ORIGINAL RESEARCH

Private Insurance Improves Survival of Patients with Stage III/IV Small Cell Lung Cancer within the National Cancer Database

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Background: The overall survival for small cell lung cancer (SCLC) patients at 5 years is only 5% to 10%, and improvements in treatment have proved to be unsatisfactory in prolonging SCLC survival. One of the challenges in improving cancer survival is identifying health disparities. In this study, we determined how disparities in payer status affected SCLC patient survival by analyzing data from the National Cancer Data Base (NCDB) between 1998 and 2011.

Methods: We evaluated a cohort of 71,724 patients ages 18–65 diagnosed with stage III or IV SCLC who had not undergone surgery or hormonal therapy registered in the NCDB. Overall survival (OS) was the outcome variable, and payer status was the primary predictor variable. Multivariate Cox regression was used to investigate the effect of payer status on OS while adjusting for other factors.

Results: The majority of patients diagnosed at stage III–IV had private insurance (57.93%), while 17.75%, 14.69% and 9.64% of patients had Medicare, Medicaid or were uninsured, respectively. Multivariate Cox regression analysis revealed a statistically significant relationship between payer status and overall survival when controlling for other variables. Uninsured, Medicaid, and Medicare patients were found to have a higher risk of death from SCLC compared to privately insured patients ($p<.0001$). The adjusted median OS of privately insured, uninsured, Medicare, and Medicaid patients was 10.32, 8.97, 9.00, and 9.00 months, respectively.

Conclusions: Payer status proved to be a significant predictor of overall survival for SCLC, which remained true after adjusting for the other study variables. Uninsured, Medicaid, and Medicare patients had higher mortality compared to privately insured patients. Further study is needed to investigate the mechanism of payer status on survival of SCLC.

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The authors have no conflicts of interest to disclose.

Introduction

Lung cancer is the second most commonly diagnosed cancer and accounts for more deaths than any other cancer.[1] Lung cancers are classified as small cell (SCLC) or non-small cell (NSCLC). SCLC accounts for 15% of bronchogenic cancers[2] and is found nearly exclusively in smokers and those exposed to second-hand smoke.[3] SCLC is more responsive to chemotherapy and radiation therapy than other lung cancers, but it tends to be diagnosed at a later stage, making cures difficult.[4]

A challenge in improving SCLC outcomes is addressing health inequities. Previous literature using data from the National Cancer Data Base (NCDB) identified disparities in SCLC mortality following the passage of the Affordable Care Act (ACA) based on sex, race/ethnicity, socioeconomic status, and payer status.[5] In another study among patients with stage I, II, or III SCLC, factors associated with better survival included female sex, higher income, better education, private insurance, and earlier stage at diagnosis.[6]

Payer status affects survival in NSCLC[7] and other cancers. Specifically, privately insured patients with breast and colorectal cancers were more likely to be diagnosed at an earlier stage[9,13,14] and had greater overall survival compared to uninsured, Medicare, and Medicaid patients.[7–11] Cancer patient outcomes also involve socioeconomic status, distance travelled to receive care, and number of comorbidities. Patients of lower socioeconomic status,[12–14] traveling longer distances,[15,16] and presenting with more comorbidities[17–19] have worse survival. In this study, we investigated disparities, with a primary focus on payer status, on the survival of patients with late-stage (AJCC Stage III and IV) small-cell lung cancer.

Methods

We evaluated a cohort of 71,724 SCLC patients with stage III or IV disease who had not undergone surgery or hormonal therapy registered in the NCDB. Stage III and IV patients were included as this is the stage where most patients are diagnosed.[20] The NCDB is a hospital-based cancer registry that is jointly maintained by the American Cancer Society and the American College of Surgeons, capturing approximately 70% of all newly diagnosed cases of cancer in the United States.[21]

Patients ages 18–64 years diagnosed with SCLC from 1998–2011 and followed to the end of 2012 were included in the analysis. Age was divided into two sub-categories, 18–55 and 56–64, with the data evenly distributed within these ranges. Race/ethnicity was divided into White, Black, and Asian based on original coding.[5,6] Payer status was categorized as uninsured, private, Medicaid, or Medicare. Income, or median household income at zip-code level, was grouped as <$36k or ≥$36k per year. The percentage of adults in the patient's zip code who did not graduate from high school as a measure of education was grouped as ≥20% and <20%. Distance traveled was defined as the distance from the patient's residential zip code to a medical center and was grouped as <30 and ≥30 miles.[5,6] Income, education, and distance traveled were determined using 2000 census data.[21] The Charlson Comorbidity Index was defined as 0, 1, ≥2, or unknown.[22] Facilities were classified as community facilities, comprehensive community cancer programs, or academic/research programs.[5,6]

For simplicity, we combined patients receiving single and multiple-agent chemotherapy agents into one group, 'chemotherapy,' and patients receiving any form of radiation into 'radiation therapy.'

