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Cancer Outcomes in Low-Income Elders: Is There An Advantage to Being on Medicaid?

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Background: Because of reduced financial barriers, dual Medicare-Medicaid enrollment of low-income Medicare beneficiaries may be associated with receipt of definitive cancer treatment and favorable survival outcomes.

Methods: We used a database developed by linking records from the Ohio Cancer Incidence Surveillance System with Medicare and Medicaid files, death certificates, and U.S. Census data. The study population included community-dwelling Medicare fee-for-service beneficiaries, age 66 years or older, with low incomes, residing in Ohio, and diagnosed with incident loco-regional breast (n=838), colorectal (n=784), or prostate cancer (n=946) in years 1997–2001. We identified as "duals" Medicare beneficiaries who were enrolled in Medicaid at least three months prior to cancer diagnosis. Multivariable logistic regression and survival models were developed to analyze the association between dual status and (1) receipt of definitive treatment; and (2) overall and disease-specific survival, after adjusting for tumor stage and patient covariates.

Results: Dual status was associated with a significantly lower likelihood to receive definitive treatment among colorectal cancer patients (Adjusted Odds Ratio: 0.60, 95% Confidence Interval, or CI, [0.38, 0.95]), but not among breast or prostate cancer patients. Furthermore, dual status was associated with decreased overall survival among prostate cancer patients (Adjusted Hazard Ratio, or AHR, 1.45, 95% CI [1.05, 2.02]), and decreased disease-specific survival among colorectal cancer patients (AHR: 1.52 [1.05, 2.19]).

Conclusion: Enrollment of low-income Medicare beneficiaries in Medicaid is not associated with favorable treatment patterns or survival outcomes. Differences in health and functional status between community-dwelling duals and non-duals might help explain the observed disparities.

Keywords: Dually Eligible; Low-Income Medicare-Medicaid Beneficiaries; Cancer-Related Outcomes; Breast Cancer; Colorectal Cancer; Prostate Cancer; Cancer treatment; Linked Databases

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Introduction

Breast, prostate, and colorectal cancer are three of the most common cancers in the elderly, claiming more than an estimated 75,000 lives among individuals 60–79 years old in 2009 alone (Jemal et al., 2009).

A vast body of literature has documented disparities in cancer-related outcomes. Non-clinical factors, such as older age (Yancik et al., 2001), race/ethnicity (Shavers & Brown, 2002), and provider-related factors (Keating, Kouri, He, Weeks, & Winer, 2009) have been identified as influencing cancer stage at diagnosis and receipt of recommended treatment.

Low socioeconomic status (Kimmick et al., 2009), insurance status (Bradley, Neumark, Shickle, & Farrell, 2008d; Halpern, Bian, Ward, Schrag, & Chen, 2007), Medicaid status (Bradley, Gardiner, Given, & Roberts, 2005), and nursing home status (Bradley, Clement, & Lin, 2008a) have been shown to be associated with poor outcomes. Prior studies pertaining to elders have examined patterns of cancer treatment in dually eligible Medicare-Medicaid beneficiaries (or duals) and non-dually eligible (or non-duals), and documented unfavorable treatment patterns and outcomes in duals compared to their non-dual counterparts (Bradley, Dahman, & Given, 2008b; Bradley, Given, Dahman, & Fitzgerald, 2008c). However, these studies do not compare outcomes by dual status specifically among low-income elders; and given the strong association between income and health outcomes, it is imperative to make comparisons across individuals of similar incomes when evaluating the effectiveness of the Medicaid program in cancer prevention and control. As well, prior studies were able to account for nursing home status in duals, but not in non-duals.

Low-income Medicare beneficiaries face considerable financial barriers in accessing health services. In addition to Part B premiums, Medicare beneficiaries pay co-insurance and deductibles when receiving outpatient care. Because out-of-pocket health spending uses a substantial proportion of their income (Atherly, 2001; Goldman & Zissimopoulos, 2003) and competes with daily living expenses, elders with low-incomes might ration their health care, resulting in sub-optimal treatment for conditions that necessitate services rendered in outpatient settings.

By serving as a public supplemental health insurance program for low-income Medicare beneficiaries, the Medicaid program may relieve low-income elders from the financial burden associated with health care use and considerably improve access to care (Niefeld & Kasper, 2005). We therefore hypothesize that participation of low-income Medicare beneficiaries in the dual Medicare-Medicaid program may be associated with favorable patterns of health services use and outcomes compared to Medicare enrollment alone.

To test our hypothesis, we compare receipt of definitive treatment for loco-regional breast, prostate, and colorectal cancer and survival by dual eligibility status, exclusively in low-income Medicare beneficiaries. Furthermore, using a previously validated claims-based

algorithm (Koroukian, Xu, & Murray, 2008), we identify and exclude nursing home residents from both dual and non-dual subgroups of the study population. In addition to being three of the most prevalent cancers, these cancers offer the benefit of relatively low case-fatality and, therefore, offer the opportunity to study survival benefits in extended follow-up periods.

Methods

Our study uses the Ohio Cancer-Aging Linked Database, developed by linking data from the Ohio Cancer Incidence Surveillance System (OCISS) with Medicare and Medicaid enrollment and claims data, as well as data from the U.S. Census and Ohio death certificates. As described elsewhere (Koroukian, 2008; Koroukian et al., 2007), the files were linked by using patient identifiers, including patient social security number, first and last name, date of birth, and sex. OCISS and Medicare files were linked by the Centers for Medicare & Medicaid Services (CMS), while linkage with the Medicaid and death certificate files was accomplished by the investigative team.

