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Original Paper

The Relationship between Health Insurance and Mortality for Cancer Patients: Medicare Advantage versus Fee-For-Service Medicare

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Abstract

Compared to traditional fee-for-service Medicare (FFS), private Medicare Advantage (MA) plans offer additional health insurance coverage but restrict access to medical providers. This study measured how MA enrollment, relative to FFS enrollment, may influence mortality for cancer patients. The study used linked data from the Surveillance, Epidemiology, and End Results Program and Medicare administration (SEER-Medicare) including diagnoses between 2006 and 2011 at all four major cancer sites (breast, colorectal, lung, prostate). The key innovation of the study was to measure and account for variation in prescription drug coverage between MA and FFS cancer patients. Among cancer patients with Part D coverage, MA enrollment was associated with modestly increased mortality. The estimated relationships were statistically distinguishable from zero for lung cancer and (in most model specifications) colorectal cancer. The findings are consistent with a hypothesis that restricted provider access may reduce health outcomes for patients who already have a serious illness.

Keywords

Cancer, Medicare, Medicare advantage, managed care

1. Introduction

There has been a recent policy shift in the US to favor the use of private companies to administer health insurance. Between Medicare Parts A and B, Medicare Part D, Medicaid, and the health insurance marketplaces, over 100 million people in the US now have public health insurance that is administered by a private insurer. In Medicare, private and publicly administered insurance operate in parallel. Medicare beneficiaries elect to receive their combined Part A and Part B coverage in one of two ways. About 70 percent of current beneficiaries enroll in the public plan, traditional fee-for-service Medicare (FFS).

The remaining 30 percent enroll in a Medicare Advantage (MA) plan offered by a private company.

MA plans offer coverage beyond what is provided by FFS in exchange for restricting access to medical providers. MA plans thus allow patients to obtain supplemental coverage by sacrificing provider access, typically at little to no extra financial cost. Due to data constraints, researchers have very limited understanding of what provider networks look like in MA plans. Jacobson, Trilling, Neuman, Damico and Gold (2016) manually collected provider network data, from PDF files or searchable directories embedded within company websites, for the MA plans in 20 counties in 2015. They found that provider network breadth varied significantly by plan. About one-sixth of MA enrollees had coverage that applied to less than 30 percent of the hospitals in their county, about two-thirds of MA enrollees had coverage that applied to somewhere between 30 and 70 percent of the hospitals in their county, and the remaining one-sixth had coverage that applied to more than 70 percent of the hospitals in their county.

New research shows that MA plans save 10 to 25 percent in costs relative to FFS (Curto, Einav, Levin, & Bhattacharya, 2014; Curto, Einav, Finkelstein, Levin, & Bhattacharya, 2017). The savings is likely due to the limited provider networks. MA patients use less care overall and substitute less expensive types of care (e.g., primary care) for more expensive types of care (e.g., specialist care) compared to FFS patients (Curto et al., 2017). In other contexts, it has been found that limited provider networks tend to produce similar effects (Atwood & Lo Sasso, 2016; Gruber & McKnight, 2016). The natural question that follows is whether less utilization, particularly for specialized types of care, in MA plans reduces quality of care for patients with major illness. This study uses cancer patients as a case study to begin to answer this question.

Health insurance is specifically meant to provide financial protection in the case of a health shock, such as a cancer diagnosis. Cancer is one of the deadliest and costliest chronic conditions. It is also one of the most researched conditions, which leads to frequent advances in cancer care. However, managed care organizations (like MA plans) may discourage the use or adoption of high-cost, innovative treatments (Baker, 2001; Baker & Phibbs, 2002; Goodman & Stano, 2016; and Mobley et al., 2011) and, relatedly, may limit access to specialized cancer care providers.

There are a number of studies that show more specialized cancer care leads to better outcomes. The best survival outcomes for ovarian cancer patients result from treatment by a gynecologic oncologist (Chan et al., 2007). Similarly, surgeon specialization improves survival for breast cancer (Gillis & Hole, 1996), colorectal cancer (McArdle & Hole, 2004), and lung cancer (Goodney, Lucas, Stukel, & Birkmeyer, 2005; and Sahni, Dalton, Cutler, Birkmeyer, & Chandra, 2016). If MA plans did limit access to specialized care, it is then plausible that they might increase mortality for cancer patients.

1.1 New Contribution

Previous studies have found no apparent relationship between enrollment in Medicare HMOs and cancer mortality (Potosky et al., 1997; Merrill et al., 1999; Potosky et al., 1999; Roetzheim et al., 2000; Roetzheim et al., 2000; Lee-Feldstein, Feldstein, Buchmueller, & Katterhagen, 2001; Lee-Feldstein, Feldstein, & Buchmueller, 2002; and Roetzheim et al., 2008). Unlike this study, these prior studies

generally focused on older time periods and were thus unable to control for prescription drug coverage. The main contribution of this study was to condition on prescription drug coverage, particularly Medicare Part D coverage, when examining the relationship between MA enrollment and mortality. This methodological enhancement led to a new conclusion, that (conditional on having Medicare Part D) MA enrollment is associated with increased mortality for cancer patients.

