

Disparities in Stage at Diagnosis, Treatment, and Survival in Nonelderly Adult Patients With Cancer According to Insurance Status

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Terms in [blue](#) are defined in the glossary, found at the end of this article and online at www.jco.org.

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A B S T R A C T

Purpose

The purpose of this study was to determine the association of insurance status with disease stage at presentation, treatment, and survival among the top 10 most deadly cancers using the SEER database.

Patients and Methods

A total of 473,722 patients age 18 to 64 years who were diagnosed with one of the 10 most deadly cancers in the SEER database from 2007 to 2010 were analyzed. A Cox proportional hazards model was used for multivariable analyses to assess the effect of patient and tumor characteristics on cause-specific death.

Results

Overall, patients with non-Medicaid insurance were less likely to present with distant disease (16.9%) than those with Medicaid coverage (29.1%) or without insurance coverage (34.7%; $P < .001$). Patients with non-Medicaid insurance were more likely to receive cancer-directed surgery and/or radiation therapy (79.6%) compared with those with Medicaid coverage (67.9%) or without insurance coverage (62.1%; $P < .001$). In a Cox regression that adjusted for age, race, sex, marital status, residence, percent of county below federal poverty level, site, stage, and receipt of cancer-directed surgery and/or radiation therapy, patients were more likely to die as a result of their disease if they had Medicaid coverage (hazard ratio [HR], 1.44; 95% CI, 1.41 to 1.47; $P < .001$) or no insurance (HR, 1.47; 95% CI, 1.42 to 1.51; $P < .001$) compared with non-Medicaid insurance.

Conclusion

Among patients with the 10 most deadly cancers, those with Medicaid coverage or without insurance were more likely to present with advanced disease, were less likely to receive cancer-directed surgery and/or radiation therapy, and experienced worse survival.

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INTRODUCTION

It is estimated that 15.4% of the US population, representing 48 million individuals, does not have health insurance.¹ The Patient Protection and Affordable Care Act (ACA)² was signed into law in March 2010 and aims to expand access to public and private health insurance.³

Cancer is currently the second leading cause of death in the United States and is responsible for approximately one in four deaths.⁴ Previous studies have shown that uninsured patients with cancer are more likely to present with advanced disease,^{5,6} do not receive the same treatment,⁷⁻⁹ and display worse survival^{7,10-12} compared with those with insurance. However, these studies have generally been limited

to certain populations with select cancers. Estimates of the impact of insurance status on the presentation, treatment, and survival of patients with cancer on a larger scale are lacking.

The SEER program of the National Cancer Institute assembles information on cancer incidence, local treatment, and survival in the United States. SEER program registries collect data on patient demographics, including primary tumor site, tumor morphology and stage at diagnosis, first course of treatment, and follow-up for survival. In addition, this past year, the SEER program released information regarding individual patient insurance status. Registries participating in the SEER program capture approximately 97% of incident cases,¹³ and the population residing within the areas served by SEER