This study was approved by the Institutional Review Board (IRB) of the Ohio Department of Health, which maintains the OCISS; the Ohio Department of Job and Family Services, which is responsible for the Medicaid program; the CMS Privacy Board; and the IRB of the University Hospitals of Cleveland.

Data Sources

The Ohio Cancer Incidence Surveillance System (OCISS)

The OCISS was established in 1991. With the exception of carcinoma in situ of the cervix, and basal- and squamous-cell carcinoma of the skin, all incident cases of cancer diagnosed among Ohio residents are to be reported to the OCISS. The rate of completeness of the OCISS has been improving in recent years, estimated to be at greater than 90% for the study period. In addition to patient identifiers, demographics, and residence address at the time of cancer diagnosis, the OCISS includes the date of cancer diagnosis, anatomic cancer site, and cancer stage. Due to a high proportion of missing values in the tumor size (T), number of lymph nodes (N), and metastasis (M), we were unable to account for stage in a detailed fashion. Rather, we resorted to the Surveillance, Epidemiology, and End Results (SEER) summary stage in our analyses. The residence address at the time of diagnosis was geocoded, and the census block group identified through geocoding was used to obtain income and educational attainment levels from the U.S. Census data.

The OCISS served as the source file to identify incident cases of breast, colorectal, and prostate cancer diagnosed in older residents of Ohio.

Medicare and Medicaid Enrollment and Claims Files

The Medicare Denominator file, which includes one record for every beneficiary, carries monthly variables indicating beneficiaries' enrollment in Part A, Part B, and managed care programs. This file was used to identify beneficiaries enrolled in Medicare in the 12 months preceding and 6 months following cancer diagnosis, and receiving their care exclusively through the fee-for-service system during that period. This strategy was aimed to ensure the completeness of claims history.

The Medicare claims files included the Medicare Provider, Analysis, and Review (MedPAR) file, the Outpatient Standard Analytic File (SAF), and the Carrier SAF. The MedPAR file includes one record per hospital admission, and carries 10 slots for diagnosis codes in the International Coding of Diseases, 9th Edition (ICD-9), and 10 slots for ICD-9 procedure codes, along with dates of admission and discharge. The Outpatient SAF and Carrier files were used to identify services received in ambulatory settings. Records in these files carry 4 slots for ICD-9 diagnosis codes at the header level, and procedure codes at the line-item level, along with the date of service. These procedures are coded in Current Procedural Terminology, 4th Edition (CPT-4), and in the Healthcare Common Procedure Coding System (HCPCS). All of these data sources were combined to identify comorbid conditions and cancer treatment modalities, and to determine the beneficiaries' nursing home status.

Medicaid enrollment files were used for two purposes: first to identify dual Medicare-Medicaid beneficiaries, and second, to construct the duals' history of enrollment in the Medicaid program relative to their date of cancer diagnosis.

Despite the availability of both Medicare and Medicaid claims data for duals, we refrained from using Medicaid claims data to identify comorbid conditions, treatment modalities, or nursing home status. This strategy was aimed to ensure that we used only Medicare claims data for both duals and non-duals.

Ohio Death Certificate Files

Death certificates served as the source to retrieve the date and cause of death for all individuals in the study population who died during the follow-up period.

Study Population

Our study population included incident cases of loco-regional breast, colorectal, and prostate cancer diagnosed in Ohio residents 66 years of age or older in the years 1997–2001, as identified through the OCISS, without a second primary breast, prostate, or colorectal cancer diagnosis during the study period. We included patients with continuous enrollment in Part A and Part B in 12 months preceding and 6 months following cancer diagnosis (n=43,216). We further limited our analysis to low-income Medicare beneficiaries, or those residing in census block groups with median household incomes at or below the 10th percentile of the distribution

statewide. For duals, we required enrollment in Medicaid at least 3 months before cancer diagnosis and residence in the same census block groups as low-income Medicare beneficiaries (n=3,908). Our exclusion criteria were: a) HMO enrollment in the 12 months preceding and 6 months following cancer diagnosis and b) nursing home stay in the 6 months preceding cancer diagnosis, as identified by using a previously validated claims-based algorithm (Koroukian et al., 2008). Based on the nursing home criterion, we excluded nearly one third of duals, but only less than 5% of non-duals. Our final study population was comprised of 2,568 cancer patients.

Variables of Interest

Outcome Variables

- Receipt of standard or definitive treatment, defined as follows (Shavers & Brown, 2002):
  - Breast cancer:
    - Local stage: Mastectomy *OR* Lumpectomy plus radiation therapy
    - Regional stage: Treatment for local stage plus chemotherapy
  - Colorectal cancer:
    - Local stage: Colon resection
    - Regional stage: Treatment for local stage plus chemotherapy
  - Prostate cancer:
    - Local stage: Radical prostatectomy *OR* radiation therapy (brachytherapy or external beam radiation)
    - Regional stage: Treatment for local stage plus androgen deprivation treatment

The diagnosis and procedure codes pertaining to the above treatment modalities are presented in the Appendix.

- Survival, defined as time elapsed between date of cancer diagnosis and date of death. Patients who survived until December 31, 2005 were censored. Using the cause of death, we measured overall survival, as well as disease-specific survival.