The importance of controlling for prescription drug coverage was previously demonstrated by Gowrisankaran, Town and Barrette (2011), who found that the combination of MA and Part D coverage was associated with lower mortality than FFS coverage but MA coverage without Part D was associated with higher mortality than FFS coverage. Unlike this study, Gowrisankaran, Town and Barrette (2011) did not distinguish Part D enrollment among FFS patients and also were not primarily focused on cancer patients.

2. Study Data

This study used linked data from the cancer registries of the Surveillance, Epidemiology, and End Results (SEER) Program and Medicare administrative records. For the requested cancer sites and years of diagnosis, the data include all Medicare-eligible individuals living in counties within a SEER registry region who were diagnosed with cancer. The SEER registry regions cover various urban and rural geographic areas that together comprise 28 percent of the US population. In those regions, this study examined patients diagnosed with the four most prevalent cancers (breast, colorectal, lung, and prostate) between 2006 and 2011. Together, these cancers accounted for over half of all first cancer diagnoses that were recorded in SEER during the study period.

2.1 Sample

The unit of observation in the study was a patient and only first cancer diagnoses were included, so all observations represented unique patients. In order to have MA enrollment in the year of cancer diagnosis be defined for all patients, patients who were first diagnosed with cancer before turning age 65 were excluded. Since dual coverage is related to mortality and likely changes the tradeoff between MA and FFS, patients who were dually eligible for Medicaid and Medicare at any time in the study period (about 15 percent of patients) were excluded. Finally, patients were excluded if they were ever eligible for Medicare due to a disability or end-stage renal disease, were diagnosed at an age older than 90, were not enrolled in both Medicare Parts A and B, were missing critical information such as county of residence or date of diagnosis, or had their diagnosis information taken from a death certificate, autopsy, or nursing home. About 20 percent of patients were excluded due to these criteria. The resulting sample consisted of 344,173 cancer patients, with 70 percent of those patients being covered by FFS at diagnosis and the other 30 percent being covered by an MA plan at diagnosis.

As discussed at the end of this section, a descriptive analysis of the relationship between Medicare Part D enrollment, MA enrollment, and mortality led to an additional sample restriction for the statistical analyses. In particular, patients without Part D coverage at the time of their cancer diagnoses were

excluded from the statistical analyses. The final sample for the statistical analysis thus included 181,256 cancer patients, 50.7 percent of whom were covered by FFS at diagnosis.

2.2 Mortality Measures

The outcome of interest was mortality. Cancer diagnoses in the sample ranged from 2006 through 2011 and mortality (taken from the Medicare administrative data) follow-up lasted through 2013, so each patient had at least two-years of follow-up and some had up to 8 years.

The study used multiple measures of mortality, each with its own advantages and disadvantages. The simplest mortality measure was an uncensored indicator for death by any cause within two years of cancer diagnosis. Since MA patients tend to be healthier than FFS patients, even conditional on patient characteristics and chronic conditions (see Newhouse, Price, McWilliams, Hsu, & Mcguire, 2015; for an excellent summary of the Medicare selection literature), the statistical model would ideally control for patients' non-cancer comorbidities. Unfortunately, however, this information is not available. The SEER registries do not collect information on comorbidities and the Medicare claims data only includes FFS patients. Because differential non-cancer health is not addressed, estimates from this measure should be considered a lower bound.

In the absence of comorbidity measures, information about cause of death was used to (at least partially) control for selection related to non-cancer health. The SEER registries use algorithms that process cause of death from death certificate data (Note 1). If a cancer patient dies from something unrelated to their cancer, an all-causes mortality measure considers that the same as it does a death caused by cancer. Cancer-caused mortality measures, on the other hand, consider the two causes of death to be different.

The second mortality measure used in the study was an indicator for death caused by cancer within two years of cancer diagnosis. This measure implicitly, and likely inaccurately, assumes that all patients who died from something unrelated to cancer would not have died from cancer within two years of cancer diagnosis. Because of this, estimates from this measure should be considered an upper bound.

The two other mortality measures used were similar to the two discussed above, except placed in a framework of a hazard model in order to address censoring. They are discussed in the *Cox Proportional Hazards: Methodology and Results* section.

2.3 Key Independent Variables

The independent variable of interest was MA enrollment during the year of cancer diagnosis. While patients can switch between MA and FFS over time, switching is rare. Over the same time frame as this study, Lissenden (2018) found that a cancer diagnosis induced more switches to FFS and less switches to MA in the year *after* cancer diagnosis, but no detectable change in switching behavior in the year *of* cancer diagnosis. This is because switching was generally not allowed within a calendar year in these years. Thus, enrollment in the year of cancer diagnosis reflects a decision the patient made prior to being diagnosed with cancer. Sensitivity models that defined MA enrollment from the year prior to cancer diagnosis or excluded all switchers (at any point before or after cancer diagnosis) produced results that were similar to the preferred models.

