Variation in Intensity and Costs of Care by Payer and Race for Patients Dying of Cancer in Texas

An Analysis of Registry-linked Medicaid, Medicare, and Dually Eligible Claims Data

B. Ashleigh Guadagnolo, MD, MPH,† Kai-Ping Liao, PhD,† Sharon H. Giordano, MD, MPH,†‡ Linda S. Elting, DrPH, MPH,† and Ya-Chen T. Shih, PhD†*

Purpose: To investigate end-of-life care for Medicaid, Medicare, and dually eligible beneficiaries dying of cancer in Texas.

Methods: We analyzed the Texas Cancer Registry (TCR)-Medicaid and TCR-Medicare linked databases' claims data for 69,572 patients dying of cancer in Texas from 2000 to 2008. We conducted regression models in adjusted analyses of cancer-directed and acute care and total costs of care (in 2014 dollars) in the last 30 days of life.

Results: Medicaid patients were more likely to receive chemotherapy and radiation therapy. Medicaid patients were more likely to have >1 emergency room (ER) [odds ratio (OR) = 5.27; 95% confidence interval (CI), 4.76–5.84], and were less likely to enroll in hospice (OR = 0.59; 95% CI, 0.55–0.63) than Medicare patients. Dual eligibles were more likely to have >1 ER visit than Medicare-only beneficiaries (OR = 1.19; 95% CI, 1.07–1.33). Black and Hispanic patients were more likely to experience >1 ER visit and >1 hospitalization than whites. Costs were higher for nonwhite Medicare, Medicaid, and dually eligible patients compared with white Medicare enrollees.

Conclusions: Variation in acute care utilization and costs by race and payer suggest efforts are needed to address palliative care coordination at the end of life for Medicaid and dually eligible beneficiaries and minority patients dying of cancer.

Key Words: Medicaid, end-of-life care, Medicare, dually eligible

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Studies of insurance claims data have identified trends of aggressive end-of-life care for patients dying of cancer, specifically with respect to utilization of chemotherapy, emergency room (ER) care, hospitalization, lack of hospice use, and radiation therapy.[1–3] These findings led to the development of claims-based indicators to assess the intensity of care at the end-of-life for patients dying of cancer.[4,5] Most of these studies have focused on patients enrolled in fee-for-service Medicare whose claims data are linked to the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) registries that provide cancer-related clinical information. However, a recent study linking cancer registry data in New York and California to Medicaid claims files showed that Medicaid patients had significantly lower hospice enrollment compared with their same-state Medicare counterparts.[6] There are few other published studies regarding cancer-related care and outcomes for Medicaid patients in general, but some data do indicate that a high proportion of Medicaid enrollees present with late-stage cancer at diagnosis which is often incurable,[7–9] raising the importance of quality end-of-life cancer care for Medicaid patients.

A focus on Medicaid care delivery bears particular contemporary policy relevance given that, as of this writing (February 2015), Medicaid expansion is occurring in 29 states and the District of Columbia and its expansion is under debate in 7 other states. It is the primary payer for health care for many of the nation's most vulnerable populations (ie, low-income and largely minority).[10] There is also current policy relevance to understanding care delivery and outcomes for patients who are dually eligible for Medicare and Medicaid. Dual-eligible beneficiaries are comprised of those who are disabled, chronically ill, or require admission to long-term care facilities and fall below an income threshold such that they are eligible for both programs to pay for their medical care. Dually eligible patients present challenges of

From the Departments of *Radiation Oncology; †Health Services Research; and ‡Breast Medical Oncology, MD Anderson Cancer Center, Houston, TX.

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Reprints: B. Ashleigh Guadagnolo, MD, MPH, Departments of Radiation Oncology and Health Services Research, M.D. Anderson Cancer Center, 1515 Holcombe Blvd, Houston, TX 77030. E-mail: aguadagn@mdanderson.org.