Independent Variables

Main variable of interest: Dual status, defined as cancer patients identified successfully through the process of linking the OCISS and Medicaid files for the same calendar year. As noted above, we limited our study population to duals using the Medicaid program as a supplemental health insurance program rather than a safety net program, by including only those enrolled in Medicaid at least 3 months prior to cancer diagnosis. The comparison group of non-duals was comprised of low-income Medicare beneficiaries who were not enrolled in Medicaid at any time during the year in which they were diagnosed with cancer.

To ensure comparability of incomes between duals and non-duals, we required—for both duals and non-duals—residence in census block groups with median household incomes at or below the 10th percentile, based on the statewide distribution.

Other Covariates

Other covariates included age (grouped in 5 year increments), sex (accounted for in analysis of colorectal cancer patients), race (African American vs. all other), marital status (married vs. all other), cancer stage (local vs. regional stage cancer at diagnosis), and count of Charlson comorbid conditions, Klabunde adaptation (0, 1, 2+), as identified in claims data for services received in the year prior to cancer diagnosis. County of residence at the time of diagnosis, as recorded in the OCISS, was categorized as follows: Appalachian/Rural, Metro, and Suburban.

Analysis

We conducted univariate and bivariate analysis and compared receipt of definitive treatment, as well as Kaplan-Meier curves for duals and non-duals. For multivariable analysis, we developed logistic regression models predicting receipt of definitive treatment, and Cox survival models to examine the association between dual status and the outcomes of interest after adjusting for patient covariates. The survival models also controlled for receipt of definitive treatment.

While the results presented in this study pertain to duals and non-duals residing in census block groups, with median household incomes at or below the 10th percentile of the statewide distribution, we also conducted a detailed sensitivity analysis by raising the income threshold to the 15th percentile, and then by lowering it to the 5th percentile. Differences in the results observed through the sensitivity analysis are discussed below. SAS version 9.1 (Cary, NC) was used in all analyses.

Results

The study population included 838 breast cancer patients, 784 colorectal cancer patients, and 946 prostate cancer patients. Duals comprised 20.3%, 17.5%, and 9.1% of the patient population, respectively. African American patients and those with a higher number of comorbidities were over-represented among duals compared to non-duals. Conversely, the proportion of married patients was higher among non-duals than among duals (Exhibit 1).

Exhibit 1. Characteristics of the Study Population, (Local- and Regional-Stage Cancers Only; Pre-Duals Compared With Non-Duals in the Two Lowest Income Categories)

	Breast Cancer					Colon Cancer					Prostate Cancer				
	Duals		Non-Duals			Duals		Non-Duals			Duals		Non-Duals		
Demographic Characteristics	N	(% of Total)	N	(% of Total)		N	(% of Total)	N	(% of Total)		N	(% of Total)	N	(% of Total)	
Age:															
66–69	34	(20.0)	113	(16.9)		27	(19.7)	74	(11.4)	***	24	(27.9)	191	(22.2)	
70–74	60	(35.3)	166	(24.9)		37	(27.0)	187	(28.9)		33	(38.4)	289	(33.6)	
75–79	37	(21.8)	167	(25.0)		33	(24.1)	179	(27.7)		18	(20.9)	222	(25.8)	
80–84	28	(16.5)	142	(21.3)		27	(19.7)	121	(18.7)		•		117	(13.6)	
85+	11	(6.5)	80	(12.0)		13	(9.5)	86	(13.3)	***	•		41	(4.8)	
Race:															
African American	73	(42.9)	146	(21.9)		55	(40.2)	140	(21.6)	***	42	(48.8)	319	(37.1)	***
All Others	97	(57.1)	522	(78.1)		82	(59.8)	507	(78.4)		44	(51.2)	541	(62.9)	
Sex:															
Male	0	(0.0)	0	(0.0)		30	(21.9)	309	(47.8)		86	(100)	860	(100)	
Female	170	(100)	668	(100)	***	107	(78.1)	338	(52.2)	***	0	(0.0)	0	(0.0)	
Marital Status:															
Married	13	(7.7)	181	(27.1)	***	15	(11.0)	251	(38.8)	***	28	(32.6)	468	(54.4)	***
All Other	157	(92.4)	487	(72.9)		122	(89.1)	396	(61.2)		58	(67.4)	392	(45.6)	
Cancer Stage:															
Local	115	(67.7)	490	(73.4)		57	(41.6)	276	(42.7)		70	(81.4)	792	(92.1)	
Regional	55	(32.4)	178	(26.6)	***	80	(58.4)	371	(57.3)	***	16	(18.6)	68	(7.9)	***
Comorbidities:															
0	87	(52.2)	453	(67.8)	***	53	(38.7)	418	(64.6)	***	45	(52.3)	601	(69.9)	***
1	44	(25.9)	159	(23.8)		44	(32.1)	151	(23.4)		22	(25.6)	180	(20.9)	
2+	39	(22.9)	56	(8.4)		40	(29.2)	78	(12.1)		19	(22.1)	79	(9.2)	
County of Residence:															
Appalachian / Rural	36	(21.2)	191	(28.6)		38	(27.7)	224	(34.6)		•		252	(39.3)	
Metro	117	(68.8)	431	(64.5)		88	(64.2)	369	(57.0)		61	(70.9)	533	(62.0)	
Suburban	17	(10.0)	46	(6.9)		11	(8.1)	54	(8.4)		•		75	(8.7)	
Receipt of Definitive Treatment:															
Yes	126	(74.1)	489	(73.2)		74	(54.0)	398	(61.5)		52	(60.5)	536	(62.3)	
No	44	(25.9)	179	(26.8)		63	(46.0)	249	(38.5)		34	(39.5)	324	(37.7)	
Total	170	(100)	668	(100)		137	(100)	647	(100)		86	(100)	860	(100)	

*0.01 <= p < 0.05; **0.001 <= p < 0.01; *** p < 0.001; All other statistics not significant at p < 0.05.