Insurance Status of Patients With Cancer

Table 1. Patient Demographics and Clinical Characteristics

Characteristic	All Patients		Non-Medicaid Insurance		Uninsured		Medicaid Coverage		Unknown		P
	No.	%	No.	%	No.	%	No.	%	No.	%	
All patients	473,722	100.0	371,628	78.4	22,442	4.7	55,135	11.6	24,517	5.2	
Age, years											< .001
Median	56		56		55		55				
Range	18-64		18-64		18-64		18-64				
18-29	5,288	1.1	3,553	1.0	437	1.9	1,040	1.9	258	1.1	
30-39	20,321	4.3	15,113	4.1	1,245	5.5	3,085	5.6	878	3.6	
40-49	85,957	18.1	65,893	17.7	4,596	20.5	11,833	21.5	3,635	14.8	
50-59	213,497	45.1	167,395	45.0	10,173	45.3	24,802	45.0	11,127	45.4	
≥ 60	148,659	31.4	119,674	32.2	5,991	26.7	14,375	26.1	8,619	35.2	
Percent of county below poverty											< .001
< 10	111,857	23.6	94,353	25.4	3,643	16.2	7,343	13.3	6,518	26.6	
10-12.99	111,520	23.5	91,443	24.6	3,985	17.8	10,482	19.0	5,610	22.9	
13-16.49	141,156	29.8	107,197	28.8	7,850	35.0	19,327	35.1	6,782	27.7	
≥ 16.5	109,041	23.0	78,591	21.1	6,960	31.0	17,980	32.6	5,510	22.5	
Unknown	148	0.0	44	0.0	4	0.0	3	0.0	97	0.4	
Sex											< .001
Female	235,238	49.7	185,171	49.8	9,972	44.4	31,676	57.5	8,419	34.3	
Male	238,484	50.3	186,457	50.2	12,470	55.6	23,459	42.5	16,098	65.7	
Race											< .001
White	317,903	67.1	263,124	70.8	12,060	53.7	27,056	49.1	15,663	63.9	
Black	65,961	13.9	45,350	12.2	5,092	22.7	12,596	22.8	2,923	11.9	
Hispanic	49,344	10.4	32,930	8.9	3,718	16.6	10,314	18.7	2,382	9.7	
Asian or Pacific Islander	31,852	6.7	25,419	6.8	1,364	6.1	4,002	7.3	1,067	4.4	
American Indian/Alaska native	2,639	0.6	1,444	0.4	75	0.3	979	1.8	141	0.6	
Unknown	6,023	1.3	3,361	0.9	133	0.6	188	0.3	2,341	9.5	
Marital status											< .001
Single	162,265	34.3	108,626	29.2	12,965	57.8	35,439	64.3	5,235	21.4	
Married	280,578	59.2	245,813	66.1	8,430	37.6	17,367	31.5	8,968	36.6	
Unknown	30,879	6.5	17,189	4.6	1,047	4.7	2,329	4.2	10,314	42.1	
Residence											< .001
Rural	416,346	88.0	331,564	89.3	18,561	82.7	45,618	83.3	20,603	84.2	
Urban	56,638	12.0	39,861	10.7	3,872	17.3	9,129	16.7	3,776	15.4	
Unknown	148	0.0	44	0.0	4	0.0	3	0.0	97	0.4	
Tumor stage*											< .001
0	3,389	0.8	2,617	0.7	157	0.8	379	0.7	236	1.0	
1	147,049	33.1	123,125	35.3	4,307	20.8	13,296	25.6	6,321	28.0	
2	135,706	30.6	111,140	31.9	4,637	22.4	13,176	25.3	6,753	30.0	
3	68,029	15.3	53,031	15.2	4,259	20.6	8,909	17.1	1,830	8.1	
4	48,065	10.8	32,373	9.3	4,433	21.4	9,901	19.0	1,358	6.0	
Unknown	41,945	9.4	26,662	7.6	2,907	14.0	6,329	12.2	6,047	26.8	
Nodal stage*											< .001
0	271,920	61.2	223,777	64.1	9,867	47.7	24,982	48.1	13,294	59.0	
1	72,889	16.4	57,140	16.4	3,764	18.2	10,094	19.4	1,891	8.4	
2	50,455	11.4	36,542	10.5	3,650	17.6	8,961	17.2	1,302	5.8	
3	15,339	3.5	10,854	3.1	1,088	5.3	3,003	5.8	394	1.7	
Unknown	33,580	7.6	20,635	5.9	2,331	11.3	4,950	9.5	5,664	25.1	
Metastasis*											< .001
No	349,453	78.7	285,654	81.9	13,019	62.9	35,576	68.4	15,204	67.4	
Yes	70,947	16.0	49,030	14.1	6,293	30.4	13,346	25.7	2,278	10.1	
Unknown	23,783	5.4	14,264	4.1	1,388	6.7	3,068	5.9	5,063	22.5	
Ann Arbor lymphoma staging*											< .001
1	8,441	28.6	6,684	29.5	390	22.4	761	24.2	606	31.1	
2	4,454	15.1	3,564	15.7	275	15.8	474	15.1	141	7.2	
3	4,562	15.5	3,613	16.0	323	18.6	492	15.7	134	6.9	
4	9,897	33.6	7,531	33.3	670	38.5	1,244	39.6	452	23.2	
Unknown	2,125	7.2	1,253	5.5	83	4.8	171	5.4	618	31.7	