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both care and financing coordination because they are often medically complicated and their health care reimbursements have to be coordinated between federal and state payers.[11] Although dual-eligible patients comprise one-fifth of those covered by each payer, they account for approximately one-third of expenditures for Medicaid and Medicare, respectively.[12] Some studies have shown that dually eligible patients have disparate cancer care utilization and poorer survival than cancer patients enrolled upon Medicare alone.[13]

Recently the Texas Cancer Registry (TCR) has linked cancer-specific clinical data to Medicaid and Medicare claims files for analysis of outcomes, utilization, and costs of cancer care for the citizens of Texas. Texas' database offers a robust and nationally relevant population sample, as it is the second most populous state in the United States and one whose population is diverse and currently represents the future predicted racial/ethnic diversity of the United States by 2040.[14,15] The aims of this study are to ascertain differences in and costs of end-of-life care among patients dying of cancer in Texas with respect to whether a patient was enrolled in Medicaid and/or Medicare. We hypothesized that Medicaid and dually eligible patients would have higher rates of poor quality end-of-life care indicators (eg, lack of hospice enrollment, more acute care utilization, receipt of chemotherapy in the last 30 d of life, etc.) than their Medicare counterparts.

METHODS

Data Sources and Cohort Definition

We conducted this analysis using the TCR-Medicare and TCR-Medicaid linked databases. In Texas, 12% of citizens are Medicare beneficiaries and 19% are Medicaid enrollees. Among these Texans who receive publicly funded health care, over 640,000 were dually eligible for both Medicare and Medicaid in 2010.[16] TCR files are linked to Medicare and Medicaid claims files using probabilistic linkage methods that protect individual patient privacy to obtain utilization data. All data were deidentified such that no protected health information could be linked to individual patients, and the MD Anderson Cancer Center's institutional review board exempted this study.

We identified 69,572 patients who died as a result of breast, colorectal, lung, melanoma, pancreatic, and prostate cancers between January 1, 2000 and December 31, 2008. Of these, 3561 were fee-for-service Medicaid enrollees, 56,875 were Medicare beneficiaries (who were not dually eligible), and 9137 were dually eligible for both Medicaid and Medicare. Payer status was valid for the final 60 days of life. Medicare patients who were dually eligible for Medicaid were identified by an encrypted beneficiary ID linked with Medicaid monthly enrollment status abstracted from Medicaid Analytic Extracts Personal Summary files. Date of death was determined from TCR. Patients' causes of death were determined using the ninth and 10th revisions of the International Classification of Disease Codes (ICD-9 and ICD-10). End-of-life health care utilization and cost data were examined for patients dying of these 6 cancers because these malignancies comprise over 60% of cancer causes of death in the United States.[17] Table 1 shows the criteria for cohort development for this study.

End-of-Life Care Utilization

We analyzed claims data to assess for receipt of various aspects of oncology, acute, and end-of-life care utilization in the last 30 days of life in this cohort. Receipt of radiation therapy was identified using Current Procedural Terminology codes to confirm radiation therapy delivery (see Appendix, Supplemental Digital Content 1, http://links.lww.com/MLR/A943). Receipt of chemotherapy was also determined by presence of Current Procedural Terminology chemotherapy codes (codes in Appendix, Supplemental Digital Content 1, http://links.lww.com/MLR/A943).

We determined whether a patient had an ER visit in the study window by using the following ER service codes (provided in Appendix, Supplemental Digital Content 1, http://links.lww.com/MLR/A943), and the number of ER days were determined by the number of dates with one of these service codes present. Similarly the number of hospital

TABLE 1. Cohort Development Criteria in TCR-Medicare and TCR-Medicaid Linked Databases

		Medicare [N (%)]	Medicaid [N (%)]
1	Diagnosis = colorectal, pancreas, lung, breast, prostate, or melanoma	486,873 (100.0)	29,352 (100.0)
2	Matched year and month of death between TCR and Medicare*	470,836 (96.7)	—
3	Date of death between 2000 and 2008	193,506 (39.7)	26,762 (91.2)
4	Cause of death matches cancer diagnosis	103,869 (21.3)	26,762 (91.2)
5	Diagnosis reporting source not from autopsy or death certificate	95,129 (19.5)	23,918 (81.5)
6	Pathologic confirmation of cancer	87,404 (18.0)	21,604 (73.6)
7	Medicare Part A and B coverage, no HMO in 2 mo prior death	74,355 (15.3)	—
8.1	Medicaid enrollment 2 mo prior death	—	—
8.2	No managed care coverage 2 mo prior death	—	18,013 (61.4)
8.3	Full scope of Medicaid coverage 2 mo prior death	—	15,327 (52.2)
8.4	No private insurance coverage 2 mo prior death	—	12,023 (41.0)
8.5	No Medicare coverage in 2 mo prior death	—	11,119 (37.9)
9	Survived at least 1 mo since diagnosis	70,485 (14.5)	3561 (12.1)
10	Texas residents	66,015 (13.6)†	3561 (12.1)

