burden of costs for men with prostate cancer at the end of life are known to be substantial and have been estimated at 3-4 times the costs accrued in the year following diagnosis but remain less well understood.¹¹ Several factors may unnecessarily increase end-of-life costs of care in patients dying from prostate cancer, including pathologic fractures and associated complications,¹² the use of invasive procedures, radiation,¹³ or systemic chemotherapy and emerging agents.¹⁴ However, a key component of end-of-life care in patients with prostate cancer is the acknowledgement that most men do not die from their prostate cancer, and that competing risks of mortality may also pose competing financial risks, may increase or decrease end-of-life care costs, and may also impact the receipt of less resource-intensive care such as hospice.¹⁵

In this study, we characterized medical resource use and costs to Medicare among patients who died from prostate cancer and patients with prostate cancer who died from other causes between 2000 and 2007.

Materials and Methods

Data Source

Data were from the Surveillance, Epidemiology and End Results (SEER)-Medicare linked data set, a collaborative project of the National Cancer Institute and the Centers for Medicare & Medicaid Services that links routinely collected population-based data from SEER cancer registries to Medicare administrative claims data. SEER data represent approximately 25% of the US population with cancer. SEER-Medicare data have been used to examine factors that affect cancer care quality, including sociodemographic characteristics, physician and hospital characteristics, treatment, comorbid conditions, complications, screening, relapse, and costs.¹⁶⁻¹⁸ We used SEER data from 1992 through 2007 to identify prostate cancer diagnoses, disease stage, patient demographic characteristics, and cause of death. Medicare is the health insurer for 97% of persons 65 years and older in the United States.¹⁸ We used linked Medicare claims from 1991 through 2007 to confirm Medicare enrollment and to capture Medicare payments associated with end-of-life care. The study was approved by the institutional review board of the Duke University Health System.

Study Population

From the 12 SEER registries that were continuously active from 1992 onward, we identified all patients who had a diagnosis of prostate cancer between 1992 and 2007. To identify patients likely to have complete Medicare claims related to prostate cancer care, we required that patients have a primary diagnosis of prostate cancer on an inpatient, outpatient, durable medical equipment, hospice, home health, or carrier-based Medicare claim within 2 months of the SEER-reported diagnosis (*International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM]* code 185). We limited the study population to men who were 66 years or older at diagnosis and died between 2000 and 2007. We excluded patients who were diagnosed at autopsy or death or had another diagnosis of malignancy in the year before the prostate cancer diagnosis. We also excluded patients who had a diagnosis of 1 or more malignancies in the 2 years before death and patients who had discontinuous Medicare Part A and Part B coverage (ie, fee-for-service Medicare) from the year before diagnosis until death.

Study Outcomes

The primary outcomes included resource use in the last year of life and mean costs to Medicare by claim type. Measures for resource use in the last year of life included all-cause hospitalizations, inpatient days, intensive care unit (ICU) days, use of skilled nursing facilities, hospice, home health, durable medical equipment, and physician visits. Use of selected tests and procedures associated with treatment or complications of prostate cancer was based on Current Procedural Terminology and *ICD-9-CM* codes (Supplemental Table 1). We calculated mean costs to Medicare by summing Medicare reimbursement amounts by claim source (ie, inpatient, outpatient, physician, hospice, home health, and durable medical equipment). Costs represent Medicare payments and were adjusted for inflation using the US Consumer Price Index for Medical Care to 2008 US dollars.¹⁹

We obtained demographic variables from the SEER Patient Entitlement and Diagnosis Summary File, including age at diagnosis, age at death, time from diagnosis to death, sex, race, ethnicity, marital status, and local census tract characteristics (ie, metropolitan urban or rural status, proportion of the population not finishing high school, proportion below the poverty line, and proportion with black race). We identified comorbid conditions using inpatient, outpatient, and carrier Medicare claims²⁰ in the year before diagnosis and 1 year before death.

SEER-recorded baseline patient characteristics at diagnosis, age at death, and time from diagnosis to death, were all compared between patients whose cause of death was prostate cancer versus another cause. We used the SEER-recorded cause of death to identify deaths from prostate cancer and deaths from other causes. Patient baseline characteristics included age at diagnosis, race, marital status, disease stage at diagnosis, and receipt of surgery or radiation.