A key confounder related to both MA enrollment and cancer mortality is prescription drug coverage. Prescription drug coverage decreases mortality for Medicare (cancer and other) patients (Gowrisankaran, Town, & Barrette, 2011). Prescription drug coverage also varies significantly between MA and FFS patients; the vast majority of MA patients have Medicare Part D included in their benefits but many FFS patients have alternative or no prescription drug coverage. Relative to previous studies measuring the relationship between MA enrollment and cancer mortality, the key advantage of this study is that prescription drug coverage is at least partially observed. In particular, it is observed whether or not each patient had Medicare Part D coverage when they were diagnosed with cancer. Over 91% of the MA cancer patients in the study had Medicare Part D, but fewer than 45% of FFS cancer patients did. Many of the patients without Medicare Part D coverage may have had alternative prescription drug coverage, but this is unobservable in the data.

2.4 Descriptive Statistics

Table 1 summarizes the observed two-year mortality rates for each of four subsamples of cancer patients: FFS without Part D, FFS with Part D, MA with Part D, and MA without Part D. For all four cancer types and regardless of MA or FFS coverage, it is clear that patients with Part D coverage are much more likely to survive at least two years than patients without Part D coverage. This is consistent with Gowrisankaran, Town and Barrette (2011). Given that Part D coverage is related to mortality, and that there are so few MA patients without Part D coverage, the focus of the study is on patients with Part D coverage. MA and FFS patients without Part D coverage are dropped from the analysis sample.

Among MA and FFS patients with Part D coverage (the second and third columns of Table 1), survival rates were similar (within one percentage point) for MA and FFS patients with breast cancer, colorectal cancer, and prostate cancer. For lung cancer, the deadliest of the four major cancers, 32.1% of FFS patients with Part D coverage survived compared to only 29.2% of MA patients with Part D coverage. In other words, conditional on having Part D coverage, MA coverage was associated with a 2.9 percentage point (9 percent) higher chance of dying within two years after a lung cancer diagnosis.

Table 1. Two-Year Mortality Rates by Cancer Site and Insurance Type

	Fee-for-Service without Part D	**Fee-for-Service with Part D**	**Medicare Advantage with Part D**	**Medicare Advantage without Part D**
Breast Cancer				
# Total Patients	32,090	25,443	23,047	2,189
# Died from cancer	1,860 (5.8%)	1,081 (4.2%)	970 (4.2%)	224 (10.2%)
# Died from other	1,328 (4.1%)	980 (3.9%)	790 (3.4%)	109 (5.0%)
# Survived	28,902 (90.1%)	23,382 (91.9%)	21,287 (92.4%)	1,856 (84.8%)
Colorectal Cancer				
# Total Patients	26,210	15,697	16,463	2,288

# Died from cancer	6,581 (25.1%)	3,081 (19.6%)	3,368 (20.5%)	897 (39.2%)
# Died from other	2,482 (9.5%)	1,276 (8.1%)	1,160 (7.0%)	289 (12.6%)
# Survived	17,147 (65.4%)	11,340 (72.2%)	11,935 (72.5%)	1,102 (48.2%)
Lung Cancer				
# Total Patients	40,812	21,861	20,151	4,767
# Died from cancer	27,011 (66.2%)	12,960 (59.3%)	12,684 (62.9%)	3,695 (77.5%)
# Died from other	3,929 (9.6%)	1,893 (8.7%)	1,587 (7.9%)	459 (9.6%)
# Survived	9,872 (24.2%)	7,008 (32.1%)	5,880 (29.2%)	613 (12.9%)
Prostate Cancer				
# Total Patients	51,107	28,921	29,673	3,454
# Died from cancer	1,690 (3.3%)	761 (2.6%)	970 (3.3%)	184 (5.3%)
# Died from other	2,349 (4.6%)	1,099 (3.8%)	1,144 (3.9%)	188 (5.4%)
# Survived	47,068 (92.1%)	27,061 (93.6%)	27,559 (92.9%)	3,082 (89.2%)

Source: Author's analysis of 2006-2011 SEER Medicare data, first cancer diagnoses. Insurance status is measured during the year of the patient's first cancer diagnosis.

3. Linear Regression: Methodology and Results

The goal of this section is to measure how MA enrollment relates to mortality *conditional on observable patient characteristics that may influence mortality*. In particular, a linear regression was used with control variables for health service area (HSA), age band, sex, race, ethnicity, marital status, measures of socioeconomic status, year of diagnosis, and measures of cancer site and severity. Non-cancer comorbidities were unobserved, but as discussed in the previous section, the use of both all-causes (lower bound) and cancer-caused mortality (upper bound) outcomes help to understand the implications of any resulting bias.