NOTES for Exhibit 1 (cont).
• Small cells masked in accordance with guidelines from the Centers for Medicare & Medicaid Services. An additional cell within the same category was also masked to prevent the derivation of the masked number.
SOURCE: Ohio Cancer Incidence Surveillance System, 1997–2001; U.S. Census data, 2000; Medicare enrollment and claims files, 1996–2002; and Ohio Medicaid enrollment files, 1996–2002.

Exhibit 2 reports findings from the multivariable analysis predicting receipt of definitive treatment. Adjusting for patient covariates, duals among breast and prostate cancer patients were not significantly more or less likely than non-duals to undergo definitive treatment (Adjusted Odds Ratio, or AOR, and 95% Confidence Interval, or CI, 1.01 [0.65, 1.59] and 1.07 [0.65, 1.78], respectively). However, duals among colorectal cancer patients remained significantly less likely than their non-dual counterparts to receive definitive treatment (AOR: 0.60, 95% CI: [0.38, 0.95]). Other notable findings included significantly decreased odds to receive definitive treatment in older patients and those diagnosed with regional-stage cancer. In addition, being African American was associated with a lower likelihood to receive definitive treatment among prostate cancer patients, but not among breast or colorectal cancer patients.

Exhibit 3 shows the Kaplan-Meier curves by dual status for overall and disease-specific survival for each of the cancer sites. Consistently, for overall and disease-specific survival, outcomes were significantly less favorable for duals among colorectal and prostate cancer patients, but not among breast cancer patients.

Findings from the Cox regression models indicated that after adjusting for patient covariates and for receipt of definitive treatment, dual status was associated with increased hazard for overall survival among prostate cancer patients, but not among breast or colorectal cancer patients (Adjusted Hazard Ratio and 95% CI: 1.45 [1.05, 2.02]). Conversely, dual status was associated with unfavorable disease-specific survival among colorectal cancer patients (1.52 [1.05, 2.19]), but not among breast or prostate cancer patients (Exhibit 4).

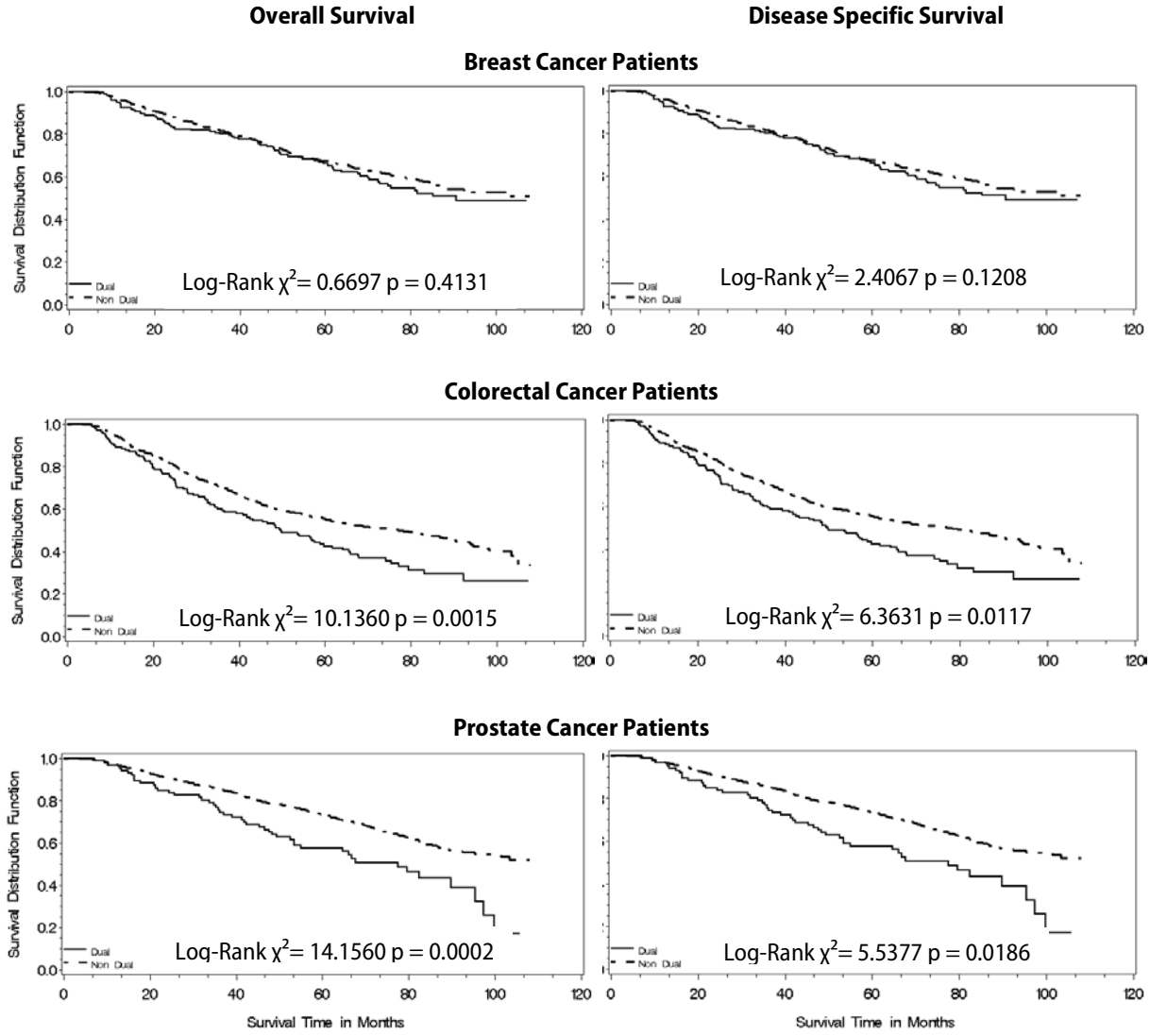
Exhibit 2. Results From the Multivariable Analysis Predicting Receipt of Definitive Treatment: Adjusted Odds Ratio (AOR) and 95% Confidence Interval (CI)