Statistical Analysis

We examined the distribution of common comorbid conditions (ie, those with > 2% frequency) at 1 year before death, as well as baseline characteristics of patients who died from prostate cancer compared with patients with prostate cancer who died from other causes. To help investigate potential heterogeneity in this population of patients who died from causes other than prostate cancer, we also examined the most common causes of death other than prostate cancer, which included diseases of the heart, cerebrovascular disease, pneumonia and influenza, and chronic obstructive pulmonary disease (COPD) and related conditions. We also examined mean costs to Medicare, resource use in the last year of life, and procedures. We plotted total, inpatient, and hospice claims payments to compare costs in the year before death.

We compared patients who died from prostate cancer and patients with prostate cancer who died from other causes using χ^2 tests for categorical variables and Wilcoxon rank sum tests for continuous variables. We assessed trends in categorical variables over time (year of death) using Cochran-Mantel-Haenszel tests. For continuous variables, we used ordinary least squares regression of each variable as a linear function of the year of death.

To adjust for confounding factors influencing end-of-life costs in heterogeneous patient populations, we conducted a multivariable regression analysis of total costs in the last year of life using a generalized linear model with a gamma distribution and a log link to normalize the error distribution. Our goal was to evaluate objective measures of aggressiveness of care in the form of invasive procedures and hospice, while adjusting for important control variables that provided an indication of a patient's overall health and other unmodifiable drivers of cost that included cause of death, age at death, black race, marital status, initial treatment (ie, surgery, radiation, or none as a proxy for performance status), prostate cancer stage at diagnosis (ie, metastatic, locoregional, or unstaged), and number of comorbid conditions (ie, 0, 1, or 2 or greater). All causes of death with more than 1000 patients were analyzed as individual categories and the remainder were grouped with "other." To avoid misclassification, we placed causes of death coded as "miscellaneous malignant cancer" into the "other" group (less than 1% of all patients). Because potential

cost savings from hospice would be expected to be duration-dependent, we modeled receipt of hospice as none, 30 days or less, or more than 30 days. We modeled the number of invasive procedures as none, 1, or multiple invasive procedures. Factors intentionally excluded from the model were skilled nursing facility use, ICU stays, hospitalizations, outpatient visits, and receipt of ADT or chemotherapy, all of which are direct sources of costs and may or may not be avoidable without a premeditated decision to deescalate care. We set the significance level at $P = .001$ to address multiple hypothesis testing. We used SAS version 9.2 (SAS Institute, Cary, North Carolina) for all analyses.

Results

A total of 34,727 patients met the study criteria (Figure 1). Patients who died from prostate cancer were slightly older and lived fewer months from diagnosis until death than patients who died from other causes. They also were significantly more likely to have incident distant metastatic disease (27.4% vs 3.6%) and less likely to have undergone surgery (26.5% vs 30.2%) or radiation therapy (28.2% vs 32.4%) as initial treatment. Patients who died from cancer were more likely to be treated with androgen deprivation therapy (ADT; 62.1% vs 26.5%) and chemotherapy (22.2% vs 3.8%) in the last year of life ($P < .001$ for all comparisons; Table 1).

The proportion of patients who died from prostate cancer decreased from 25.3% in 2000 to 22.7% in 2007, and median time from diagnosis until death increased from 55 to 85 months ($P < .001$ for both comparisons; Supplemental Table 2). The proportion of patients with metastatic disease remained relatively unchanged during the study period. There was a significant decrease in the proportion of patients with missing or unknown disease stage (47.0% vs 22.2%) and a concordant increase in the proportion of patients with localized or regional disease (42.9% vs 68.5%). The proportion of patients with multiple comorbid conditions in the year before death also increased (29.4% vs 34.0%; $P < .001$).

The mean number of hospitalizations remained similar during the study period in both groups of patients (Table 2), but the proportion of hospitalizations decreased significantly among men who died from prostate cancer ($P = .01$). Overall, these patients had fewer hospitalizations, inpatient days, ICU days, and skilled nursing facility days in the year before death, compared with patients who died from other causes. However, they had significantly greater use of outpatient services, including physician visits and home health care services.

In the last year of life, patients who died from prostate cancer were more likely than those who died from other causes to enroll in hospice (62.3% vs 27.8%; $P < .001$) and received more days of hospice care (31.4 vs 12.1 days; $P < .001$). They also were significantly more likely to undergo chemotherapy (22.2% vs 3.8%; $P < .001$), blood transfusions, cystoscopy, ureteral and bladder catheter procedures, and orchiectomy (see Table 3). Insertion of a central venous catheter was the only procedure we examined that was more likely to be performed in patients with prostate cancer who died from other causes (17.4% vs 9.3%; $P < .001$). During the study period, the proportion of patients undergoing chemotherapy who died from prostate cancer increased from 16.3% in 2000 to 25.3% in 2007. Following the

FDA approval of docetaxel for metastatic, hormone-refractory prostate cancer in 2004, we observed decreased utilization of ADT from 2004 to 2007 both in patients who died from prostate cancer (69.4% to 57.4%) and in those who died from other causes (28.0% to 21.2%).