There were two socioeconomic variables measured based on the census tract in which the patient lived at the time of their diagnosis; the percent of residents without a high school degree and the percent of residents with a college degree. The other control variables were all categorical. The HSAs were defined using county of residence and the mapping from the National Cancer Institute, which is meant to represent service areas for cancer treatment. There were several SEER variables used to measure cancer severity: summary stage, cancer grade, and, for breast cancers, estrogen and progesterone receptivity. Sensitivity models that measured cancer severity more granularly, using SEER's derived American Joint Committee on Cancer 6th edition stage groupings, produced results that were similar to the preferred models.

3.1 Summary of Control Variables

Table 2 summarizes patient demographic characteristics, which were generally similar between MA and FFS patients with Part D coverage. The exceptions are that MA patients were more likely to be black or Hispanic and live in less-educated census tracts.

Table 2. Summary of Patient Characteristics at Time of Cancer Diagnosis

Variable	**Medicare Advantage Patients N = 89,334**	**Fee-for-Service Patients N = 91,922**
Age 65-69	0.218	0.221
Age 70-74	0.276	0.278
Age 75-79	0.241	0.224
Age 80-84	0.165	0.170
Age 85+	0.099	0.108
Female	0.468	0.505
Black	0.081	0.046
Hispanic	0.096	0.032
Married	0.561	0.564
No High School Degree (CT)	0.179 (0.132)	0.165 (0.115)
At Least 4 Years of College (CT)	0.278 (0.169)	0.286 (0.180)

The sample is restricted to Medicare Advantage and Medicare Fee-for-Service beneficiaries enrolled in Medicare Part D (prescription drug coverage). All variables are binary indicators except the two educational attainment variables, which are measured as the proportion of residents in the patient's census tract. The values shown are the means. For the two continuous variables at the bottom of the table, the sample standard deviations are shown in parentheses. All variables are measured at the time of the patient's cancer diagnosis.

Table 3 summarizes cancer type, including site and severity. Compared to FFS patients, MA patients were more likely to have colorectal or prostate cancer rather than breast or lung cancer. Within each of the four sites, however, the distribution of cancer severity was similar between MA and FFS patients.

Table 3. Summary of Cancer Severity at Time of Cancer Diagnosis

Variable	**Medicare Advantage Patients**	**Fee-for-Service Patients**
Breast Cancer	N = 23,047	N = 25,443
Local, Grade 1, ER+, PR+	0.160	0.160
Local, Grade 1, ER+, PR-	0.021	0.019
Local, Grade 1, ER missing, PR missing	0.010	0.012
Local, Grade 2, ER+, PR+	0.227	0.233
Local, Grade 2, ER+, PR-	0.037	0.035
Local, Grade 2, ER-, PR-	0.021	0.019
Local, Grade 2, ER missing, PR missing	0.018	0.017
Local, Grade 3, ER+, PR+	0.064	0.071
Local, Grade 3, ER+, PR-	0.022	0.021
Local, Grade 3, ER-, PR-	0.053	0.057

Local, Grade 3, ER missing, PR missing	0.008	0.010
Local, Grade missing, ER+, PR+	0.024	0.030
Local, Grade missing, ER missing, PR missing	0.017	0.020
Regional, Grade 1, ER+, PR+	0.024	0.025
Regional, Grade 2, ER+, PR+	0.071	0.065
Regional, Grade 2, ER+, PR-	0.014	0.011
Regional, Grade 3, ER+, PR+	0.029	0.029
Regional, Grade 3, ER+, PR-	0.010	0.010
Regional, Grade 3, ER-, PR-	0.024	0.021
Colorectal	N = 16,463	N = 15,697
Local, Grade 1	0.063	0.056
Local, Grade 2	0.271	0.277
Local, Grade 3	0.038	0.045
Local, Grade missing	0.096	0.083
Regional, Grade 1	0.020	0.017
Regional, Grade 2	0.214	0.215
Regional, Grade 3	0.073	0.079
Regional, Grade 4	0.008	0.011
Regional, Grade missing	0.013	0.013
Distant, Grade 2	0.079	0.078
Distant, Grade 3	0.035	0.039
Distant, Grade missing	0.041	0.037
Stage missing, Grade 2	0.011	0.013
Stage missing, Grade missing	0.018	0.017
Lung	N = 20,151	N = 21,861
Local, Grade 1	0.028	0.032
Local, Grade 2	0.055	0.062
Local, Grade 3	0.049	0.053
Local, Grade missing	0.062	0.067
Regional, Grade 1	0.011	0.011
Regional, Grade 2	0.052	0.057
Regional, Grade 3	0.074	0.074
Regional, Grade 4	0.009	0.010
Regional, Grade missing	0.094	0.094
Distant, Grade 1	0.011	0.010
Distant, Grade 2	0.042	0.039
Distant, Grade 3	0.104	0.101
Distant, Grade 4	0.022	0.024
Distant, Grade missing	0.331	0.312
Stage missing, Grade missing	0.044	0.039
Prostate	N = 29,673	N = 28,921