	Breast Cancer		Colon Cancer		Prostate Cancer	
Demographic Characteristics	AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)
Age:						
66–69 (ref)	1.00		1.00		1.00	
70–74	0.99	(0.56, 1.78)	0.78	(0.44, 1.37)	0.65	(0.43, 0.99)*
75–79	0.54	(0.30, 0.95) *	0.61	(0.35, 1.08)	0.29	(0.19, 0.44)***
80–84	0.46	(0.25, 0.83) *	0.41	(0.22, 0.74)**	0.17	(0.10, 0.28)***
85+	0.12	(0.06, 0.23) ***	0.17	(0.08, 0.33) ***	0.13	(0.07, 0.28)***
Race:						
African American	0.88	(0.57, 1.35)	1.03	(0.68, 1.56)	0.71	(0.51, 0.99) *
All Others (ref)	1.00		1.00		1.00	
Sex:						
Male	N/A		0.95	(0.67, 1.34)	N/A	
Female (ref)			1.00			
Marital Status:						
Married	1.26	(0.81, 1.98)	0.81	(0.56, 1.18)	1.31	(0.99, 1.75)*
All Other (ref)	1.0		1.00		1.00	
Dual Status:						
No (ref)	1.00		1.00		1.00	
Yes	1.01	(0.65, 1.59)	0.60	(0.38, 0.95) *	1.07	(0.65, 1.78)
Cancer Stage:						
Local (ref)	1.00		1.00		1.00	
Regional	0.18	(0.12, 0.26) ***	0.15	(0.11, 0.22) ***	0.17	(0.10, 0.28)***
Comorbidities:						
0 (ref)	1.00		1.00		1.00	
1	1.15	(0.76, 1.74)	0.97	(0.66, 1.43)	1.13	(0.79, 1.62)
2+	1.22	(0.69, 2.15)	1.11	(0.68, 1.80)	1.04	(0.65, 1.66)
County of Residence						
Appalachian / Rural	0.97	(0.47, 1.99)	1.54	(0.82, 2.87)	0.93	(0.52, 1.67)
Metro	0.73	(0.37, 1.44)	1.10	(0.60, 2.01)	0.84	(0.48, 1.45)
Suburban (ref)	1.00		1.00		1.00	

* 0.01 <= p < 0.05; ** 0.001 <= p < 0.01; *** p < 0.001; All other statistics not significant at p < 0.05

SOURCES: Ohio Cancer Incidence Surveillance System, 1997–2001; U.S. Census data, 2000; Medicare enrollment and claims files, 1996–2002; and Ohio Medicaid enrollment files, 1996–2002.

Exhibit 3. Survival Times (in months) by Eligibility Status for Breast, Colorectal, and Prostate Cancer Patients



SOURCE: Ohio Cancer Incidence Surveillance System, 1997–2001; U.S. Census data, 2000; Medicare enrollment files, 1996–2002; Ohio Medicaid enrollment files, 1996–2002; and Ohio Death Certificate data, 1997–2005.

Exhibit 4. Results From the Cox Survival Analysis: Adjusted Hazard Ratio (AHR) and 95% Confidence Interval (CI)