*Exact date of death not recorded in Medicaid files and thus cannot be cross-verified with TCR.
†9137 patients were dually eligible for both Medicare and Medicaid.
HMO indicates Health Maintenance Organization; TCR, Texas Cancer Registry.

days was determined by the number of hospital (inpatient) service dates, including intensive care unit service dates in the MEDPAR claims file for Medicare and the Medicaid Analytic Extract Inpatient Claims file. Hospice care was identified as any hospice admission and/or service date in the hospice claims file for Medicare or in the Medicaid file.

Costs

We calculated costs from the payer's perspective (total amount reimbursed by Medicaid and Medicare) and included all costs incurred in the 30-day window before death except for outpatient prescription drug costs. We did not include prescription drug costs because Medicare Part D data were only available starting in 2007. Costs were normalized to the 2014 dollar using the Consumer Price Index-Medical Care services from the Bureau of Labor Statistics and the US Medicaid inflation rate.[18,19]

Statistical Analyses

Statistical analyses were conducted with SAS Systems software for Windows (version 9.2) and STATA (version 13.0). The unadjusted association of whether the patient was a beneficiary of Medicaid, Medicare, or dually eligible with each potential sociodemographic variable, and health care utilization outcomes was assessed with χ^2 tests for categorical variables. All *P*-values were 2-sided, and a threshold of 0.05 was used to determine significance. Multivariable logistic regression models were used to examine independent association between explanatory variables and health care utilization patterns. In addition to type of publicly funded insurance coverage, other explanatory variables included: sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other), cancer type causing death, and whether the patient had distantly metastatic cancer at the time of cancer diagnosis. We also adjusted for comorbidity by computing claim-based comorbidity weights based on the National Cancer Institute's Statistical Analysis System (SAS) algorithm that uses diagnosis, surgery, and HCPCS codes abstracted from the patient's hospital claims and carrier claims submitted to either Medicare or Medicaid 1-year prior to the date of death, which computes a Charlson comorbidity index score.[20] We adjusted for geographic variation in both medical costs and medical care availability within Texas by including Health Services Area fixed effect in adjusted models. The county and Health Services Area crosswalk was obtained from the Texas Department of Health and Human Services.[21] Both the Hosmer Lemeshow and the Pearson correlation tests were conducted for model-fit assessments, and showed no systematic patterns in the residuals across predictors. Cost data were analyzed using the method of extended estimating equations for analyzing highly skewed costs data.[22] The approach adopts power variance

$$\left(\mathrm{PV}=\mathrm{h}\left(\mu_i - \theta_1, \theta_2\right)=\theta_1\mu_{\mathrm{i}}^{\theta_2} - \text{ link function}=\left(\mu^{\lambda}-1\right)/\lambda, \text{ if } \lambda \neq 0\right)$$

to derive robust estimations when no specific distribution for the outcome measure is identified.

RESULTS

Characteristics of the Study Cohort

The characteristics of the study cohort are shown in Table 2. As expected, the Medicaid patients were younger than the Medicare and dually eligible patients. Less than half of the Medicaid and dually eligible patients were non-Hispanic white, whereas 80% of the Medicare patients were non-Hispanic white. Hispanics comprised 24% and 30% of the Medicaid and dually eligible cohorts, respectively; and non-Hispanic black patients comprised 25% and 22% of the Medicaid and dually eligible cohorts, respectively. Sixty percent of the Medicaid patients had distantly metastatic cancer at the time of diagnosis compared with 39% and 41%, respectively, of the Medicare and dually eligible cohorts. Over half of Medicaid enrollees had no comorbidities compared with 37% and 23% of the Medicare and dually eligible patients, respectively.