(continued on following page)

Table 1. Patient Demographics and Clinical Characteristics (continued)

Characteristic	All Patients		Non-Medicaid Insurance		Uninsured		Medicaid Coverage		Unknown		P
	No.	%	No.	%	No.	%	No.	%	No.	%	
Cancer-directed surgery and/or radiation therapy											< .001
No	114,473	24.2	75,809	20.4	8,506	37.9	17,698	32.1	12,460	50.8	
Yes	359,249	75.8	295,819	79.6	13,936	62.1	37,437	67.9	12,057	49.2	
Malignancy											NA
Breast	135,736	28.7	111,948	30.1	3,458	15.4	16,317	29.6	4,013	16.4	
Prostate	101,899	21.5	86,477	23.3	2,515	11.2	3,718	6.7	9,189	37.5	
Lung	66,918	14.1	47,326	12.7	5,036	22.4	12,036	21.8	2,520	10.3	
Colorectal	61,116	12.9	46,971	12.6	4,088	18.2	7,046	12.8	3,011	12.3	
Head and neck	29,691	6.3	21,335	5.7	2,125	9.5	4,501	8.2	1,730	7.1	
NHL	29,539	6.2	22,680	6.1	1,742	7.8	3,145	5.7	1,972	8.0	
Liver	16,541	3.5	10,659	2.9	1,247	5.6	3,788	6.9	847	3.5	
Pancreas	13,687	2.9	10,168	2.7	917	4.1	1,996	3.6	606	2.5	
Ovary	12,340	2.6	9,561	2.6	858	3.8	1,570	2.8	351	1.4	
Esophagus	6,255	1.3	4,503	1.2	456	2.0	1,018	1.8	278	1.1	

Abbreviations: NA, not available; NHL, non-Hodgkin lymphoma.
*TNM staging applies to all tumors except NHL.

cancer registries is comparable to the general US population, because the catchments for the 18 SEER registries comprise approximately 28% of the US population.¹⁴

The purpose of this study was to determine the association of insurance status with disease stage at presentation, treatment, and survival among non-Medicare-age adult patients diagnosed with one of the 10 most deadly cancers using the SEER public-use database.

PATIENTS AND METHODS

Description of Study Cohort

A total of 1,069,590 patients who were diagnosed with one of the 10 most deadly cancers (ie, breast, prostate, lung, colorectal, head and neck, liver, pancreatic, ovarian, and esophageal cancers and non-Hodgkin lymphoma [NHL]) between January 1, 2007, and December 31, 2010, were identified in the public-use SEER database using SEER Stat software (version 8.1.2).¹⁵ SEER began collecting information on insurance status in 2007. Patients were excluded if age at diagnosis was < 18 years (n = 1,786) or if they did not undergo active follow-up (ie, death certificates or autopsy results only; n = 2,103). Patients age > 64 years (n = 591,979) were excluded, because this is the age at which most patients become eligible for Medicare, and per the SEER program, designation of insurance status is unreliable for these patients. Because this data set is in the public domain, it was deemed institutional review board exempt.