Local/Regional, Grade 2	0.392	0.378
Local/Regional, Grade 3	0.483	0.514
Local/Regional, Grade missing	0.020	0.021
Distant, Grade 3	0.030	0.024
Distant, Grade missing	0.015	0.013
Stage missing, Grade 2	0.019	0.012
Stage missing, Grade 3	0.019	0.014
Stage missing, Grade missing	0.011	0.012

The sample is restricted to Medicare Advantage and Medicare Fee-for-Service beneficiaries enrolled in Medicare Part D (prescription drug coverage). All variables are binary indicators. Only variables with frequencies of at least 1% among either Medicare Advantage of Fee-for-Service patients are shown, within cancer site, are shown. The values shown are the frequencies (i.e., means). All variables are measured at the time of the patient's cancer diagnosis.

The variable with the most notable difference between MA and FFS patients was the HSA variable. It is well known that the popularity of MA plans varies geographically. The regression model used HSA fixed effects in order to account for this variation. Table 4 summarizes characteristics of HSAs at the patient level in order to illustrate differences between MA and FFS patients, but these variables are not used in the model (due to the inclusion of HSA fixed effects) (Note 2). MA patients lived in HSAs that were nearly twice as large, in terms of population, as the HSAs that FFS patients lived in on average. This is not surprising since MA plans are most popular in urban areas. MA patients also had more physicians, radiation oncologists, hospitals, and hospitals with cancer programs within their HSA than FFS patients. This does not necessarily imply that MA patients had more choice with respect to cancer care, however, since MA plans limit access through their provider networks. Unfortunately, data measuring provider networks for MA plans is not readily available for researchers.

Table 4. Summary of Health Service Areas at Time of Diagnosis

	Medicare Advantage Patients N = 89,334	**Fee-for-Service Patients N = 91,922**
Population	3.1 million (3.0 million)	1.7 million (2.2 million)
# Physicians	2,303 (2,128)	1,324 (1,642)
# Radiation Oncologists	46 (47)	27 (36)
# Hospitals	35 (33)	21 (24)
# Hospitals with Cancer Programs	9 (7)	6 (6)

The sample is restricted to Medicare Advantage and Medicare Fee-for-Service beneficiaries enrolled in Medicare Part D (prescription drug coverage). The table summarizes, at the individual level, characteristics of HSAs where the individuals in the sample reside. Means are shown, with standard deviations in parentheses.

3.2 Results

Tables 5A (all-causes mortality) and 5B (cancer-caused mortality) report the linear regression estimates. The estimates from the model that includes the control variables are the preferred estimates. The estimates for all-causes mortality (Table 5A) are all positive, but (similar to Table 1) only the estimate for lung cancer patients is statistically distinguishable from zero with a 5 percent threshold. The estimates for cancer-caused mortality (Table 5B) are also all positive, and the estimates for colorectal cancer and lung cancer patients are both statistically distinguishable from zero with a 1 percent threshold.

Interpreting the all-causes mortality estimates as a lower bound and the cancer-caused mortality estimates as an upper bound, the results imply that (conditional on having Part D coverage and controlling for observable patient demographics and cancer severity) MA enrollment was associated with a 1.1 to 1.9 percentage point (3 to 6 percent) higher chance of dying within two years after a lung cancer diagnosis. Similarly, MA enrollment was associated with a 0.8 to 1.3 percentage point (1 to 2 percent) higher chance of dying within two years after a colorectal cancer diagnosis. There were similar, but smaller and statistically insignificant associations, among patients with breast or prostate cancer.

Table 5A. Relationship between Medicare Advantage Enrollment and Two-Year All-Causes Mortality

Variable	**Breast Cancer**		**Colorectal Cancer**		**Lung Cancer**		**Prostate Cancer**	
Medicare Advantage	-0.0046* (0.0028)	0.0017 (0.0028)	-0.0025 (0.0050)	0.0084* (0.0049)	0.0288*** (0.0052)	0.0109** (0.0048)	0.0069*** (0.0025)	0.0030 (0.0021)
Female		-0.0561*** (0.0167)		-0.0375*** (0.0043)		-0.0682*** (0.0041)		
Black		0.0116* (0.0064)		0.0254** (0.0100)		-0.0015 (0.0082)		0.0080** (0.0040)
Hispanic		-0.0063 (0.0048)		-0.0059 (0.0087)		-0.0023 (0.0099)		-0.0068* (0.0035)
Married		-0.0093*** (0.0028)		-0.0350*** (0.0057)		-0.0463*** (0.0048)		-0.0075*** (0.0025)
Widowed		0.0034 (0.0035)		0.0035 (0.0069)		-0.0078 (0.0058)		0.0232*** (0.0055)
(CT) % No College		0.0002 (0.0002)		0.0001 (0.0003)		-0.0001 (0.0003)		0.0001 (0.0001)
(CT) % 4 Years of College		-0.0004*** (0.0001)		-0.0009*** (0.0002)		-0.0016*** (0.0002)		-0.0004*** (0.0001)
Fixed Effects								
Age (integer)		x		x		x		x
Year of Diagnosis		x		x		x		x
Health Service Area		x		x		x		x
Summary Stage x Grade x ER/PR Status		x		x		x		x
Sample Size	48,490	48,490	32,160	32,160	42,012	42,012	58,594	58,594