Table I displays the distribution of patients according to the study's variables, which were part of the original NCDB dataset and used to assist in logit modeling. Chi-squared analysis

Table I. Patient Characteristics

	Factor	n	Percent
Sex	Male	37165	51.82
	Female	34559	48.18
Age	18–55	27757	38.7
	56–64	43967	61.3
Race	White	64778	90.32
	Black	6174	8.61
	Asian	772	1.08
Comorbidity	0	30221	42.14
	1	13028	18.16
	2	4886	6.81
	Unknown	23589	32.89
Insurance	Uninsured	6914	9.64
	Private	41547	57.93
	Medicaid	10534	14.69
	Medicare	12729	17.75
Income	<36-k	27412	40.16
	>36k	40841	59.84
Education	<20%	34070	49.92
	>20%	34176	50.08
Distance	<30 Miles	56726	81.8
Travelled	30+ Miles	12617	18.2
Facility Type	Community Cancer Program	10828	15.1
	Comprehensive Community Cancer Program	41449	57.79
	Academic/Research Program	19447	27.11
Class of Case	Same Facility	51387	71.65
	Different Facility	20337	28.35
AJCC Stage	Stage III	23497	32.76
	Stage IV	48227	67.24
Radiation	No	31118	43.59
	Yes	40274	56.41
Chemotherapy	No	9006	13.14
	Yes	59541	86.86

(data not shown within manuscript) demonstrated statistically significant associations with insurance status (p<.000001).[5,6,21]

Kaplan–Meier methods were used to estimate survival curves. Log-rank tests were used to compare the survival distributions in univariate analysis, and the Šidák correction method was used for adjustment in multiple comparisons for the log-rank test where appropriate. Multivariate Cox regression was used to simultaneously estimate the hazard of death (hazard ratio) of payer status while adjusting for other factors (Table IV) and to calculate the direct adjusted median overall survival. All data management, statistical analyses, and modeling was completed using Statistical Software SAS 9.4 (SAS Inc. Gary, NC, USA). All *p*-values of less than 0.05 were considered statistically significant.

Results

Univariate analyses (Table II) present the unadjusted median overall survival (MOS) according to payer status. MOS for the entire cohort was 9.72 months. Privately insured patients, which had a MOS of 10.71 months, demonstrated the longest median overall survival, followed by Medicaid, Medicare, and uninsured patients. MOS stratified by insurance status significantly differed in all groups (p<.0001) except between Medicaid and uninsured patients.

Table II also presents MOS in months according to treatment (p<.0001). The unadjusted MOS was greatest in patients receiving a combination of radiation therapy and chemotherapy (12.52 months), followed by patients receiving chemotherapy only, radiation only, and no treatment.

Table III presents the univariate analysis of direct adjusted survival at 6, 12, and 24 months of patients by payer status and treatment (p<.0001).

Privately insured patients had greater survival than Medicare, Medicaid, and uninsured patients at 6, 12, and 24 months. Among treatment groups, a greater proportion of patients receiving both radiation and chemotherapy were surviving at 6, 12, and 24 months compared

Table II. Unadjusted and Adjusted Median Overall Survival (months) by Payer Status and Treatment

		Unadjusted			Adjusted MOS
	Level	**MOS**	**Lower**	**Upper**	
	All	9.72	9.66	9.79	9.72
Payer Status	Private	10.71	10.61	10.81	10.32
	Medicare	8.25	8.08	8.44	9.00
	Medicaid	8.67	8.48	8.84	9.00
	Uninsured	8.02	7.79	8.25	8.97
Treatment	No treatment	1.51	1.41	1.61	5.72
	Radiation only	3.12	2.89	3.38	6.77
	Chemotherapy only	8.77	8.67	8.87	9.3
	Radiation + Chemotherapy	12.52	12.39	12.62	11.17

to the other treatment groups. Figures I and II present the direct adjusted survival in months according to payer status and treatment regimen throughout the study (p<.0001).