Key Covariates

Patient characteristics included age, race, sex, marital status, and urban versus rural residence. Married status, as defined by the SEER database, includes common-law marriages. Urban was defined as big metropolitan, metropolitan, or urban, and rural was defined as less urban or rural, using SEER definitions. Insurance status was defined as non-Medicaid insurance (insured or insured/no specifics), Medicaid coverage (any Medicaid), or uninsured. The SEER definition for insured includes those with private insurance (managed care, health maintenance organization, or preferred-provider organization), Medicare, and coverage from the military or Veterans Affairs at the time of initial diagnosis and/or treatment. Patients with unknown insurance status were excluded from further analysis. Robustness of the multivariable Cox proportional hazards model (Statistical Analysis) was tested using sensitivity analysis by categorizing patients with unknown insurance status as all having non-Medicaid insurance, Medicaid insurance, or

uninsured, with similar results. Percent below federal poverty level was obtained from linked county-level data.¹⁶ Stage was based on the American Joint Committee on Cancer staging atlas (sixth edition).¹⁷ Extent of disease was based on TNM staging and categorized as localized (no nodal or metastatic disease), regional (nodal disease), or distant (any metastatic disease). The exception was NHL, for which Ann Arbor staging was used: local (stage I), regional (stage II to III), and distant (stage IV).

Treatment Course and Outcomes

Patients who received external-beam radiation therapy (RT) and surgery were identified based on SEER variables. Receipt of RT was defined as beam radiation (SEER codes: beam radiation or combination of beam with implants or isotopes). For prostate cancer, RT receipt also included brachytherapy (SEER code: radioactive implants). Surgery was defined as definitive in nature using SEER surgical codes, excluding those who underwent biopsy only. Site-specific cancer-directed surgery and/or RT was defined as surgery (breast, colorectal, liver, ovarian, and pancreatic cancers), surgery and/or RT (esophageal, head and neck, lung, and prostate cancers), or RT (NHL). SEER does not include information on receipt of chemotherapy, which can be definitive treatment for some disease sites (eg, NHL). Cause-specific survival was defined as the time between diagnosis and death resulting from the primary cancer through December 31, 2010.

Statistical Analysis

Pearson's χ^2 statistic was used to assess significance of the difference between proportions in assessment of univariable associations. Unadjusted associations between insurance groups and outcomes were displayed using Kaplan-Meier curves and compared using the log-rank test.

A multivariable logistic regression model was used to determine the association between insurance status and receipt of cancer-directed surgery and/or RT among patients with nonmetastatic disease. Patients with metastatic disease were not included in this analysis, because chemotherapy (not available in SEER) is generally the primary treatment for these patients. All sites were adjusted for age, race, sex, marital status, urban versus rural residence, and percent of county below federal poverty level. The estimated odds ratio (OR) is reported.

The Cox proportional hazards model was used for both univariable and multivariable analyses to assess the effect of patient and tumor characteristics on the end point of cause-specific death stratified by insurance status. All sites were controlled for age, race, sex, marital status, urban versus rural residence, percent of county below federal poverty level, disease stage (local, regional, or distant), and receipt of cancer-directed surgery and/or RT. In addition, breast and prostate sites were controlled for other factors: estrogen receptor and