Demographic Characteristics	Breast Cancer AHR (95% CI) Overall Survival	Breast Cancer AHR (95% CI) Disease-Specific Survival	Colon Cancer AOR (95% CI) Overall Survival	Colon Cancer AOR (95% CI) Disease-Specific Survival	Prostate Cancer AOR (95% CI) Overall Survival	Prostate Cancer AOR (95% CI) Disease-Specific Survival
Age:						
66–69 (ref)	1.00	1.00	1.00	1.00	1.00	1.00
70–74	0.74 (0.52, 1.07)	0.71 (0.43, 1.20)	1.05 (0.74, 1.50)	0.79 (0.50, 1.26)	1.34 (0.96, 1.87)	1.13 (0.49, 2.54)
75–79	1.09 (0.77, 1.54)	0.72 (0.41, 1.25)	1.19 (0.83, 1.69)	0.76 (0.48, 1.22)	1.93 (1.37, 2.72) **	3.23 (1.47, 7.10)**
80–84	1.37 (0.96, 1.96)	0.84 (0.47, 1.52)	1.45 (1.05, 2.09)*	1.12 (0.69, 1.81)	2.97 (2.02, 4.35)***	5.20 (2.13, 12.72)**
85+	2.28 (1.53, 3.40) ***	1.02 (0.50, 2.09)	2.60 (1.75, 3.86) ***	1.64 (0.95, 2.85)	5.43 (3.42, 8.63)***	5.82 (1.73, 19.61)**
Race:						
African Amer. (ref)	0.98 (0.75, 1.29)	1.14 (0.75, 1.75)	1.20 (0.94, 1.53)	1.50 (1.05, 2.14)*	0.97 (0.76, 1.24)	1.47 (0.84, 2.57)
All Others	1.00	1.00	1.00	1.00	1.00	1.00
Sex:						
Male	N/A	N/A	1.36 (1.10, 1.67)**	1.28 (0.94, 1.73)	N/A	N/A
Female	1.00	1.00	1.00	1.00	1.00	1.00
Marital Status:						
Married	0.84 (0.63, 1.12)	0.79 (0.49, 1.28)	0.91 (0.72, 1.15)	1.03 (0.74, 1.44)	0.83 (0.67, 1.02)	0.91 (0.55, 1.52)
All Other	1.00	1.00	1.00	1.00	1.00	1.00
Definitive Treatment:						
No (ref)	1.00	1.00	1.00	1.00	1.00	1.00
Yes	0.89 (0.69, 1.16)	0.97 (0.63, 1.49)	0.98 (0.78, 1.23)	1.45 (1.05, 2.00)*	0.83 (0.66, 1.04)	0.98 (0.58, 1.67)
Dual Status:						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	0.97 (0.73, 1.28)	1.13 (0.72, 1.78)	1.28 (0.99, 1.66)	1.52 (1.05, 2.19)*	1.45 (1.05, 2.02)*	1.96 (0.94, 4.06)

Exhibit 4 (cont.)	Breast Cancer AHR (95% CI)		Colon Cancer AOR (95% CI)		Prostate Cancer AOR (95% CI)	
	Overall Survival	Disease-Specific Survival	Overall Survival	Disease-Specific Survival	Overall Survival	Disease-Specific Survival
Cancer Stage:						
Local	1.00	1.00	1.00	1.00	1.00	1.00
Regional	2.05 (1.61, 2.62)***	3.68 (2.47, 5.49)***	1.32 (1.05, 1.65)*	2.95 (2.08, 4.18)***	1.24 (0.86, 1.79)	3.49 (1.77, 6.86)**
Comorbidities:						
0	1.00	1.00	1.00	1.00	1.00	1.00
1	1.80 (1.40, 2.31)***	1.31 (0.84, 2.03)	1.44 (1.15, 1.80)**	1.28 (0.93, 1.77)	1.86 (1.45, 2. 40)***	1.05 (0.55, 1.99)
2+	2.51 (1.87, 3.83)***	1.57 (0.92, 2.68)	1.89 (1.45, 2.47)***	0.99 (0.64, 1.53)	3.15 (2.35, 4.22)***	1.51 (0.69, 3.32)
County of Residence:						
Appalachian / Rural	0.82 (0.54, 1.27)	0.65 (0.31, 1.35)	0.73 (0.51, 1.05)	0.94 (0.55, 1.60)	1.17 (0.75, 1.81)	0.87 (0.30, 2.49)
Metro	0.93 (0.62, 1.39)	0.99 (0.52, 1.89)	0.85 (0.60, 1.19)	0.77 (0.46, 1.29)	1.21 (0.80, 1.84)	1.10 (0.43, 2.82)
Suburban (ref)	1.00	1.00	1.00	1.00	1.00	1.00

*0.05 < p < 0.01; **0.01 <= p < 0.001; ***p <= 0.001; All other statistics not significant at p < 0.05.

SOURCES: Ohio Cancer Incidence Surveillance System, 1997–2001; U.S. Census data, 2000; Medicare enrollment and claims files, 1996–2002; Ohio Medicaid enrollment files, 1996–2002; and Ohio Death Certificate data, 1997–2005.

Sensitivity Analysis

While we did not observe any new patterns of care or survival outcomes with the sensitivity analysis (Exhibit A in the Appendix), we note the following differences:

- Among colorectal cancer patients, and with respect to receipt of definitive treatment, dual status was associated with a lower likelihood to receive definitive treatment; however, it was statistically significant only at the 10th percentile income threshold, as reported in Exhibit 2 ($0.05 < p < 0.01$). Results from the analysis of overall survival indicated statistically significant increased hazard associated with dual status at the higher and lower income thresholds (AHR: 1.26 [1.01, 1.57], $p <= 0.001$, and 1.47 [1.05, 2.08], $0.05 < p < 0.01$, respectively), but not at the 10th percentile threshold (1.28 [0.99, 1.66], $p > 0.05$). For disease-specific survival, we observed loss of statistical significance when limiting the study population to the lowest income threshold. We note, however, that despite these differences, the direction of the association stayed the same, and the effect size remained nearly unchanged.
- Among prostate cancer patients, we note a change in the direction of the association between receipt of definitive treatment and dual status from positive to negative when lowering the income threshold to the 5th percentile. However, the association remained statistically significant. For overall survival, we note increased hazard associated with dual status but similar effect sizes in all three analyses, while losing statistical significance in the analysis limited to the lowest income threshold. With disease-specific survival, we note a slightly increased effect size and statistical significance in the analysis limited to the highest income threshold (AHR: 2.01 [1.04, 3.89]).
- No changes of significance were noted among breast cancer patients.