Chemotherapy and Radiation Therapy Utilization in the Last 30 Days of Life

A significantly higher proportion of Medicaid patients received chemotherapy in the last 30 days of life as well as in the last 14 days of life compared with Medicare and dually eligible patients (Table 3). Similarly, almost double the percentage of Medicaid patients received radiation therapy in the last 30 days of life compared with Medicare and dually eligible patients. The results of multivariable analyses adjusting for sociodemographic, health services, and clinical characteristics are shown in Table 3. Medicaid patients were significantly more likely to receive chemotherapy in the last 14 and 30 days of life, respectively [odds ratio (OR) = 1.58; 95% confidence interval (CI), 1.32–1.89 for chemotherapy in the last 14 d and OR = 1.72; 95% CI, 1.53–1.94 for the last 30 d] compared with Medicare or dually eligible patients. Similarly, Medicaid patients were also more likely to undergo radiation therapy in the last 14 and 30 days of life, respectively. Dually eligible patients were significantly less likely to receive radiation therapy in the final month of life than their Medicare-only counterparts.

Acute Care Utilization in the Last 30 Days of Life

Among Medicaid patients dying of cancer in this cohort, 20% had >1 ER visit in the last 30 days of life. Adjusted analyses (Table 3) confirmed that Medicaid patients were more likely to have >1 emergency room visit in the final 30 days of life than their Medicare counterparts (OR = 5.27; 95% CI, 4.76–5.84). Dually eligible patients were also more likely to have >1 ER visit than Medicare-only patients (OR = 1.19; 95% CI, 1.07–1.33). Dually eligible patients were significantly less likely to have >1 hospital admission in the last 30 days of life compared with Medicare-only patients (OR = 0.90; 95% CI, 0.84–0.97).

Multivariable analyses also revealed that black and Hispanic patients were more likely to experience >1 ER visit in the last 30 days of life than white patients. Nonwhite race was also associated with a significantly greater likelihood of having >1 hospital admission in the final 30 days of life (Table 3).

TABLE 2. Characteristcs of the Entire Study Cohort by Payer Status

	Total [N (%)]	Medicaid [N (%)]	Medicare [N (%)]	Dual [N (%)]	*P*
All cancer patients	69,572* (100.0)	3561 (100.0)	56,875 (100.0)	9136 (100.0)	
Age (y)					<0.01
18–44	973 (1.3)	594 (16.6)	282 (4.0)	97 (1.0)	
45–64	7770 (11.1)	2867 (80.5)	3796 (6.6)	1107 (12.1)	
65–80	41,844 (60.1)	77 (2.1)	36,468 (64.1)	5299 (58.0)	
81+	18,985 (27.2)	23 (6.0)	16,329 (28.7)	2633 (28.8)	
Race/ethnicity					<0.01
Non-Hispanic white	51,265 (73.6)	1756 (49.3)	45,501 (80.0)	4008 (43.8)	
Black	8337 (11.9)	883 (24.7)	5415 (9.5)	2039 (22.3)	
Hispanic	9043 (12.9)	865 (24.2)	5395 (9.4)	2783 (30.4)	
Other/unknown	927 (1.3)	57 (1.6)	564 (9.0)	306 (3.3)	
Sex					<0.01
Female	33,099 (47.5)	1791 (50.2)	26,042 (45.7)	5266 (57.6)	
Male	36,473 (52.4)	1770 (49.7)	30,833 (54.2)	3870 (42.3)	
Cancer cause of death					<0.01
Breast	7833 (11.2)	595 (16.7)	6117 (10.7)	1121 (12.2)	
Colon and rectum	13,028 (18.7)	577 (16.2)	10,588 (18.6)	1863 (20.3)	
Lung and bronchus	36,606 (52.6)	1953 (54.8)	29,844 (52.4)	4809 (52.6)	
Melanoma	1442 (2.0)	98 (2.7)	1232 (2.1)	112 (1.2)	
Pancreas	5509 (7.9)	284 (7.9)	4503 (7.9)	722 (7.9)	
Prostate	5154 (7.4)	54 (1.5)	4591 (8.0)	509 (5.5)	
Distant metastases					<0.01
No	41,325 (59.3)	1423 (39.9)	34,548 (60.7)	5354 (58.6)	
Yes	28,247 (40.6)	2138 (60.0)	22,327 (39.2)	3782 (41.3)	
Residency					<0.01
Urban	15,953 (22.9)	658 (18.4)	12,928 (22.7)	2367 (25.9)	
Rural	53,619 (77.0)	2903 (81.5)	43,947 (77.2)	6769 (74.0)	
Charlson					<0.01
0	25,340 (36.4)	1984 (55.7)	21,222 (37.3)	2134 (23.3)	
1	19,604 (28.1)	912 (25.6)	16,009 (28.1)	2683 (29.3)	
2+	20,668 (29.7)	588 (16.5)	15,829 (27.8)	4251 (46.5)	
Unknown	3960 (5.6)	77 (2.1)	3815 (6.7)	68 (7.0)	
Survival (mo)					<0.01
1–6	24,484 (35.1)	1787 (50.1)	18,933 (33.2)	3764 (41.1)	
7–12	11,762 (16.9)	664 (18.6)	9365 (16.4)	1733 (18.9)	
13–24	12,366 (17.7)	685 (19.2)	9953 (17.4)	1728 (18.9)	
>24	20,960 (30.1)	425 (11.9)	18,624 (32.7)	1911 (20.9)	
House income (county)					
Mean	$41,137	$40,936	$41,457	$39,220	
Median	$41,220	$41,256	$41,256	$38,624	
Lower quartile (Q1)	$34,138	$34,247	$34,357	$32,270	
Upper quartile (Q3)	$46,012	$46,468	$46,468	$44,156	
Education (% >high school) (county)					
Mean	79.0	78.2	79.4	76.4	
Median	80.7	80.7	80.7	79.8	
Lower quartile (Q1)	76.3	76.5	77.3	73.8	
Upper quartile (Q3)	83.5	83.0	83.7	81.2	