Further examination of patient demographic characteristics and resource use by specific causes of death revealed that patients who died from causes other than prostate cancer were more likely to be older at the time of death, have multiple comorbid conditions, and have more hospitalizations, total inpatient days, intensive care unit days, SNF use, and total SNF days (Table 4; $P < .001$ for all). Death from pneumonia, influenza, COPD, or related conditions were associated with more frequent hospitalizations and associated intensity of inpatient care. This was most notably reflected in the average of 5.7 and 4.2 ICU days for pneumonia/influenza and COPD, respectively, compared with 1.4 ICU days for patients who died from their prostate cancer.

Total mean Medicare payments in the year before death were \$43,572 for patients who died from prostate cancer and \$45,830 for patients who died from other causes ($P < .001$; Table 5). The largest absolute difference between the groups was in inpatient claims (\$20,769 vs \$29,851; $P < .001$). This difference was offset by differences in payments for carrier and outpatient claims. Mean payments for hospice claims were significantly higher for men who died from prostate cancer (\$5117 vs \$1981; $P < .001$). Among patients who died from causes other than prostate cancer, patients who died from pneumonia/influenza or COPD had considerably higher costs, with total mean costs of \$56,841 and \$49,874, respectively. These costs were driven by increased inpatient expenditures, with means of \$41,830 and \$34,038, respectively. Overall costs increased in the months before death (Figure 2). Mean inpatient costs in the last month of life were approximately \$4700 lower for men who died from prostate cancer (\$6,856 vs \$11,574).

Multivariable regression analysis of total costs in the last year of life revealed that, after adjustment for patient age, comorbid conditions, year, race, marital status, stage at diagnosis, and initial treatment, patients who died from prostate cancer had roughly 12% lower costs compared with patients who died from most other causes of death (fold change, 0.88; 95% CI, 0.85-0.92; Table 6). The strongest predictor of elevated costs was the use of 1 or especially multiple invasive procedures (ie, transfusions, central lines, invasive genitourinary procedures, etc). Patients who underwent multiple such procedures had roughly a 2.4-fold increase in costs compared with patients who underwent no invasive procedures. Overall, enrollment in hospice, either within 2 weeks of death or earlier, was not significantly associated with a difference in the costs of end-of-life care. Because we hypothesized that the role of hospice may differ for patients with more chronic than acute illness (eg, prostate cancer vs pneumonia), we examined the interaction between cause of death and hospice. We did not observe any change in costs for patients who died from either prostate cancer or other malignancies. However, for patients who died of heart disease, receipt of hospice was associated with a roughly 21% to 23% increase in total costs. For patients who died of pneumonia, receipt of hospice was associated with a 20% to 21% decrease in costs. Patients with more comorbid conditions had more costly care, as did black patients and younger patients. We saw no consistent trends were across years, initial prostate

cancer stage, or initial prostate cancer treatment (not shown, but included in the regression model as controls).

Discussion

In this study, we used SEER-Medicare data to examine changes in resource use and costs to Medicare for patients who died from prostate cancer and patients with prostate cancer who died from other causes between 2000 and 2007. Despite concerns of potential excessive utilization of health care resources at the end of life, we found that mean total payments in the last year of life were in fact similar or lower for patients who died from prostate cancer as compared with patients with prostate cancer who died from other causes. Differences in costs were driven by less intense utilization of inpatient care among patients who died from prostate cancer, reflected by lower mean inpatient costs and fewer hospitalizations, inpatient days, intensive care unit days, receipt of invasive procedures such as central line placement, and skilled nursing facility days. These findings were supported in multivariable regression analyses, which demonstrated that the use of invasive procedures near the end of life were the strongest single predictor of life costs, and confirmed lower end-of-life costs for patients who died from prostate cancer after adjustment for observed factors such as age and comorbid conditions. We did observe increased outpatient, carrier, and hospice costs, attributable to higher utilization of hospice, ADT, and chemotherapy. However, as of 2007, higher treatment- and hospice-related costs among patients who died from prostate cancer were still less than the excess in inpatient costs among patients who died from other causes. To our surprise, receipt of hospice was not associated with a decrease in costs in patients with prostate cancer, and was associated with an increase in costs in patients who died from heart disease.