Discussion

In this study, we reported cancer treatment and survival outcomes among dually enrolled Medicare-Medicaid eligible and low-income Medicare beneficiaries. The findings do not support our hypothesis that the use of Medicaid as a supplemental health insurance program would be associated with beneficial outcomes, despite reduced financial barriers. On the other hand, with a few exceptions, some of the large disparities by dual status reported in other studies were not observed in our findings. We believe that differences in health and functional status between community-dwelling duals and non-duals might help explain the disparities in overall survival outcomes, which persisted despite our effort to adjust for numerous confounders. Indeed, aside from excluding nursing home residents and adjusting for comorbid conditions documented in claims data, we were unable to account for other pertinent variables to better

characterize our subjects' clinical presentation. Functional limitations and geriatric syndromes and their co-occurrence with comorbidities have been shown to be strongly associated with cancer-related outcomes (Koroukian, Bakaki, Schluchter, & Owusu, 2011; Koroukian, Xu, et al., 2010), and the absence of relevant measures in claims data severely limits our risk-adjustment abilities.

To our knowledge, this is the first study to compare cancer-related outcomes by dual enrollment status across community-dwelling elders with comparable income levels. This is in contrast to prior studies, which have included patients of all income levels, and adjusted for income in the multivariable models (Bradley, Dahman, et al., 2008b; Bradley, Given, et al., 2008c; Bradley, Given, Dahman, Luo, & Virnig, 2007). As well, our study is the first to exclude nursing home residents both in duals and non-duals, based on Medicare claims data.

We also note the following findings: First, we highlight the significantly lower likelihood of undergoing definitive treatment in patients of older age, revealing a pattern consistent with that of other studies (Field et al., 2011; Hurria et al., 2003; Yancik et al., 2001). Second, we note the lower likelihood to receive definitive treatment for prostate cancer, and increased hazard of death from cancer among African American patients with colorectal cancer despite adjusting for definitive treatment. This finding is all the more surprising, given the comparable income level among patients in the study population. Third, we note a mostly positive, albeit a statistically non-significant association, between comorbidities and receipt of definitive treatment. This finding is in contrast to that of other studies (Enger et al., 2006; Field et al., 2011). However, this association may be affected by the multiple sources of bias involved in how data on health state information are collected and documented in administrative databases (Terris, Litaker, & Koroukian, 2007). Also, some of the effects associated with comorbidities may be reflected through that observed by the patients' dual status and their vulnerable health status, although no collinearity was detected upon conducting diagnostic testing of our multivariable models.

Strengths of the study include the use of a unique database that made it possible to gather the relevant variables and test our hypothesis. Additionally, the use of Medicaid data to identify duals has proven to be a superior approach compared to the use of the state buy-in variable in the Medicare denominator file (Koroukian, Dahman, Copeland, & Bradley, 2010.

Limitations should be noted as well:

First, we note our inability to identify—among non-duals—those with supplemental health insurance from a private source, employer-based or otherwise. Given the escalating cost of insurance premiums, however, the proportion of those with supplemental health insurance in this subgroup of elders with low-income is likely to be low. Additionally, we were unable to account for the benefits covered as part of being dually enrolled in Medicare and Medicaid. Depending on their income level, their coverage can include the Part B premium only (Specified Low-Income Medicare Beneficiaries or SLMBs), Part B premium and cost-sharing amounts (Qualified Medicare Beneficiaries or QMBs), or full Medicaid benefits.

Second, the median household income level at the census block group level has been approximated to that of the individual level income. While imperfect (Soobader, LeClere, Hadden, & Maury, 2001), this method is deemed acceptable in the absence of individual-level income levels (Krieger, 2001; Krieger et al., 1999), especially when such approximations are made at small geographical units (i.e., at census block group level vs. at the zip code level).

Finally, given the high proportion of missing values on tumor size, number of lymph nodes or metastatic disease in the OCISS, we relied on SEER summary stage, rather than a detailed categorization of cancer stage.

In closing, we highlight the lack of evidence showing favorable treatment and survival outcomes among duals compared with their non-dual low income counterparts, thus refuting our hypothesis that enrollment of low-income Medicare beneficiaries in the Medicaid program would improve their access to care and therefore outcomes. On the other hand, we show the lack of disparities by dual status at the level of magnitude highlighted in prior studies, once the study population was limited to community-dwelling patients and to individuals residing in low-income areas.

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APPENDIX

CPT/HCPCS Treatment Codes

Radiotherapy, all cancers: 55860, 55862, 55865, 76965, 77300–77799, C9725, G0256, and G0261

Chemotherapy, all cancers: 96400–96549, C8953–C8955, G0355, G0359, G0361, J9000, J9001, J9010, J9070, J9080, J9090–J9097, J9190, J9250, J9260, J9999, Q0083, Q0085.

