An Uneven Playing Field for Fighting Cancer

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Introduction

Upon receiving the devastating and frightening news of a cancer diagnosis, nearly everyone would expect that every feasible treatment will be considered to produce the best possible chance at survival. However, depending on where individuals live and what type of insurance they have, their chance at survival can be vastly different. While there would likely be a disparity between the outcomes of those with "Cadillac" insurance plans and those who are uninsured and unable to afford care, the survival gap between those with more nuanced differences in types of insurance plans may be less obvious.

Within the vastly complex and inefficient United States healthcare system, people pay for their healthcare services in dramatically different ways based on where they live, who they work for, and how much they earn. Some people simply have coverage through their employers, which usually is administered in some form of managed care. Those over the age of 65 will receive Medicare, which can be accessed either through private managed care plans or through a public fee-for-service program. Individuals with low incomes who meet certain criteria may qualify for government assistance in purchasing a private plan or may qualify for Medicaid, which is nearly entirely provided by the government.

While one would hope in an egalitarian spirit that all with any form of health insurance would receive universally quality care, this is far from reality. Those receiving Medicaid insurance likely face steeper odds of survival with fewer potentially life-saving treatments being approved and a generally lower quality of care for the treatments that are approved. Although it is difficult to examine within our empirical framework, the quality of physicians also likely varies between networks that accept Medicaid and those that do not. Even within the group of individuals receiving Medicaid across the country, spending levels and plan offerings vary vastly from state-to-state. We will explore how the survival rates differ among Medicaid recipients and examine of states with more generous public insurance plans have any impact on patient outcomes.

While previous studies have attempted to examine the relationship between insurance status and cancer survival rates and outcomes, this has been a historically difficult task. Most data recorded on cancer patients are intended to inform clinical research and not to aid in economic studies of cancer or the healthcare system. The major national database maintained by the National Cancer Institute, the SEER research data set, has only recorded a variable on insurance status since 2007 (2014). Thus, studies on insurance's effect on cancer outcomes are just becoming viable. I aim to add to the existing body of literature on the economics of cancer by utilizing the most recent data on a national scale to evaluate what some smaller-scale studies have done in the past with much narrower datasets. I also attempt to characterize the impact of different types of state-run Medicaid programs on patients' health outcomes.

Literature Review

One study examining the effects of insurance status on cancer outcomes, Niu and Roche (2013) found that patients receiving Medicaid faced significantly higher risks of death than did privately insured patients. To conduct this study the researchers used a much smaller sample from The New Jersey State Cancer Registry with data from 1995 to 2009. Additionally, their primary economic model used a univariate chi-squared test to evaluate contributing factors to different cancer survival rates. While this test has some merit, I worry that it fails to control for other important factors, such as geographical diversity, income level and previous incidence of cancer.

Ortiz-Ortiz and Ramirez-Garcia (2014) examined the relative excess risk of death from colorectal cancer in 2004-2005 among the Puerto Rican population. They find that having government health insurance versus non-government health insurance produces a significantly higher chance of death among individuals aged 50-64. They conducted their economic framework also around a Chi-square test for five-year survival rate among the different insurance statuses of individuals included in the sample. Once again, while this is a convenient econometric method to employ given the limited nature of public health data available in Puerto Rico, it introduces several crucial limitations. While it does control for age, it fails to examine the fixed effects presented by different exogenous events in Puerto Rico and its healthcare system.

Also, the utilization of the five-year survival rate as the primary metric for cancer outcome is restrictive and myopic. There is no clear literature or consensus that surviving five years from the time of diagnosis holds any particular merit or significance. Lakdawalla and Romley (2012) make the argument that patients value high risk treatments with potential high rewards more heavily than they do more proven treatment methods that may produce a much smaller survival gain. This further serves to reinforce the fact that the 5-year survival rate is relatively arbitrary when patients place different marginal values on increments of survival and this is presumably not uniform across the population. I find it far more robust to measure the cancer outcome with the survival time from the time of diagnosis to the time of death.

Methodology

To address some of the problems that I have identified with the econometric methods of the previous studies, I will introduce a multivariate regression approach that I believe effectively controls for many related variables. As my primary dependent variable, I will define S_i as the survival time, in months, of patient i from the time of their diagnosis to their time of death or to the most recent data level. To correct for the fact that some patients survive to the end of the dataset, and therefore maybe coded as having passed away when they have in fact survived, I use the Cox proportional hazards model. This model attempts to estimate the time at which the individual would have passed away given her conditions using an underlying hazard function to estimate risk.