Insurance Status of Patients With Cancer

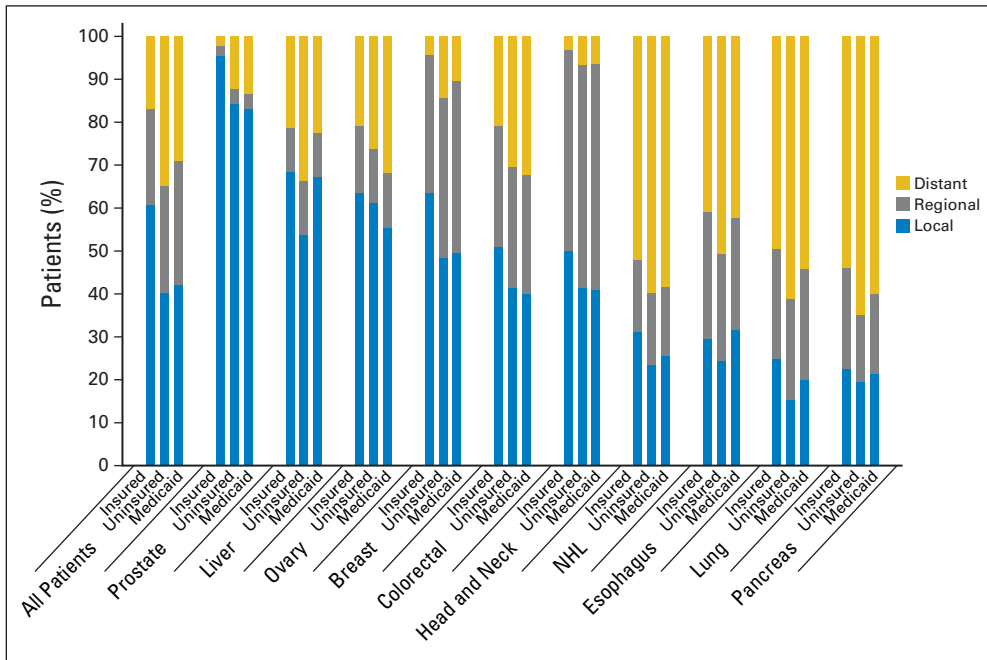


Fig 1. Proportion of patients presenting with localized, regional, or distant disease by insurance status. All $P < .001$. For non-Hodgkin lymphoma (NHL), Ann Arbor stage I disease was considered localized, stage II to III disease was considered regional, and stage IV disease was considered distant.

prostate-specific antigen and Gleason score, respectively. The estimated hazard ratio (HR) is reported.

A P value $\leq .05$ was considered to be statistically significant. Statistical tests were based on a two-sided significance level. Data analysis was performed using STATA/IC statistical software (version 12.1; STATA, College Station, TX).

RESULTS

A total of 473,722 patients met the inclusion criteria. Patient demographics and tumor characteristics of the 473,722 eligible patients are listed in Table 1. Median follow-up was 17 months (range, 0 to 47 months). A total of 371,628 (78.4%) had non-Medicaid insurance, 55,135 (11.6%) had Medicaid coverage, 22,442 (4.7%) did not have

insurance, and 24,517 (5.2%) had unknown insurance status. On univariable analysis, the following demographic factors were associated with lack of insurance: younger age, male sex, nonwhite race, being unmarried, rural residence, and higher county poverty level (all $P < .001$). A total of 55.6% of the uninsured were men. Although nonwhite individuals represented 32.9% of the cohort, they represented 46.3% of uninsured and 50.9% of those with Medicaid coverage ($P < .001$). Patients who were single represented 34.3% of the cohort, but they comprised 57.8% of the uninsured and 64.3% of those with Medicaid coverage ($P < .001$).

Stage at Diagnosis

Overall, patients with non-Medicaid insurance were less likely to present with distant disease (16.9%) than those without any insurance