The sample is restricted to Medicare Advantage and Medicare Fee-for-Service beneficiaries enrolled in Medicare Part D (prescription drug coverage). An observation is an individual. The outcome variable is an indicator for death occurring within 2 years after the individual's first cancer diagnosis. The Medicare Advantage enrollment variable is measured in the year of cancer diagnosis. The educational attainment variables are measured as the proportion of individuals in the patient's census tract who meet the criteria. Standard errors, in parentheses, are clustered by county ×year-of-diagnosis.

* p<0.10, ** p<0.05, *** p<0.01

Table 5B. Relationship between Medicare Advantage Enrollment and Two-Year Cancer-Caused Mortality

Variable	**Breast Cancer**		**Colorectal Cancer**		**Lung Cancer**		**Prostate Cancer**	
Medicare Advantage	-0.0004	0.0029	0.0083*	0.0127***	0.0366***	0.0186***	0.0064***	0.0024*
	(0.0020)	(0.0019)	(0.0045)	(0.0042)	(0.0059)	(0.0049)	(0.0017)	(0.0014)
Female		-0.0179		-0.0057		-0.0479***		
		(0.0116)		(0.0036)		(0.0044)		
Black		0.0075*		0.0176**		-0.0069		0.0006
		(0.0044)		(0.0087)		(0.0091)		(0.0026)
Hispanic		-0.0008		0.0040		0.0040		0.0018
		(0.0039)		(0.0081)		(0.0101)		(0.0023)
Married		-0.0026		-0.0171***		-0.0334***		0.0013
		(0.0020)		(0.0050)		(0.0052)		(0.0015)
Widowed		0.0031		0.0030		-0.0037		0.0160***
		(0.0026)		(0.0061)		(0.0065)		(0.0038)
(CT) % No College		0.0001		0.0002		-0.0002		0.0001
		(0.0001)		(0.0003)		(0.0003)		(0.0001)
(CT) % 4 Years of College		-0.0001		-0.0004*		-0.0014***		-0.0001
		(0.0001)		(0.0002)		(0.0002)		(0.0001)
Fixed Effects								
Age (integer)		x		x		x		x
Year of Diagnosis		x		x		x		x
Health Service Area		x		x		x		x
Summary Stage x Grade x ER/PR Status		x		x		x		x
Sample Size	48,490	48,490	32,160	32,160	42,012	42,012	58,594	58,594

The sample is restricted to Medicare Advantage and Medicare Fee-for-Service beneficiaries enrolled in Medicare Part D (prescription drug coverage). An observation is an individual. The outcome variable is an indicator for a death, caused by cancer, occurring within 2 years after the individual's first cancer diagnosis. The Medicare Advantage enrollment variable is measured in the year of cancer diagnosis. The educational attainment variables are measured as the proportion of individuals in the patient's census tract who meet the criteria. Standard errors, in parentheses, are clustered by county ×year-of-diagnosis.

* p<0.10, ** p<0.05, *** p<0.01

4. Cox Proportional Hazards: Methodology and Results

As shown in the previous section, the choice between all-causes or cancer-caused mortality as the outcome has a small but clinically meaningful impact on the estimates. This is presumably due to bias that results from MA cancer patients having more non-cancer comorbidities (or, more generally, poorer non-cancer health) than FFS cancer patients. In the absence of data on non-cancer comorbidities, the preferred approach to address this bias is to use a Cox proportional hazards model that treats non-cancer deaths as censoring events. Unlike with a linear regression model, which cannot address right-censoring, no assumption is needed regarding future survival for patients who die for reasons unrelated to their cancer.

4.1 Methodology

Unlike the linear regression that modeled the probability of death within two years after cancer diagnosis, the hazard rate modeled in the Cox proportional hazards model is the probability of death in the n^{th} month after cancer diagnosis *given survival through the* $(n\text{-}1)^{st}$ *month*. The Cox proportional hazards model is the simplest and most popular hazard model. It does not impose any assumptions regarding the underlying hazard rate. Instead, it only assumes that the relationship between the key variable(s) and the hazard rate is proportional to survival duration. Schoenfield residuals are commonly used to statistically test this assumption and the Schoenfield test for this study revealed no evidence against the proportionality assumption.

Similar to fixed effects in a linear regression, covariates can be used as stratifiers in a linear regression. Stratifiers do not have a coefficient that is estimated and need not have a true relationship with the hazard rate this is proportional to survival duration. All of the variables that were used as fixed effects in the linear regression model (age, year of diagnosis, HSA, and cancer severity) were used as stratifiers in the Cox proportional hazards model.