We observed that patients with prostate cancer who died from other causes were more likely to be diagnosed at an earlier age and live longer, consistent with previous observations.⁵ As such, many of these men may have had a diagnosis of an incidental, low-risk prostate cancer which might have had a minimal impact on their health or care in later life. For patients who died from prostate cancer, we observed a roughly 60% rate of hospice use, consistent with previous estimates.²¹ Although not directly examined in our study, previous work has observed associations between younger age,²² black race,⁶ and aggressiveness of care²³ with higher levels of end-of-life spending among Medicare beneficiaries, which may also have influenced the trends observed in our study. Use of chemotherapy and other emerging outpatient medical therapies for metastatic prostate cancer may result in increases in end-of-life prostate cancer care costs as these technologies become more widely adopted. In our study, the rate of chemotherapy use in the last year of life was 22%, comparable to a previously reported rate of 24% in patients with metastatic prostate cancer in the SEER-Medicare population.²⁴

Several new treatments have emerged in recent years for the treatment of metastatic castration-resistant prostate cancer that have the potential to substantially increase costs of end-of-life care among patients with prostate cancer. These treatments include primarily nonchemotherapeutic treatments, including bone-seeking radioactive radium 223, the potent second-generation androgen receptor inhibitor enzalutamide, the androgen synthesis

inhibitor abiraterone, second-line chemotherapy in cabazitaxel, and the autologous cell-based immunotherapy sipuleucel-T. Aside from abiraterone, these treatments remain infrequently used at the present time due to limited availability and high costs. It remains to be seen how much their use will influence aggregate treatment costs and compare to this historical perspective. In addition, inpatient costs associated with non-prostate cancer deaths will likely increase over time and may partially offset increases in cancer-specific treatment costs. Patterns in end-of-life care may continue to change in unpredictable ways with unclear implications for overall health care utilization at the end of life. For example, a recent study of Medicare beneficiaries that found that the number of deaths in acute care hospitals decreased by 8% between 2000 and 2009, but that both ICU use in the last month of life and hospice use at the time of death increased (4.9% and 20.6%, respectively) during the same time period.²⁵

A potential criticism of end-of-life studies is that the time of death of patients is not known ahead of time by managing physicians and does not provide direct, clinically actionable findings. As expected, we observed that inpatient costs among patients who died from causes other than prostate cancer were high in the last year of life, and even more so in the last month of life. However, an interesting caveat is that patients who died from prostate cancer did not experience this same spike in inpatient costs near the end of life. Presumably, this disparity reflects the contribution of hospice and patient education regarding expectations for care at the end of life, both processes that need not be limited to cancer care and are known to decrease intensity of care at the end of life. A potential actionable finding from this difference between patients who died from rather than with their cancer is the wider adoption of hospice and expectation management in patients with other chronic conditions in whom the end of life is not altogether unexpected. Such interventions are supported by observations that suggest patients in hospice are less likely to receive intensive end-of-life care and have fewer ICU admissions, inpatient stays, and multiple emergency department visits.²⁴

Our study has limitations. We only examined patients who died. The study cohorts were defined by year of death, and any events that occurred at diagnosis typically occurred several years before death and do not reflect a uniform time point. It is possible changes in screening, early diagnosis, and population trends in aging and comorbidity may have driven some of the observed changes and differences in costs between patients who died from prostate cancer and those who died from other causes. Because the study sample was defined by diagnosis of prostate cancer as recorded in the SEER data (only available from 1992 onward), the maximum follow-up period for patients who died in 2007 was longer than for patients who died in 2000, which may have influenced the overall age and competing mortality risks from other age-related causes of mortality. The SEER registry contains data for patients who are more likely than the general US population to be nonwhite, live in areas with less poverty, and live in urban areas. Costs were calculated from Medicare payments and did not include out-of-pocket costs, amounts paid by third-party insurers, and indirect costs. Medicare claims include intravenous chemotherapy and oral equivalents, but not chemotherapy and supportive medications filled as outpatient prescriptions. Whether these costs would be higher for cancer-related or non-cancer-related treatment is unclear.