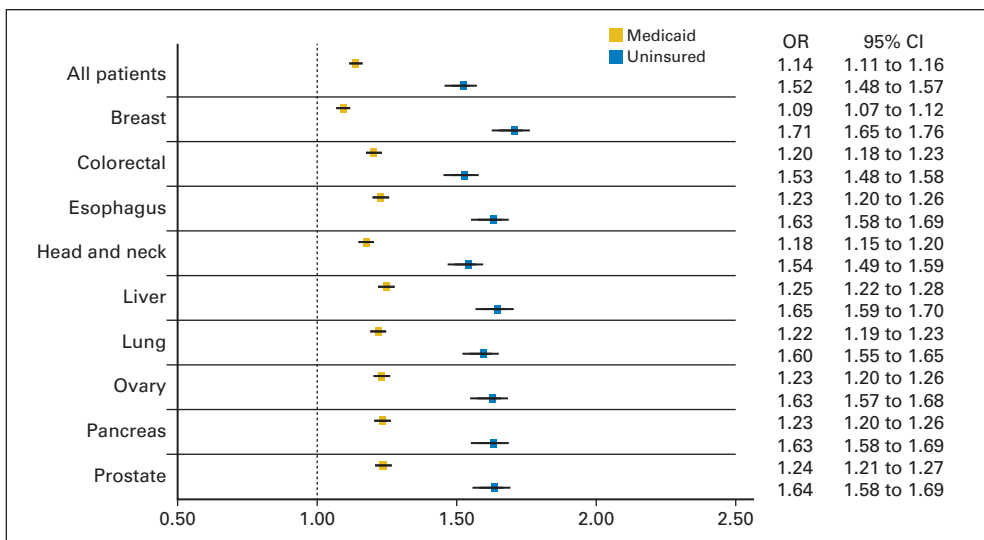


Fig 2. Forest plot depicting odds ratios (ORs) and 95% CIs for not undergoing cancer-directed surgery and/or receiving radiation therapy for patients with nonmetastatic disease with Medicaid coverage and those with no insurance as compared with patients with non-Medicaid insurance. All sites controlled for age, race, sex, marital status, residence (urban v rural), and percent of county below federal poverty level.

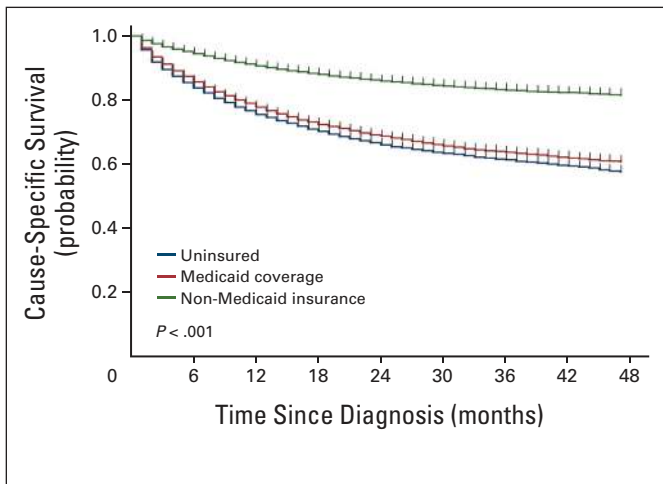


Fig 3. Unadjusted Kaplan-Meier curve illustrating cause-specific survival by insurance status for patients with one of 10 most deadly cancers. $P < .001$.

coverage (34.7%). Correspondingly, patients with non-Medicaid insurance were more likely to present with localized disease (60.8%) compared with those without insurance coverage (40.3%; $P < .001$). Of patients with Medicaid coverage, an intermediate proportion presented with distant (29.1%) and localized (42.2%) disease. Proportions of patients presenting with distant, regional, and localized disease for all patients and by cancer site are summarized in Figure 1.

Cancer-Directed Treatment

Among those with nonmetastatic disease, 50.5% underwent surgery alone, 13.8% received RT alone, and 22.4% both underwent surgery and received RT. Patients with non-Medicaid insurance were more likely to undergo cancer-directed surgery and/or receive RT (79.6%) as compared with those without insurance coverage (62.1%; $P < .001$). Again, patients with Medicaid coverage had an intermedi-

ate proportion who received definitive treatment (67.9%; Appendix Fig A1, online only). In a logistic regression that adjusted for demographics, patients with nonmetastatic disease were more likely to not undergo cancer-directed surgery and/or receive RT if they lacked insurance (OR, 1.52; 95% CI, 1.48 to 1.57; $P < .001$) or had Medicaid coverage (OR, 1.14; 95% CI, 1.11 to 1.16; $P < .001$; Fig 2).

Cause-Specific Survival

Unadjusted 2-year cause-specific survival among those with non-Medicaid insurance was 86.2%, compared with 69.1% among those with Medicaid coverage and 66.5% among those without insurance coverage ($P < .001$; Fig 3). In a Cox regression that adjusted for demographics, site, stage (local, regional, or distant), and undergoing cancer-directed surgery and/or receiving RT, patients were more likely to die as a result of their disease if they had Medicaid coverage (HR, 1.44; 95% CI, 1.41 to 1.47; $P < .001$) or did not have insurance (HR, 1.47; 95% CI, 1.42 to 1.51; $P < .001$) compared with those with non-Medicaid insurance (Fig 4). Among all patients, the following were associated with increased risk of death: Medicaid coverage or no insurance, older age, male sex, black race, single marital status, advanced disease stage, rural residence, increased county poverty level, and lack of cancer-directed surgery and/or RT (Table 2). Moreover, there was variability in risk of death according to disease site.