Survival (mo) indicates time from diagnosis until death.

*This table reflects exclusion of 4 patients due to missing values that caused small cell sizes that would have resulted in reported values that fall below the cell size threshold to maintain patient confidentiality per the data user agreement with TCR-Medicare/Medicaid.

Hospice Utilization in the Last 30 Days of Life

Among Medicaid enrollees, 49% did not have hospice enrollment within the final 30 days of life (Table 3) compared with 34% of Medicare patients and 35% of dually eligible patients, respectively. In multivariable analysis adjusting for other characteristics (Table 3), Medicaid enrollees were significantly less likely to enroll in hospice in their final 30 days of life compared with Medicare and dually eligible patients. Dually eligible patients were more likely than Medicare-only enrollees to enroll in hospice in the final 30 days of life. Nonwhite race was associated with significantly decreased likelihood of hospice enrollment.

Differences in Costs

We performed multivariable analyses of costs controlling for year of death and health service area (Table 4). We identified a significant interaction between race and payer status (eg, Medicaid, Medicare, or dually eligible) regarding association with costs, likely attributable to the differences in acute care utilization as described above. With white Medicare enrollees as the reference group, expenditures were significantly higher for nonwhite Medicare, Medicaid, and dually eligible patients. Expenditures were significantly lower for dually eligible white enrollees compared with white Medicare enrollees.

TABLE 3. Multivariable Analyses of Likelihood of End-of-Life Care Utilization Metrics