Multivariate Cox regression analysis (Table IV) revealed that demographic, socioeconomic, and cancer stage factors were statistically significant predictors of survival for SCLC, presented as Hazard ratios (HR). There was a statistically significant relationship between payer status and overall survival when controlling for the other variables. Compared to privately insured patients, Medicaid patients had an increased risk of dying of 24%, while Medicare and uninsured patients both had an increased risk of dying of 25%.

Table III. Direct Adjusted Survival at 6, 12, and 24 Months after Diagnosis

		Percent surviving		
	Level	**6 months**	**12 months**	**24 months**
Payer Status	Private	71.96%	42.52%	17.69%
	Medicare	66.71%	35.46%	12.68%
	Medicaid	66.76%	35.52%	12.72%
	Uninsured	66.56%	35.27%	12.55%
Treatment	No treatment	48.09%	15.14%	2.41%
	Radiation only	54.70%	20.61%	4.18%
	Chemotherapy only	68.81%	36.54%	12.11%
	Radiation + Chemotherapy	75.53%	46.55%	19.46%

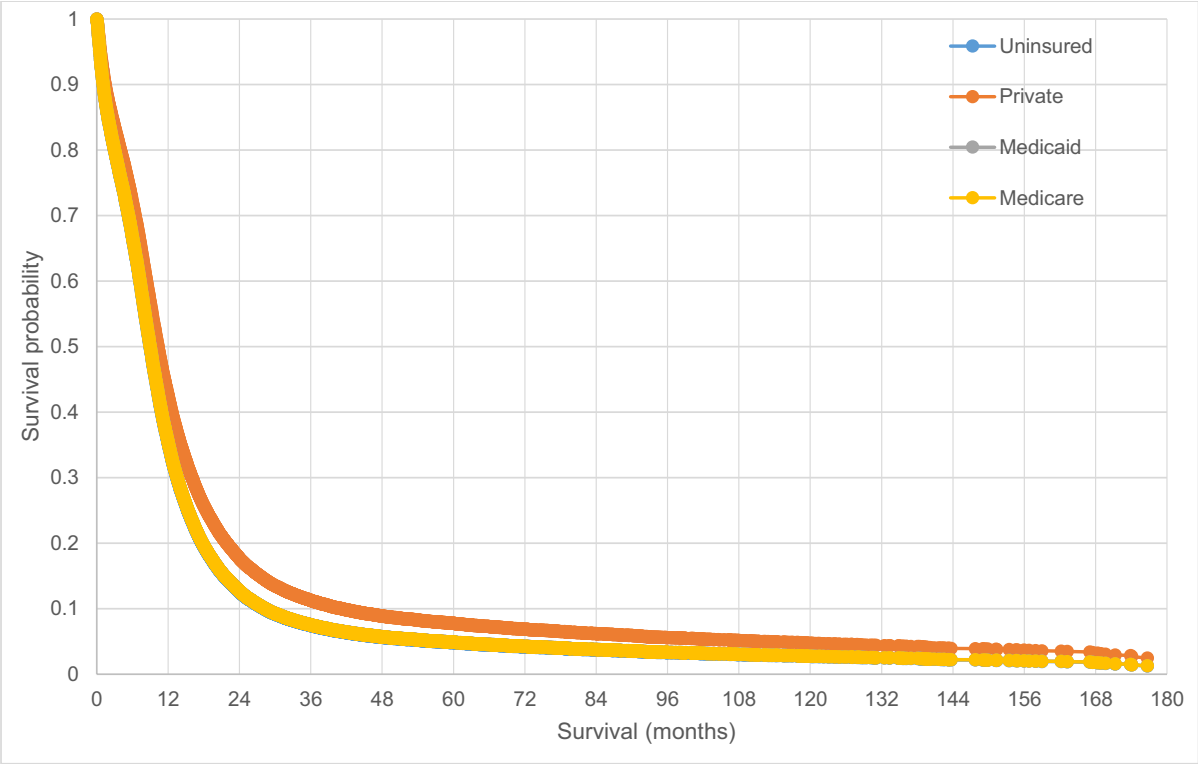

Figure 1. Direct Adjusted Overall Survival According to Payer Status

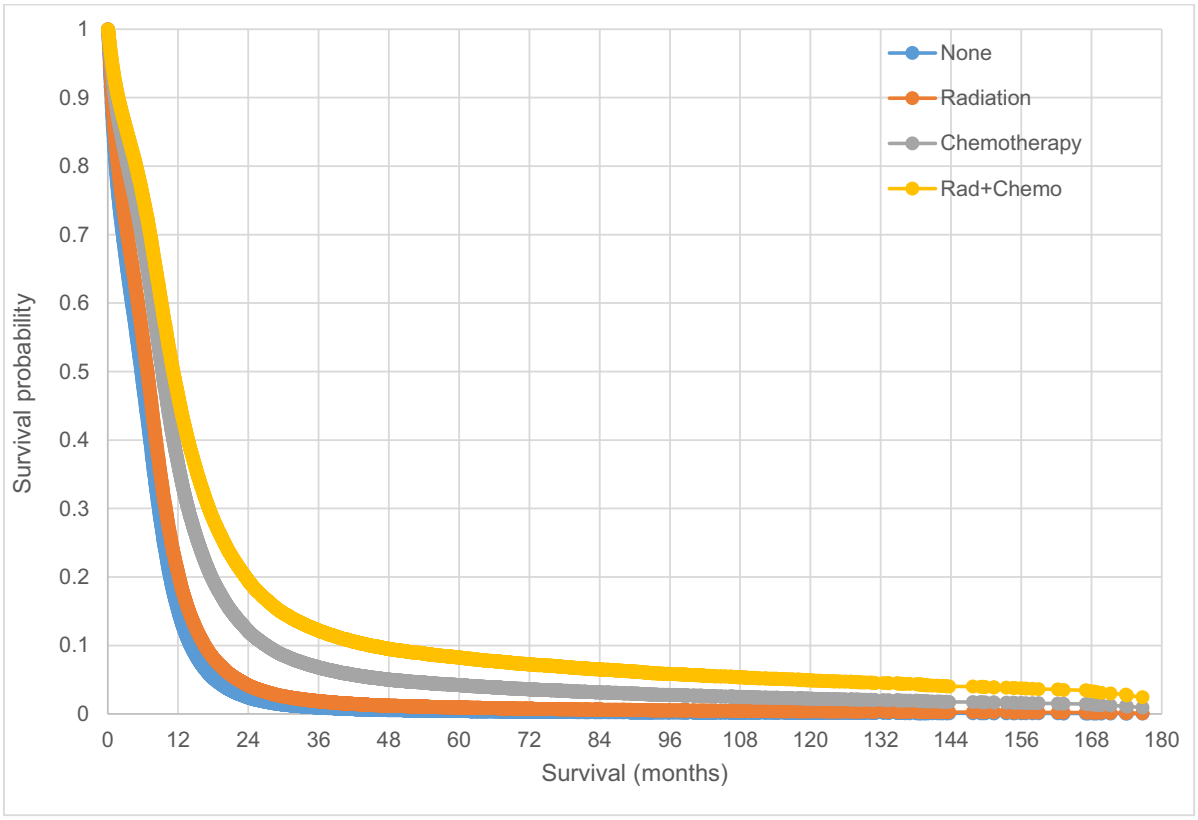

Figure 2. Direct Adjusted Overall Survival According to Treatment

Many of the variables presented in Table I, except for education level and distance traveled, were also found to be statistically significant predictors of survival. Male patients, older patients aged 56–64 years, patients treated in non-academic facilities, and patients living in zip codes where most residents earn a median yearly income of less than $36,000 were found to have an increased risk of death. Compared to White patients, Asian patients had an 18% (HR=0.82) and Black patients had a 5% (H=0.95) reduced risk of death.

Discussion

In this study, we demonstrated that payer status is a significant predictor of overall survival in SCLC after adjusting for several factors in multivariate analysis. In exploring further (data not shown), we found that treatment, AJCC stage, and the number of comorbidities differed by payer status, offering possible explanations for the results. Cancer stage differed among payer-status groups, with a greater percentage of uninsured and Medicaid patients presenting with stage IV cancer. Privately insured patients also presented with a significantly higher percentage of 0 comorbidities (67.3%), suggesting that privately insured patients tended to be healthier compared to Medicare, Medicaid, and uninsured patients (p<.000001).

Previous studies in other types of cancer corroborated this study's finding that payer status affects survival.[5,7,9,10,11,23,24] Privately insured patients are more likely to be diagnosed at an earlier stage,[25–27] have fewer comorbidities,[24,28] and receive the appropriate treatment[29–31] in comparison to Medicare, Medicaid, and uninsured patients. Additional factors, such as limited access to clinical trials, lower reimbursement rates, higher out-of-pocket drug expenses, and processing delays,[5] could also be contributing to poorer survival outcomes in patients with non-private insurance.