On the right hand side of the regression equation, I will introduce binary variables for insurance type. In the data set I am using, patients are classified as having one of the following insurance types:

1. Uninsured
2. Any Medicaid
3. Insured
4. Insured/no specifics
5. Insurance status unknown
6. Not available

Following the precedent set by Rong and Yuang (2016), I will consolidate the above insurance status possibilities to include a possibility for Uninsured/Insurance status unknown/not available, any Medicaid, multiple types of insurance during the cancer experience and insured/insured/no specifics. Thus, I will include binary variables for the 3 categories of insurance status, defined as $I_1, I_2,$ and I_3, respectively in vector I. Finally, I will include a vector, C, of control variables. For controls, I include age, ethnicity, county of residence, previous cancer diagnosis, income, and gender. Thus, my final regression equation is found as equation (1):

$$S_i = \beta_I I_i + \beta_C C_i + \varepsilon_i \qquad (1)$$

Data

To evaluate my research question, I draw on data from the National Cancer Institute's SEER dataset. This includes observations on millions of cases at the person-month level, tracking patient's experiences with cancer. New entries are started when a patient is diagnosed with cancer and consents to have his or her data tracked anonymously by the National Cancer institute for research purposes. The National Cancer Institute has the most comprehensive and robust registry of cancer-related data in the world and is commonly used in studies evaluation cancer at the macro level.

Because the data are in the form of a panel with person-month observations and I am only interested in the total survival time from the time of diagnosis, I construct a new survival time variable that counts how long the patient has survived (in months) from the time of diagnosis up until the death variable is observed, or the upper bound of the data is reached (2014). Other characteristics variables remain constant throughout the cancer experience and thus are recorded in the first observation for a given patient's cancer experience. All other observations after the first month of diagnosis are discarded after the survival time variable has been constructed and added to the diagnosis-month observation.

As Medicaid is supported by a combination of state and federal funding, the Medicaid expenditures differ from state to state. The levels of total state Medicaid expenditures and expenditures per capita are shown in Table 3, with the average state spending $1,145 per resident. Nevada has the lowest Medicaid spending per capita at $417, while the District of Columbia has the highest spending per capita at $2,495 per capita. The per capita calculations are conducted using total state population in the denominator, not strictly the population that receives benefits from the state Medicaid program. As such, the amount spent per Medicaid beneficiary would likely be higher than the cited per capita amounts.

Table 1. Summary Statistics for Individuals from 2007 to 2014

	White	***Non-white***		***White***	***Non-white***
Sample Size			**Characteristics**		
Persons	128,598	34,497	Demographics, *Average*		
Diagnoses	218,280	72,132	*Age*	38.6 (.051)	38.2 (.066)
Person Months	3,043,908	724,989	*Male*	.537 (.001)	.489 (.001)
			Female	.463 (.002)	.511 (.003)

Notes: Standard errors are shown in parentheses below the averages for age and gender.

Notably, the sample of white individuals is significantly larger than is the sample of nonwhite individuals. This is likely partially attributable to the panel construction and partially a reflection of the national population. Proper analytical weighting will ensure each observation accurately reflects its greater U.S. population bloc. The sample is slightly skewed towards males in the white population and towards females in the nonwhite population. The average age is virtually the same at around 38 years in both the white and nonwhite samples.

Results

I begin by presenting data from 3 different regressions run according to the specifications in the econometric model from the Methodology section.

Table 2. Effects of Insurance Status on Cancer Survival Times

Regression Equation	1	2	3
Uninsured/Unkown	-0.0248253**	-0.0348782**	-0.0958236**
	(0.01002728)	(0.0105312)	(0.0103300)
Mixed Insurance	0.0243048**	0.0343790*	0.1170376**
	(0.0199539)	(0.0118038)	(0.0140191)
Medicaid	-0.0183835**	-0.0138491**	-0.0638673**
	(0.0011551)	(0.0023722)	(0.0341797)
Previous Cancer Incidence	-3.816310**	-4.894303**	-4.489510**
	(0.1355644)	(0.0302910)	(0.0157212)

# of Observations	3,768,897	3,304,485	3,046,917
R^2	.3681	.4124	.4381

Notes: Robust Standard errors are in parentheses. * indicates significance at 10% and ** indicates significance at 5%.

The column titled "1" includes all observations, the column titled "2" excludes observations from the State of Louisiana due to data anomalies resulting from Hurricane Katrina and it's lasting effects on the Louisiana health system, the column titled "3" excludes both observations from the State of Louisiana and observations from Los Angeles since insurance status data is not available for observations in Los Angeles.