	CR (%)	OR	95% CI	CR (%)	OR	95% CI	CR (%)	OR	95% CI	CR (%)	OR	95% CI
	RT 14 D			RT 30 D			Chemo 14 D			Chemo 30 D		
Coverage												
Medicare	2.8	1.00		5.6	1.00		2.4	1.00		5.7	1.00	
Medicaid	5.0	**1.43**	(1.21, 1.69)	10.3	**1.56**	(1.38, 1.76)	4.2	**1.58**	(1.32, 1.89)	10.8	**1.72**	(1.53, 1.94)
Dual	2.9	0.95	(0.83, 1.10)	5.5	**0.89**	(0.80, 0.99)	2.7	1.08	(0.93, 1.25)	6.2	1.01	(0.92, 1.12)
Ethnicity												
White	2.9	1.00		5.8	1.00		2.5	1.00		5.9	1.00	
Black	2.6	0.91	(0.78, 1.06)	5.2	0.90	(0.81, 1.01)	2.2	0.85	(0.73, 1.00)	5.6	**0.88**	(0.80, 0.98)
Hispanic	3.1	1.13	(0.97, 1.31)	6.2	**1.14**	(1.03, 1.27)	2.9	1.04	(0.89, 1.21)	7.1	1.09	(0.99, 1.21)
Other/unknown	3.5	1.30	(0.91, 1.87)	6.2	1.17	(0.89, 1.54)	2.5	0.97	(0.64, 1.48)	6.2	1.03	(0.78, 1.35)
Stage at diagnosis												
In situ/local/regional	2.3	1.00		4.7	1.00		2.2	1.00		5.3	1.00	
Distant	3.8	**1.18**	(1.07, 1.30)	7.4	**1.18**	(1.10, 1.26)	3.0	**1.19**	(1.07, 1.31)	7.1	**1.23**	(1.15, 1.32)
Survival (mo)												
1–6	4.6	1.00		8.7	1.00		3.4	1.00		7.5	1.00	
7–12	2.6	**0.56**	(0.49, 0.64)	5.9	**0.65**	(0.59, 0.71)	2.4	**0.70**	(0.61, 0.81)	6.5	**0.90**	(0.83, 0.99)
13–24	2.1	**0.50**	(0.43, 0.57)	4.2	**0.50**	(0.45, 0.55)	2.0	**0.60**	(0.52, 0.70)	4.9	**0.71**	(0.65, 0.79)
>24	1.5	**0.42**	(0.36, 0.49)	3.2	**0.45**	(0.40, 0.50)	1.8	**0.58**	(0.50, 0.67)	4.7	**0.74**	(0.68, 0.82)
	ER > 1			> 1 Hospital admission			Hospice enrollment					
Coverage												
Medicare	3.8	1.00		9.6	1.00		65.3	1.00				
Medicaid	19.4	**5.27**	(4.76, 5.84)	11.7	1.07	(0.95, 1.19)	50.8	**0.59**	(0.55, 0.63)			
Dual	5.7	**1.19**	(1.07, 1.33)	11.3	**0.90**	(0.84, 0.97)	65.3	**1.15**	(1.09, 1.21)			
Ethnicity												
White	4.0	1.00		9.2	1.00		66.5	1.00				
Black	7.9	**1.69**	(1.53, 1.86)	11.0	**1.27**	(1.17, 1.37)	59.1	**0.71**	(0.67, 0.74)			
Hispanic	6.7	**1.45**	(1.30, 1.62)	13.3	**1.49**	(1.38, 1.61)	58.7	**0.78**	(0.74, 0.82)			
Other/unknown	4.6	1.11	(0.81, 1.52)	10.7	1.27	(1.02, 1.57)	61.6	0.73	(0.64, 0.84)			
Stage at diagnosis												
In situ/local/regional	4.3	1.00		9.0	1.00		63.8	1.00				
Distant	5.6	**1.08**	(1.00, 1.17)	11.4	**1.14**	(1.08, 1.21)	65.6	**1.29**	(1.24, 1.34)			
Survival (mo)												
1–6 (ref.)	5.8	1.00		13.0	1.00		58.9	1.00				
7–12	4.8	**0.84**	(0.76, 0.94)	9.1	**0.67**	(0.62, 0.72)	66.7	**1.46**	(1.40, 1.54)			
13–24	4.8	**0.89**	(0.80, 0.99)	8.0	**0.64**	(0.59, 0.69)	68.8	**1.66**	(1.58, 1.74)			
>24	3.8	**0.80**	(0.72, 0.90)	8.0	**0.68**	(0.63, 0.73)	67.6	**1.59**	(1.51, 1.66)			

Multiple logistic regression models also control for sex, cause of death, Charlson score, rural/urban residency, death year (2000–2008), area income level, and area education level. Survival (mo) indicates time from diagnosis until death.

Values in bold are statistically significant.

CI indicates confidence interval; CR, crude rate; OR, odds ratio; RT, radiation therapy.