Table IV. Hazard Ratio of Death in Multivariate Cox Regression

Factor	Level	HR	Lower	Upper
Sex	Male	1		
	Female	0.82	0.81	0.84
Age	18–55	1		
	56–64	1.10	1.08	1.12
Race	White	1		
	Black	0.95	0.92	0.98
	Asian	0.82	0.76	0.89
Comorbidity	0	1		
	1	1.14	1.11	1.16
	2	1.38	1.33	1.42
	Unknown	1.12	1.10	1.14
Insurance	Private	1		
	Uninsured	1.25	1.22	1.29
	Medicaid	1.24	1.21	1.27
	Medicare	1.25	1.22	1.27
Income	<36k	1		
	>36k	0.97	0.96	0.99
Education	<20%	1		
	>20%	0.98	0.96	1.00
Distance Travelled	<30 miles	1		
	30+ miles	0.98	0.96	1.00
Facility Type	Academic/Research Program	1		
	Community Cancer Program (CCP)	1.07	1.04	1.09
	Comprehensive CCP	1.03	1.01	1.05
Class of Case	Same Facility	1		
	Different Facility	0.90	0.89	0.92
AJCC stage	Stage III	1		
	Stage IV	2.02	1.99	2.06

Pezzi et al. similarly found, using an NCDB cohort of patients with either limited or extensive-stage SCLC from 2004 to 2013, that Medicaid insurance was not associated with improved survival compared with those who were uninsured. They found that patients with private insurance had greater median overall survival compared to all other payers. In contrast to this study, Pezzi et al. found that patients with Medicare had improved survival compared to Medicaid and uninsured patients. Additional differences between our study and the Pezzi et al. study include

methodological and statistical differences, such as their inclusion of both early and late stage SCLC patients, different dates of data selection, and use of propensity matching.[5] This study further verifies the results from the Pezzi et al. study in that it presents a similar finding despite these differences.

There are several limitations of this study. Though the large sample size allowed for accurate hazard ratio estimation, over 1,500 institutions participated in NCDB data collection, which may have introduced data variability or patient selection bias. Additionally, because the NCDB does not collect smoking history data, we do not know whether differences in survival outcomes are a result of differential smoking behaviors. Education and income were determined based on zip code, which may not be the most accurate measurement. Lead time bias may have been a confounding factor as to why privately insured patients experienced longer survival. The study period overlaps with some Affordable Care Act changes such as Medicaid expansion, which likely impacted the patient demographics within the 'Medicaid' group.[5,32] Additionally, the Charlson Comorbidity Index was not available until 2003. To estimate missing Charlson comorbidity data, we used the zero comorbidity of the 2003 or later cohort as a reference. Finally, our findings did not consider treatment specifics such as dosage, drug type, or duration, and the results can only be generalized to patients under age 65 with stage III/IV SCLC.

Conclusion

Insurance status was a statistically significant predictor of median overall survival in stage III/IV SCLC, indicating the disparity in outcomes based on insurance status that existed before the ACA has continued to persist[5]. Privately insured patients demonstrated the longest adjusted mean overall survival (10.32 months), living 1.3 months longer than Medicaid (MOS=9 months), Medicare (MOS=9 months), and uninsured patients (MOS=8.97 months). Patients receiving a combination of chemotherapy and radiation had a greater adjusted mean overall survival (11.17 months) than other treatment groups. Sex, age, race/ethnicity, income level, and treatment facility were also found to be outcome predictors. This study highlights additional policy work needed to improve SCLC outcomes for patients with non-private insurance.

Author Contributions

RS designed the study, obtained the dataset, performed all data management, and conducted the statistical data analysis. RB drafted the manuscript. RS, HL, and GM assisted with drafting the manuscript. RB, HL, and GM participated in the design of the study and interpretation of the findings. All Authors read and approved the final manuscript.

Ethics Statement

With the support from the Chair of Louisiana State University Hospital in Shreveport (currently University Health Shreveport) Cancer program, RL has applied and has been awarded the NCDB Participant Use Data File (PUF) for 1998 to 2012 from the Commission on Cancer (CoC). The PUF is a Health Insurance Portability and Accountability Act-compliant data file containing cases submitted to the Commission on Cancer's (CoC) NCDB. The PUF contains de-identified patient-level data that do not identify hospitals, healthcare providers, or patients

as agreed to in the Business Associate Agreement that each CoC-accredited program has signed with the American College of Surgeons. The PUFs are designed to provide investigators associated with CoC-accredited cancer programs with a data resource they can use to review and advance the quality of care delivered to cancer patients through analyses of cases reported to the NCDB. NCDB PUFs are only available through an application process to investigators associated with CoC-accredited cancer programs.

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