Conclusions

Our analysis demonstrates that despite concerns that care is escalated at the end of life in patients with terminal prostate cancer, patients who die from their prostate cancer as opposed to other causes had more hospice and outpatient use, less inpatient and ICU use, and lower overall costs. Potential actionable interventions based on these results include efforts to proactively reduce the use of invasive procedures in patients with other chronic conditions in whom the end of life is not altogether unexpected.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. CONSORT Diagram

Figure 2. Mean Total, Inpatient, and Hospice Claim Payments by Month and Cause of Death

Table 1
Baseline Characteristics of the Study Population by Cohort

Characteristic	Death From Other Causes (n = 26,512)	Death From Prostate Cancer (n = 8215)	P Value ^a
Age at diagnosis, median (IQR), y	76 (72-81)	77 (72-82)	.001
Age at death, median (IQR), y	83 (79-88)	82 (77-87)	< .001
Diagnosis until death, median (IQR), mo	74 (38-109)	51 (20-92)	< .001
Black race, No. (%)	2454 (9.3)	823 (10.0)	.04
Married, No. (%)	17,453 (65.8)	5319 (64.7)	.07
Initial treatment ^b			
Radiation	8581 (32.4)	2313 (28.2)	< .001
Surgery	8009 (30.2)	2175 (26.5)	< .001
Androgen deprivation therapy, No. (%) ^c	7015 (26.5)	5105 (62.1)	< .001
Chemotherapy, No. (%)	1009 (3.8)	1823 (22.2)	< .001
Disease stage at diagnosis ^d			< .001
Distant	963 (3.6)	2249 (27.4)	
Localized or regional	16,470 (62.1)	3789 (46.1)	
Missing, unknown, or unstaged	9079 (34.2)	2177 (26.5)	
Number of comorbid conditions			< .001
0	9435 (35.6)	4553 (55.4)	
1	7628 (28.8)	2091 (25.5)	
2	9449 (35.6)	1571 (19.1)	

^a P values from Wilcoxon rank sum tests for continuous variables or χ^2 tests for categorical variables.

^b Initial local treatment modality of prostate cancer as recorded in SEER.

^c Androgen deprivation therapy in the last year of life.

^d Disease stage was assigned using SEER historical staging data. Patients not categorized as having distant, localized, or regional disease were categorized as having missing, unknown, or unstaged disease.

Table 2
Resource Use in the Last Year of Life Among Patients Who Died From vs With Prostate Cancer

Resource	2000	2001	2002	2003	2004	2005	2006	2007	P Value
Patients Who Died From Prostate Cancer									
Patients, No. (%)	945 (25.3)	1009 (25.4)	1064 (24.7)	1046 (24.1)	1018 (22.5)	1082 (22.9)	1026 (22.2)	1025 (22.7)	
Inpatient care									
Any hospitalization, No. (%)	776 (82.1)	793 (78.6)	842 (79.1)	823 (78.7)	789 (77.5)	844 (78.0)	782 (76.2)	802 (78.2)	.01
Hospitalizations, mean (SD)	2 (1.7)	1.8 (1.6)	1.8 (1.7)	1.8 (1.7)	1.8 (1.8)	1.8 (1.7)	1.9 (1.9)	1.8 (1.7)	.39
Inpatient days, mean (SD)	13.6 (17.1)	12.4 (15.2)	12.8 (16)	12.1 (15.1)	11.8 (15.6)	11.6 (15.9)	12.6 (17.7)	11.1 (16)	.002
ICU days, mean (SD)	1.4 (5)	1 (3.1)	1.3 (4.5)	1.3 (4.2)	1.5 (5.2)	1.3 (3.9)	1.6 (5.1)	1.6 (4.7)	.01
Any SNF use, No. (%)	314 (33.2)	303 (30.0)	350 (32.9)	362 (34.6)	349 (34.3)	335 (31.0)	340 (33.1)	343 (33.5)	.57
SNF, mean (SD), d	10.5 (24)	9.4 (23.3)	10.3 (24.8)	12 (24.4)	13.6 (31.5)	11.2 (24.5)	13.5 (31.4)	13.4 (30.1)	< .001
Outpatient care									
Any physician visits, No. (%)	929 (98.3)	987 (97.8)	1043 (98)	1024 (97.9)	997 (97.9)	1065 (98.4)	1008 (98.3)	994 (97)	.31
Physician visits, mean (SD)	18.6 (12.7)	18.4 (14.9)	19.6 (14.7)	19.7 (14.3)	19.9 (13.7)	19.5 (13.4)	20.5 (13)	18.6 (12.4)	.07
Any home health, No. (%)	397 (42)	386 (38.3)	411 (38.6)	399 (38.2)	394 (38.7)	423 (39.1)	402 (39.2)	408 (39.8)	.71
Home health, mean (SD), d	27.5 (57.6)	24.2 (51.8)	24.4 (53.2)	26.2 (56.4)	24.8 (51.3)	26.9 (57.1)	30.5 (61.7)	29.1 (60.7)	.03
Hospice care									
Any hospice, No. (%)	514 (54.4)	610 (60.5)	628 (59)	651 (62.2)	632 (62.1)	722 (66.7)	684 (66.7)	678 (66.2)	< .001
Days in hospice, mean (SD)	23.6 (48.9)	30 (58)	28.7 (58.1)	31.6 (61)	29.1 (61.3)	34.8 (67.6)	34.9 (68.2)	37.4 (73.4)	< .001
ADT, No. (%)	565 (59.8)	604 (59.9)	668 (62.8)	649 (62.1)	706 (69.4)	692 (64.0)	633 (61.7)	588 (57.4)	0.93
Chemotherapy, No. (%)	154 (16.3)	174 (17.2)	229 (21.5)	201 (19.2)	234 (23)	291 (26.9)	281 (27.4)	259 (25.3)	< .001
Patients With Prostate Cancer Who Died From Other Causes									
Patients, No. (%)	2789 (74.7)	2962 (74.6)	3241 (75.3)	3291 (75.9)	3505 (77.5)	3645 (77.1)	3594 (77.8)	3485 (77.3)	
Inpatient care									
Any hospitalization, No. (%)	2250 (80.7)	2410 (81.5)	2626 (81.0)	2645 (80.4)	2806 (80.1)	2953 (81.0)	2900 (80.7)	2785 (79.9)	.32
Hospitalizations, mean (SD)	2 (1.9)	2.1 (1.9)	2.1 (1.9)	2.1 (2)	2 (1.9)	2.1 (2)	2.1 (2)	2.1 (1.9)	.42
Inpatient days, mean (SD)	16.1 (22.3)	16 (21.2)	16.5 (22.5)	15.8 (21.1)	15.4 (20.7)	15.5 (20.8)	15.9 (21.9)	14.9 (20.4)	.01
ICU days, mean (SD)	3.1 (7.9)	3.3 (8.1)	3.5 (8.8)	3.3 (7.1)	3.4 (8)	3.6 (8.5)	3.6 (8.9)	3.7 (8.7)	.001
Any SNF use, No. (%)	966 (34.6)	1064 (35.9)	1113 (34.3)	1141 (34.7)	1302 (37.1)	1372 (37.6)	1341 (37.3)	1298 (37.3)	< .001