4.2 Results

Tables 6A (all-causes mortality) and 6B (cancer-caused mortality) report the estimates from the Cox proportional hazards models. Again, the estimates from the models that include the control variables are the preferred estimates. For lung and prostate cancers, the estimates from the model without any control variables are similar to the estimates from the model with control variables. For breast and colorectal cancers, the inclusion of the control variables increases the estimates. This suggests that MA breast and colorectal cancer patients, compared to FFS breast and colorectal cancer patients, have observed characteristics besides insurance type that are associated with lower hazard rates (Note 3).

Table 6A. Relationship between Medicare Advantage Enrollment and Hazard of All-Cause Mortality

Variable	Breast Cancer		Colorectal Cancer		Lung Cancer		Prostate Cancer	
Medicare Advantage	-0.0553** (0.0239)	0.1190* (0.0680)	-0.0420*** (0.0162)	0.1154*** (0.0406)	0.0803*** (0.0135)	0.0892*** (0.0254)	0.0532*** (0.0266)	0.0553 (0.0367)
Female		-0.5884** (0.2554)		-0.3336** (0.0326)		-0.1672*** (0.0222)		
Black		0.1769 (0.1162)		0.1210* (0.0675)		-0.0923** (0.0430)		0.0546 (0.0520)
Hispanic		-0.3081** (0.1225)		-0.0792 (0.0864)		-0.0194 (0.0500)		-0.2272*** (0.0592)
Married		-.2536*** (0.0711)		-.2417*** (0.0483)		-0.1912*** (0.0311)		-0.2162*** (0.0328)
Widowed		-0.1129 (0.0717)		-0.0083 (0.0494)		0.0059 (0.0306)		0.1450** (0.0603)
(CT) % No College		0.0046 (0.0031)		-0.0012 (0.0024)		0.0006 (0.0018)		0.0018 (0.0022)
(CT) % 4 Years of College		-0.0015 (0.0023)		-0.0036* (0.0019)		-0.0048*** (0.0012)		-0.0081*** (0.0013)
Stratifiers								
Age (integer)		x		x		x		x
Year of Diagnosis		x		x		x		x
Health Service Area		x		x		x		x
Summary Stage x Grade x ER/PR Status		x		x		x		x
Sample Size	48,490	48,490	32,160	32,160	42,012	42,012	58,594	58,594

The sample is restricted to Medicare Advantage and Medicare Fee-for-Service beneficiaries enrolled in Medicare Part D (prescription drug coverage). An observation is an individual. Estimates are from a stratified Cox proportional hazards model, with any death treated as an event. The Medicare Advantage enrollment variable is measured in the year of cancer diagnosis. The educational attainment variables are measured as the proportion of individuals in the patient's census tract who meet the criteria. Standard errors, in parentheses, are clustered by county ×year-of-diagnosis.

* p<0.10, ** p<0.05, *** p<0.01

Table 6B. Relationship between Medicare Advantage Enrollment and Hazard of Cancer-Caused Mortality

Variable	Breast Cancer		Colorectal Cancer		Lung Cancer		Prostate Cancer	
Medicare Advantage	0.0151	0.2963**	0.0275	0.1783***	0.0988***	0.1255***	0.1682***	0.1062
	(0.0370)	(0.1237)	(0.0223)	(0.0530)	(0.0159)	(0.0266)	(0.0457)	(0.0833)
Female		-0.4573		-0.1020**		-0.1550***		
		(0.5070)		(0.0518)		(0.0245)		
Black		0.3053		0.2153**		-0.0776*		0.0287
		(0.1911)		(0.0890)		(0.0470)		(0.1120)
Hispanic		-0.4642*		0.1289		-0.0190		-0.1234
		(0.2433)		(0.1322)		(0.0537)		(0.1059)
Married		-0.3424**		-0.1561**		-0.1829***		-0.2169***
		(0.1407)		(0.0690)		(0.0311)		(0.0830)
Widowed		0.0113		-0.0185		0.0078		-0.0125
		(0.1571)		(0.0788)		(0.0313)		(0.1342)
(CT) % No College		0.0111*		-0.0017		0.0004		0.0092**
		(0.0065)		(0.0029)		(0.0016)		(0.0041)
(CT) % 4 Years of College		0.0044		-0.0048*		-0.0045***		-0.0040
		(0.0050)		(0.0026)		(0.0012)		(0.0034)
Stratifiers								
Age (integer)		x		x		x		x
Year of Diagnosis		x		x		x		x
Health Service Area		x		x		x		x
Summary Stage x Grade x ER/PR Status		x		x		x		x
Sample Size	48,490	48,490	32,160	32,160	42,012	42,012	58,594	58,594

The sample is restricted to Medicare Advantage and Medicare Fee-for-Service beneficiaries enrolled in Medicare Part D (prescription drug coverage). An observation is an individual. Estimates are from a stratified Cox proportional hazards model, with a cancer-caused death treated as an event and any other death treated as censoring. The Medicare Advantage enrollment variable is measured in the year of cancer diagnosis. The educational attainment variables are measured as the proportion of individuals in the patient's census tract who meet the criteria. Standard errors, in parentheses, are clustered by county×year-of-diagnosis.