Breast

Breast lumpectomy: 19120, 19125, 19126, 19160, 19162

Breast mastectomy: 19180–19240

Colorectal

Colorectal cancer excision: 44110, 44392–44394, 45160–45180, 45308, 45309, 45315, 45320, 45333, 45338, 45339, 45383–45385

Colorectal cancer resection: 44140–44160, 45110–45121

Colorectal cancer bypass: 44300, 44310, 44320

Prostate

Prostatectomy: 55801–55865

Radical Prostatectomy: 55810–55815, 55840–55845

Orchiectomy: 54520, 54521, 54522, 54530, 54535

Hormonal treatment: 11980, C9216, C9430, J0970, J1000, J1056, J1380, J1390, J1410, J3315, J1950, J9202, J9217, J9218, J9219, S0165

ICD-9-CM Diagnosis Codes

Chemotherapy, all cancers: V58.1 V66.2 V67.2

Radiotherapy, all cancers: V58.0 V66.1 V67.1

ICD-9-CM procedure Codes

Chemotherapy, all cancers: 99.25

Radiotherapy, all cancers: 92.21–92.29, 92.32, 92.33, 92.41

Breast

Breast lumpectomy: 85.20–85.25

Breast mastectomy: 85.41–85.48

Colorectal

Colorectal cancer excision: 45.41–45.49, 48.31–48.35

Colorectal cancer resection: 45.8, 48.5, 45.71–45.76, 45.79, 48.41, 48.49, 48.61–48.69

Colorectal cancer bypass: 46.0, 46.10–46.2

Prostate

Prostatectomy: 60.2–60.4

Prostatectomy, radical: 60.5

Prostate nodectomy: 40.3, 40.5, 40.50, 40.52, 40.53, 40.59

Prostate orchiectomy: 62.4

Hormonal treatment: 99.24

Exhibit A. Sensitivity Analysis of Income Threshold Changes for Dual Status Compared to Non-Dual Status:

	% without and with definitive treatment (unadjusted)				Adjusted Odds Ratio (95% Confidence Interval)	Overall survival: Adjusted Hazard Ratio (95% Confidence Interval)	Disease-specific survival: Adjusted Hazard Ratio (95% Confidence Interval)
	Duals		Non-duals				
BREAST CANCER							
Limiting to the 15th percentile	57	(26.5)	265	(24.6)	1.00	1.00	1.00
	158	(73.5)	813	(75.4)	0.97 (0.66, 1.43)	1.09 (0.86, 1.37)	1.17 (0.80, 1.72)
	215	(100.0)	1,078	(100.0)			
Limiting to 10th percentile	44	(25.9)	179	(26.8)	1.00	1.00	1.00
	126	(74.1)	489	(73.2)	1.01 (0.65, 1.59)	0.97 (0.73, 1.28)	1.13 (0.72, 1.78)
	170	(100.0)	668	(100.0)			
Limiting to the 5th percentile	28	(25.7)	85	(28.4)	1.00	1.00	1.00
	81	(74.3)	214	(71.6)	1.09 (0.60, 1.98)	0.96 (0.67, 1.38)	1.05 (0.59, 1.86)
	109	(100.0)	299	(100.0)			
COLON CANCER							
Limiting to the 15th percentile	76	(43.4)	420	(39.6)	1.00	1.00	1.00
	99	(56.6)	641	(60.4)	0.75 (0.51, 1.10)	1.26 (1.01, 1.57)***	1.44 (1.05, 1.98)***
	175	(100.0)	1,061	(100.0)			
Limiting to 10th percentile	63	(46.0)	249	(38.5)	1.00	1.00	1.00
	74	(54.0)	398	(61.5)	0.60 (0.38, 0.95)*	1.28 (0.99, 1.66)	1.52 (1.05, 2.19)*
	137	(100.0)	647	(100.0)			
Limiting to the 5th percentile	36	(44.4)	122	(40.5)	1.00	1.00	1.00
	45	(55.6)	179	(59.5)	0.59 (0.32, 1.11)	1.47 (1.05, 2.08)*	1.40 (0.83, 2.37)
	81	(100.0)	301	(100.0)			

Exhibit A (cont.)	% without and with definitive treatment (unadjusted)				Adjusted Odds Ratio and 95% Confidence Interval	Overall survival: Adjusted Hazard Ratio and 95% Confidence Interval	Disease-specific survival: Adjusted Hazard Ratio and 95% Confidence Interval
	Duals		Non-duals				
PROSTATE CANCER							
Limiting to the 15th percentile	39	(38.2)	492	(35.8)	1.00	1.00	1.00
	63	(61.7)	883	(64.2)	1.12 (0.71, 1.76)	1.48 (1.10, 1.99)**	2.01 (1.04, 3.89)***
	102	(100.0)	1,375	(100.0)			
Limiting to 10th percentile	34	(39.5)	324	(37.7)	1.00	1.00	1.00
	52	(60.5)	536	(62.3)	1.07 (0.65, 1.78)	1.45 (1.05, 2.02)*	1.96 (0.94, 4.06)
	86	(100.0)	860	(100.0)			
Limiting to the 5th percentile	23	(43.4)	143	(37.0)	1.00	1.00	1.00
	30	(56.6)	244	(63.0)	0.93 (0.48, 1.80)	1.27 (0.84, 1.93)	1.77 (0.70, 4.49)
	53	(100.0)	387	(100.0)			

*0.01 <= p < 0.05; **0.001 <= p < 0.01; ***p < 0.001; All other statistics not significant at p < 0.05

SOURCE: Ohio Cancer Incidence Surveillance System, 1997–2001; U.S. Census data, 2000; Medicare enrollment and claims files, 1996–2002; and Ohio Medicaid enrollment files, 1996–2002, and Ohio death certificate files, 1997-2005.

Exhibit B. Distribution by Nursing Home Status

Cancer Type	% residing in a nursing home in the 6 months preceding cancer diagnosis	
	Duals	Non-Duals
Breast Cancer	33.6	4.0
Colorectal Cancer	32.5	4.8
Prostate Cancer	26.9	2.3

SOURCE: Ohio Cancer Incidence Surveillance System, 1997–2001; and Medicare enrollment and claims files, 1996–2002.

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