DISCUSSION

Medicaid patients dying of cancer experienced more aggressive cancer-directed therapy and more emergency room utilization at the end of life than their Medicare-insured counterparts. Dually eligible patients also had more intense emergency room use at the end of life than Medicare-only patients. Hospice enrollment was significantly underutilized among Medicaid patients and racial/ethnic minority patients of any payer status. Regardless of payer, racial/ethnic minority patients experienced higher acute care utilization in the last 30 days of life and strongly influenced the observed costs of care reimbursed by both Medicaid and Medicare whether patients were beneficiaries of one or both.

The observed proportions of Medicare-enrolled (including dually eligible enrollees) patients receiving chemotherapy in the final month of life in this analysis are similar to those seen by other investigators who have investigated this in other Medicare cohorts.[1,5] However, the proportion of Medicaid patients who received chemotherapy in the last month of life was approximately double that seen for reported Medicare-only cohorts. The proportion of Texas Medicare enrollees receiving radiation therapy in the last month of life was slightly lower than observed in another large, multistate cohort of Medicare enrollees.[3] In contrast, the proportion of Medicaid patients receiving radiation therapy in the last month of life was slightly higher. The significance of the proportion receiving radiation therapy is not clear, and it should be noted that it has not itself been deemed a quality indicator of end-of-life care. Some studies suggest proportional underuse of radiation therapy,[23] whereas others suggest high intensity of radiation therapy use among those who do receive radiation therapy at the end of life.[3,24] Understanding of radiation therapy use is relevant to end-of-life care, but it is a subject that needs further study. The explanation for higher proportional utilization of cancer-directed therapies, in general, among Medicaid enrollees may relate to the fact that Medicaid patients were younger and had fewer

TABLE 4. Adjusted Analyses of All Costs of Care in the Final 30 Days of Life

	Unadjusted		Adjusted (Extended GLM)		
	Average	Difference	Coefficient	95% CI	*P*
Coverage × ethnicity					
Medicare (white)	$10,977	$0	Ref.	—	—
Medicare (nonwhite)	$12,502	$1524	$1415	($1121, $1709)	<0.001
Dual (white)	$10,363	−$614	−$1358	(−$1736, −$980)	<0.001
Dual (nonwhite)	$13,847	$2870	$1778	($1339, $2216)	<0.001
Medicaid (white)	$11,595	$618	$529	(−$143, $1201)	0.121
Medicaid (nonwhite)	$12,233	$1256	$967	($418, $1516)	<0.001
Sex					
Female	$11,190	$0	Ref.	—	—
Male	$11,688	$498	$429	($221, $637)	<0.001
COD					
Breast	$10,758	$0	Ref.	—	—
Colon and rectum	$10,969	$211	−$785	(−$1140, −$430)	<0.001
Pancreas	$10,875	$117	−$2067	(−$2500, −$1635)	<0.001
Lung	$12,179	$1422	−$472	(−$809, −$136)	0.006
Prostate	$9599	−$1159	−$1507	(−$1954, −$1059)	<0.001
Melanoma	$9896	−$862	−$984	(−$1618, −$350)	0.002
Stage					
In situ/local/regional	$11,180	$0	Ref.	—	—
Distant metastasis	$11,847	$667	−$522	(−$734, −$309)	<0.001
Residency					
Urban	$10,451	$0	Ref.	—	—
Rural	$11,748	$1297	$632	($401, $864)	<0.001
Charlson					
0	$10,435	$0	Ref.	—	—
1	$11,965	$1530	$1209	($965, $1453)	<0.001
2+	$12,850	$2415	$2019	($1751, $2287)	<0.001
Unknown	$8101	−$2334	−$2816	(−$3268, −$2364)	<0.001
Survival (mo)					
1–6	$14,100	$0	Ref.	—	—
7–12	$10,441	−$3658	−$3797	(−$4189, −$3404)	<0.001
13–24	$9988	−$4112	−$4022	(−$4424, −$3620)	<0.001
>24	$9787	−$4312	−$4325	(−$4731, −$3920)	<0.001

The adjusted model controls for listed variables as well as death year (2000–2008) and Health Service Area. The link parameter is estimated as $\hat{\lambda}$=0.81(95% CI: 0.57, 1.06). The parameter estimations of the power variance model are $\hat{\theta}_1$=1.26 (95% CI: 1.02, 1.31) and $\hat{\theta}_2$=1.69 (95% CI: 1.49, 1.92), which is close to the form of gamma distribution $\theta_1 > 0$ and θ_2=2.