* p<0.10, ** p<0.05, *** p<0.01

All of the preferred Cox estimates (i.e., the ones with control variables included in the model) are greater than zero. The estimates for colorectal and lung cancers, for both all-causes and cancer-caused mortality, are distinguishable from zero with a 1 percent statistical threshold. The breast cancer estimate for cancer-caused mortality is distinguishable from zero with a 5 percent statistical threshold but the breast cancer estimate for all-causes mortality is only distinguishable from zero with a 10 percent statistical threshold. The prostate cancer estimates are not distinguishable from zero with any conventional statistical threshold.

For lung cancer patients, MA enrollment was associated with an 8.9 percent increased hazard of dying from any cause and a 12.6 percent increased hazard of dying from cancer. For colorectal cancer patients, MA enrollment was associated with an 11.5 percent increased hazard of dying from any cause and a 17.8 percent increased hazard of dying from cancer.

5. Limitations

This study had several limitations. Though the statistical analysis attempted to minimize selection bias, this was an observational study. A causal interpretation of the estimates requires a key assumption that no unobserved factors increase (decrease) the likelihood of enrolling in MA plans and decrease (increase) the time between diagnosis and death for patients who are ultimately diagnosed with cancer. Factors that could influence mortality for cancer patients, such as financial resources, family support, severity of cancer, and comorbid conditions, may not have been perfectly controlled for due to data limitations. To the extent that residual components of these or other factors (a) vary between MA and FFS cancer patients and (b) influence mortality for cancer patients, the results of the study may not represent a causal effect of MA enrollment. Other limitations are described below.

First, this study only considered patients who were already diagnosed with cancer and thus focused only on post-diagnosis cancer care. Preventive aspects of cancer care, such as living a healthy lifestyle and adhering to recommended cancer screenings, are critical in reducing the chance of a cancer-related death but were not the focus of this study. Other studies have found evidence that MA enrollment increases the likelihood of screening for cancer, likely because MA plans have historically reduced patient cost-sharing for cancer screening services (Baker, Phillips, Haas, Liang, & Sonneborn, 2004; and Rizzo, 2005). It is thus possible that MA enrollment may improve pre-diagnosis cancer care. However, it is important to note that routine cancer screening is not recommended or common for lung cancer.

Second, the SEER-Medicare data is not a nationally representative sample. However, SEER regions contain over one-fourth of the US population. They are also similar to non-SEER regions in terms of cancer incidence by age and race (Kuo & Mobley, 2016), and in terms of MA penetration rates over time. Third, due to data constraints, this study was unable to adjust for quality of life. Fourth, this study was not able to examine any heterogeneity within types of MA plans.

6. Discussion

Conditional on having Medicare Part D and controlling for patient characteristics, MA enrollment was found to be associated with increased mortality for patients diagnosed with cancer. The most convincing statistical evidence was for lung cancer, followed by colorectal cancer. These two cancers, and especially lung cancer, are much more deadly than breast and prostate cancer on average.

Like any observational study, the potential for selection bias due to unobserved factors must be taken seriously. However, a rich set of controls was used and the estimates (particularly for lung cancer cancer)

were not sensitive to those controls. Additionally, a large risk selection literature implies that any selection bias is most likely to understate any effect of MA enrollment to increase mortality. If the results of this study are driven by selection bias, it is a new selection bias that has not yet been documented in the literature.

This study was unable to confirm a mechanism for the observed positive association between MA enrollment and mortality for cancer patients. One hypothesis, based on the trade-off of enhanced coverage but restricted provider access in MA plans compared to FFS, is that restricted provider access in MA plans increases mortality for patients with particularly deadly cancers that may benefit from access to particular specialists. Examining the implications of restricted provider access for vulnerable populations is a promising area for future work, particularly now that MA encounter data have become available to researchers (Note 4). In studies that were not restricted to cancer patients, evidence indicates that MA patients are admitted to lower-quality hospitals (Friedman & Jiang, 2010) and lower-quality nursing homes (Meyers, Mor, & Rahman, 2018) than FFS patients.

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Notes

Note 1. For more information, see https://www.seer.cancer.gov/causespecific/ (accessed on 6/29/2018).

Note 2. These statistics were calculated using the Area Health Resources File.

Note 3. It may not be a coincidence that these are the two cancer sites for which routine screening is common and recommended. MA plans may encourage cancer screening (Baker, Phillips, Haas, Liang, & Sonneborn, 2004; and Rizzo, 2005)

Note 4. See https://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2018-Fact-sheets-items/2018-04-26.html (accessed on 7/1/2018).