Resource	2000	2001	2002	2003	2004	2005	2006	2007	P Value
SNF, mean (SD), d	12 (26.6)	13.4 (28.7)	13.1 (29.3)	13.9 (29.5)	14.8 (30)	16.3 (34.3)	16.5 (34)	16.8 (35.4)	<.001
Outpatient care									
Any physician visits, No. (%)	2717 (97.4)	2905 (98.1)	3176 (98)	3226 (98)	3432 (97.9)	3578 (98.2)	3522 (98)	3395 (97.4)	.89
Physician visits, mean (SD)	15.5 (11)	15.8 (11.6)	16.1 (12.3)	16.6 (12.8)	16.6 (12.2)	16.5 (12.2)	17.1 (12.6)	16.1 (12.3)	<.001
Any home health, No. (%)	1004 (36)	1015 (34.3)	1113 (34.3)	1114 (33.9)	1189 (33.9)	1295 (35.5)	1327 (36.9)	1285 (36.9)	.02
Home health, mean (SD), d	26.1 (59.3)	23.6 (54.7)	23.1 (54.1)	23.2 (52.9)	25.3 (57.4)	26.6 (57.7)	27.1 (56.5)	28.8 (60.1)	<.001
Hospice care									
Any hospice, No. (%)	532 (19.1)	579 (19.6)	722 (22.3)	865 (26.3)	1052 (30)	1147 (31.5)	1261 (35.1)	1206 (34.6)	<.001
Days in hospice, mean (SD)	6.5 (30.1)	7.2 (31)	8 (32.2)	11.1 (42.1)	14.5 (51.2)	13.9 (49.6)	17.6 (56.8)	15.6 (50.5)	<.001
ADT, No. (%)	791 (28.4)	844 (28.5)	928 (28.6)	937 (28.5)	980 (28.0)	965 (26.5)	830 (23.1)	740 (21.2)	<.001
Chemotherapy, No. (%)	93 (3.3)	101 (3.4)	113 (3.5)	106 (3.2)	110 (3.1)	122 (3.4)	194 (5.4)	170 (4.9)	<.001

Abbreviations: ADT, androgen deprivation therapy; SNF, skilled nursing facility.