CI indicates confidence interval; COD, cancer cause of death; GLM, generalized linear model.

comorbidities than Medicare and dually eligible patients, which may have influenced decision making about cancer-directed therapy administration toward treating these patients more aggressively.

The higher utilization of emergency care among Medicaid enrollees, and minority patients regardless of payer, suggests that patients from vulnerable populations may not be receiving optimal supportive care at the end of life. Likely related to this finding, we observed significantly less hospice utilization among Medicaid enrollees and minorities. Others have observed similar hospice utilization trends among Medicaid patients in other states.[6] One explanation could be lack of access to hospice care, and we did observe that rurally residing patients were less likely to enroll in hospice (data not shown). Other investigators have documented that racial and ethnic minorities dying of cancer were less likely to enroll in hospice services,[25] and this disparity may be due in some part to patient preferences regarding the discontinuation of cancer-directed therapy.[26] In our cohort, it is also possible that lack of knowledge of hospice services and benefits, cultural barriers, or language barriers may have also impeded hospice enrollment among Medicaid patients. However, efforts can and should be made to address these barriers and coordinate appropriate supportive care for Medicaid patients, such as was done for Medicaid enrollees in Maryland with use of a palliative care case management program that significantly decreased acute care utilization at the end of life for Medicaid beneficiaries.[27]

Patients in our study who were dually eligible for both Medicare and Medicaid had similar end-of-life chemotherapy utilization as that observed for patients enrolled in Medicare only, but were less likely to receive radiation therapy. There are few data regarding cancer-directed therapy utilization for dual eligibles. However, Bradley et al[13] showed that dually eligible beneficiaries in Michigan were less likely to undergo curative surgery for lung cancer than Medicare counterparts, even when controlling for comorbidities. The relatively high observed costs for nonwhite dually eligible beneficiaries in our cohort are likely related to

the high proportion of dually eligible patients with multiple comorbidities (Table 2) combined with the high acute care utilization observed for nonwhite patients regardless of payer. Relatedly, the lower expenditures observed for white dually eligible patients is likely related to the lower likelihood of >1 hospital admission among white patients. In other words, the racial/disparities in acute care utilization exerted the strongest influence among dually eligible patients; that is, costs were actually significantly lower for white dual eligibles compared with all other groups but significantly higher for nonwhite dual eligible compared with all other groups. These findings signal a need for targeted palliative care access and coordination efforts for terminally ill, dually eligible minority patients.

Our study has inherent limitations to retrospective cohort analyses using registry data linked to claims data. Chief among them is that patient and provider preference information is not available in these databases. We also acknowledge that use of death as the reference point and looking retrospectively at care is controversial.[28] It has been established that physicians cannot accurately predict survival times for individual patients, thus limiting the ability to make inferences regarding whether end-of-life care was appropriate or not. However, we would like to note that other investigators have used death as an investigative reference point to study acute care and cancer-directed therapy quality metrics for other population-based cohorts.[1,4,29] We also cannot glean any information in this database regarding which patients may have low English proficiency and thus cannot ascertain to what extent that may influence treatment utilization, especially in a cohort with a large proportion of Hispanic patients such as ours.

In conclusion, our study has identified that patients dying of cancer and who were enrolled upon Medicaid were more likely to receive cancer-directed therapy and more likely to utilize emergency services in the last 30 days of life than Medicare. Dually eligible beneficiaries were also more likely to have >1 emergency room visit in the last month of life, but costs for these patients were largely driven by observed racial differences in acute care utilization. Our analyses revealed that minority patients, regardless of payer status, were more likely to experience more intensive acute care utilization and less likely to enroll in hospice care in the final 30 days of life and that their care was correspondingly significantly more expensive. Efforts are needed to address palliative care coordination at the end of life for Medicaid enrollees and minority patients dying of cancer.

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