The R squared value indicates that the first regression explains 36.8% of the variation in the data, the second explains 41.24% and the third one explains 43.81%. The several statistically significant results also point to the validity of these regressions.

As seen in Table 4, we can see a slightly positive effect of state Medicaid spending effect per capita on survival times, when controlling for all other factors. One may expect this to have a more significant effect on survival times, as states like New York and the District of Columbia are spending drastically more on Medicaid beneficiaries than are states like Nevada and Utah.

Table 3. Medicare Spending By State

	MEDICARE SPENDING (MILLIONS)	MEDICARE SPENDING PER CAPITA
ALABAMA	$ 3,897	$ 828
ALASKA	$ 1,065	$ 1,525
ARIZONA	$ 8,341	$ 1,265
ARKANSAS	$ 3,242	$ 1,122
COLORADO	$ 3,375	$ 871
CALIFORNIA	$ 38,892	$ 1,842
CONNECTICUT	$ 5,619	$ 1,597
DC	$ 1,556	$ 2,595
DELAWARE	$ 1,232	$ 1,392
FLORIDA	$ 14,258	$ 769
GEORGIA	$ 7,237	$ 736
HAWAII	$ 1,271	$ 981
IDAHO	$ 1,289	$ 834
ILLINOIS	$ 12,744	$ 987
INDIANA	$ 5,768	$ 898
IOWA	$ 2,843	$ 945
KANSAS	$ 2,366	$ 839
KENTUCKY	$ 5,213	$ 1,208
LOUISIANA	$ 5,628	$ 1,253
MAINE	$ 2,468	$ 1,872
MARYLAND	$ 6,340	$ 1,112
MASSACHUSETTS	$ 12,275	$ 1,862
MICHIGAN	$ 10,022	$ 1,005
MINNESOTA	$ 7,214	$ 1,370
MISSISSIPPI	$ 3,689	$ 1,250
MISSOURI	$ 6,928	$ 1,157
MONTANA	$ 845	$ 866
NEBRASKA	$ 1,538	$ 856
NEVADA	$ 1,245	$ 471
NEW HAMPSHIRE	$ 1,111	$ 839
NEW JERSEY	$ 8,352	$ 959
NEW MEXICO	$ 3,204	$ 1,594
NEW YORK	$ 46,665	$ 2,388
NORTH CAROLINA	$ 11,058	$ 1,179
NORTH DAKOTA	$ 573	$ 886
OHIO	$ 13,335	$ 1,155

OKLAHOMA	$	3,878	$	1,052
OREGON	$	3,540	$	925
PENNSYLVANIA	$	16,270	$	1,291
RHODE ISLAND	$	1,755	$	1,666
SOUTH CAROLINA	$	4,625	$	1,014
SOUTH DAKOTA	$	709	$	873
TENNESSEE	$	7,124	$	1,131
TEXAS	$	21,919	$	884
UTAH	$	1,615	$	580
VERMONT	$	971	$	1,561
VIRGINIA	$	5,550	$	704
WASHINGTON	$	6,194	$	929
WEST VIRGINIA	$	2,441	$	1,341
WISCONSIN	$	6,675	$	1,180
WYOMING	$	528	$	969

Conclusion

Overall, we can clearly see that insurance status does have some effect upon the ultimate survival rates of cancer patients. There exists a negative penalty in terms of survival time due to both having no insurance and due to having Medicaid. The effect of being uninsured understandably appears to be more dramatic than that of having Medicare. This aligns with the basic logic that having some insurance, even if it is of lower quality, is better than having no insurance at all. These penalties are relative to the survival times for individuals with some level of private insurance. There also exists a slightly positive effect on survival times for having a mix of Medicaid and other insurance. Although it is unclear why exactly this might be more advantageous than just having private insurance for the duration of the cancer experience, this result does follow the expectations that having some private insurance would be better than having no private insurance and only Medicaid.

While these results are statistically significant and do seem to have some impact on the patient's ultimate survival time, the magnitude of these insurance effects pale in comparison to the effects of one of our control variables listed, previous cancer incidence. Patients who previously had a separate case of cancer have an average of 3 to 4 fewer months of survival time relative to those with no previous history with cancer.

Although it appears that states that spend more per capita on Medicaid do also have slightly better cancer survival outcomes, the benefits are not to the extent that a policymaker would hope. The District of Columbia spends more than 5 times as much per capita on Medicaid as does Nevada, yet it's cancer survival rates are only marginally better. Although this data is less accessible, perhaps a better proxy for the robustness of state Medicaid programs would be state spending per Medicaid beneficiary rather than per capita, which includes its total population.

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