Table 3
Invasive Procedures Used in Patients Who Died From Prostate Cancer and Patients With Prostate Cancer Who Died From Other Causes^a

Procedure	Died From Other Causes (n = 26,512)	Died From Prostate Cancer (n = 8215)	P Value ^b
Patients with at least 1 invasive procedure, No. (%) ^c	11,725 (44.2)	4743 (57.7)	< .001
Blood transfusion, No. (%)	4832 (18.2)	1901 (23.1)	< .001
Central venous catheter, No. (%)	4602 (17.4)	768 (9.3)	< .001
Other cystoscopy, No. (%)	2259 (8.5)	1287 (15.7)	< .001
Chemotherapy injection or infusion, No. (%)	1386 (5.2)	1129 (13.7)	< .001
Insertion of indwelling bladder catheter, No. (%)	1297 (4.9)	788 (9.6)	< .001
Control of hemorrhage of prostate or bladder, No. (%)	895 (3.4)	821 (10.0)	< .001
Ureteral catheterization, No. (%)	910 (3.4)	725 (8.8)	< .001
Cystoscopy and dilatation of urethral strictures, No. (%)	870 (3.3)	401 (4.9)	< .001
Irrigation of other indwelling urinary catheter, No. (%)	395 (1.5)	382 (4.7)	< .001
Replacement of nephrostomy tube, No. (%)	87 (0.3)	266 (3.2)	< .001
Orchiectomy, No. (%)	98 (0.4)	192 (2.3)	< .001

^aOnly procedures received by 2% or more of patients in any subgroup are shown. Prostate cancer-related procedures in less than 2% of patients included nephrostomy; replacement of nephrostomy tube; percutaneous cystostomy or replacement of cystostomy tube; replacement of ureterostomy tube; control of hemorrhage of prostate or bladder; bone scan; biopsy of bone; biopsy of abdominal mass; local excision of lesion or tissue of bone; magnetic resonance imaging of spinal canal; other exploration and decompression of spinal canal; superficial radiation; insertion of totally implantable vascular access device; and venous cut down.

^bP values from Wilcoxon rank sum tests for continuous variables and from χ^2 tests for categorical variables.

^cIncludes all prostate cancer-related procedures (including those used in less than 2% of patients).

Table 4
Comparison of Baseline Demographic Characteristics and Resource Use by Cause of Death

Characteristic	Cause of Death					P Value ^a
	Prostate Cancer (n = 8215)	Diseases of the Heart (n = 10,319)	Cerebrovascular Diseases (n = 2207)	Pneumonia or Influenza (n = 1062)	COPD and Allied Conditions (n = 1844)	
Age at diagnosis, median (IQR), y	77 (72-82)	77 (72-81)	77 (73-81)	78 (74-83)	76 (72-80)	<.001
Age at death, median (IQR), y	82 (77-87)	83 (79-88)	84 (80-88)	85 (81-89)	82 (78-86)	<.001
No. of comorbid conditions 1 year before death, No. (%)						
0	4553 (55.42)	3442 (33.36)	867 (39.28)	368 (34.65)	324 (17.57)	<.001
1	2091 (25.45)	2860 (27.72)	599 (27.14)	305 (28.72)	675 (36.61)	<.001
2	1571 (19.12)	4017 (38.93)	741 (33.57)	389 (36.63)	845 (45.82)	<.001
Any hospitalization, No. (%)	6451 (78.53)	7956 (77.10)	1896 (85.91)	972 (91.53)	1611 (87.36)	<.001
Hospitalizations, mean (SD)	1.8 (1.7)	2.0 (2.0)	2.0 (1.7)	2.3 (1.8)	2.4 (2.0)	<.001
Inpatients Days, mean (SD)	12.2 (16.1)	14.5 (19.8)	14.9 (19.9)	21.2 (26.2)	19.4 (23.1)	<.001
ICU days, mean (SD)	1.4 (4.5)	3.3 (8.0)	3.0 (7.5)	5.7 (11.9)	4.2 (8.8)	<.001
Any SNF use, No. (%)	2696 (32.82)	3456 (33.49)	946 (42.86)	493 (46.42)	761 (41.27)	<.001
SNF, mean (SD), days	11.7 (27.0)	13.6 (30.2)	17.3 (33.7)	20.5 (36.9)	15.3 (30.0)	<.001

Abbreviations: COPD, chronic obstructive pulmonary disease; ICU, intensive care unit; IQR, interquartile range; SNF, skilled nursing facility.

^a P values from χ^2 tests for proportions and ANOVA for continuous variables.

Table 5
Costs in the Last Year of Life Among Patients by Cause of Death^a

Source	Cause of Death						P Value
	Prostate Cancer (n = 8215)	Other Causes (n = 26,512)	Diseases of the Heart (n = 10,319)	Cerebrovascular Diseases (n = 2207)	Pneumonia or Influenza (n = 1062)	COPD and Allied Conditions (n = 1844)	
Carrier file, mean (SD), \$	11,764 (12,657)	8569 (9215)	8061 (8056)	7308 (7332)	9293 (9910)	8024 (7681)	< .001
DME, mean (SD), \$	460 (1197)	850 (2644)	733 (3094)	780 (2114)	790 (1783)	2174 (2443)	< .001
Home health, mean (SD), \$	1687 (3578)	1826 (4127)	1786 (3954)	1841 (4322)	2102 (5161)	1898 (3845)	< .001
Hospice, mean (SD), \$	5117 (9797)	1981 (6804)	1538 (6349)	1579 (5732)	660 (3100)	2019 (6830)	< .001
Outpatient, mean (SD), \$	3774 (7000)	2753 (6416)	2466 (5856)	1846 (4044)	2166 (4898)	1721 (3938)	< .001
Inpatient, mean (SD), \$	20,769 (26,074)	29,851 (40,573)	27,869 (38,875)	28,851 (37,020)	41,830 (51,584)	34,038 (42,949)	< .001
Total costs, mean (SD), \$	43,572 (34,325)	45,830 (48,738)	42,452 (47,033)	42,205 (43,440)	56,841 (60,629)	49,874 (49,619)	< .001

Abbreviations: COPD, chronic obstructive pulmonary disease; DME, durable medical equipment.

^a All costs are adjusted to 2008 US dollars.

Table 6
Multivariable Regression Analysis of Costs^a

Characteristic	Fold Change in Costs (95% CI)	P Value ^b
Cause of death		
Cerebrovascular disease	0.97 (0.89-1.06)	.53
COPD	1.08 (1.00-1.16)	.06
Diseases of the heart	0.89 (0.84-0.95)	< .001
Pneumonia	1.25 (1.11-1.41)	< .001
Prostate cancer	0.88 (0.85-0.92)	< .001
Non-prostate malignancy	1.08 (1.01-1.16)	.03
Other cause of death	1.00 [Reference]	
Hospice		
No hospice	1.00 [Reference]	
1-14 days	1.01 (0.92-1.12)	.82
More than 14 days	1.12 (1.03-1.22)	.007
Interaction between hospice and cause of death		
Prostate cancer: 1-14 days	0.97 (0.90-1.05)	.45
Prostate cancer: more than 14 days	1.01 (0.94-1.09)	.80
Non-prostate malignancy: 1-14 days	0.96 (0.91-1.02)	.17
Non-prostate malignancy: more than 14 days	0.92 (0.86-0.98)	.02
Diseases of the heart: 1-14 days	1.23 (1.13-1.32)	< .001
Diseases of the heart: more than 14 days	1.21 (1.13-1.30)	< .001
Cerebrovascular disease: 1-14 days	1.00 (0.89-1.14)	.94
Cerebrovascular disease: more than 14 days	1.13 (0.99-1.30)	.07
Pneumonia: 1-14 days	0.80 (0.70-0.92)	.002
Pneumonia: more than 14 days	0.79 (0.69-0.90)	< .001
COPD: 1-14 days	1.01 (0.95-1.07)	.71
COPD: more than 14 days	0.98 (0.87-1.11)	.76
Invasive procedures		
0	1.00 [Reference]	
1	1.71 (1.66-1.77)	< .001
2	2.39 (2.22-2.58)	< .001
Number of comorbid conditions		
1	1.10 (1.06-1.15)	< .001
2	1.32 (1.26-1.38)	< .001
Age at death (in decades)	0.87 (0.84-0.89)	< .001
Black race	1.27 (1.14-1.43)	< .001

Abbreviations: COPD, chronic obstructive pulmonary disease; SEER, Surveillance, Epidemiology, and End Results.

^aVariables included in the model are cause of death, hospice, the interaction between hospice and cause of death, number of invasive procedures performed, comorbid conditions, marital status, black race, initial stage and treatment, year of death, and errors clustered at the registry level.

Stage, initial treatment, and marital status were not significant and are not reported in the table but were included in the model as controls. Although some years were associated with increases or decreases in costs, the differences were small and showed no consistent pattern across years (not shown). Disease stage was assigned using SEER historical staging data. Patients not categorized as having distant, localized, or regional disease were categorized as having missing, unknown, or unstaged disease.

^b *P* values from generalized linear regression of total costs using a gamma distribution with a log link.

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