DISCUSSION

This study analyzed the association of insurance status with disease stage at presentation, treatment, and survival among patients diagnosed with one of the 10 most deadly cancers and is the first to do so, to our knowledge, using the SEER data set. We found that those with Medicaid coverage or without insurance were more likely to present with advanced-stage disease and less likely to undergo cancer-directed surgery and/or receive RT for nonmetastatic disease. In addition, we found that patients with Medicaid coverage or without insurance had

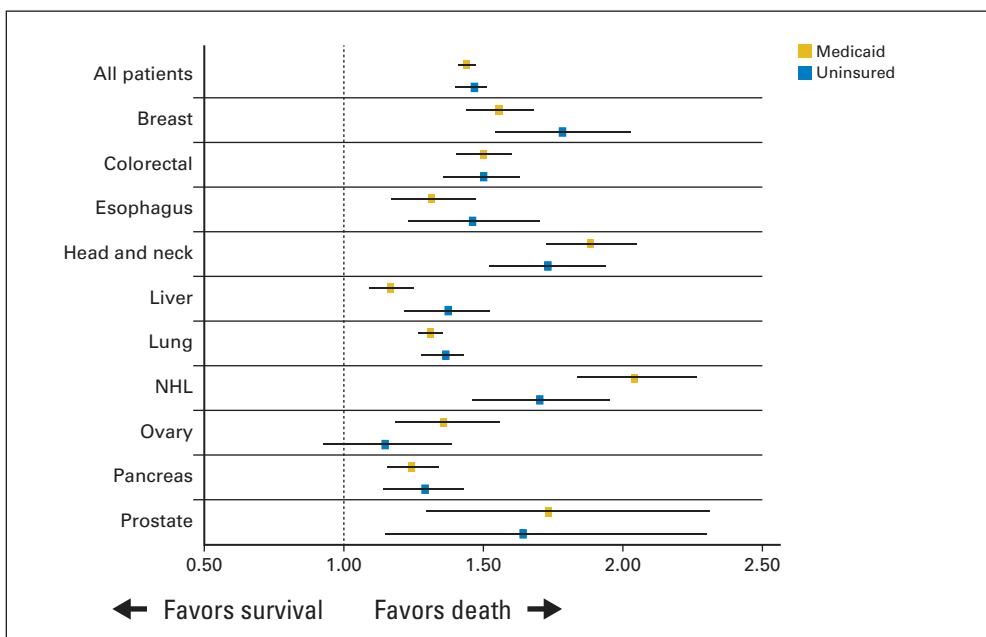


Fig 4. Forest plot depicting hazard ratios and 95% CIs for cancer-specific death for patients with Medicaid coverage and those with no insurance as compared with patients with non-Medicaid insurance. All sites controlled for age, race, sex, marital status, stage (local, regional, or distant), residence (urban v rural), percent of county below federal poverty level, and undergoing cancer-directed surgery and/or receiving radiation therapy. Breast and prostate sites also controlled for estrogen receptor and prostate-specific antigen and Gleason score, respectively. NHL, non-Hodgkin lymphoma.

Table 2. Results of Multivariable Analysis to Determine Predictors of Cancer-Specific Mortality

Variable	HR	95% CI	P
Insurance status			
Non-Medicaid insurance	1		
Medicaid coverage	1.44	1.41 to 1.47	< .001
Uninsured	1.47	1.42 to 1.51	< .001
Age			
Continuous	1.01	1.01 to 1.01	< .001
Sex			
Female	1		
Male	1.26	1.24 to 1.29	< .001
Race			
White	1		
Black	1.15	1.12 to 1.17	< .001
Hispanic	1.00	0.97 to 1.03	.83
Asian or Pacific Islander	0.89	0.86 to 0.92	< .001
American Indian/Alaska native	1.08	0.96 to 1.21	.20
Unknown	0.54	0.44 to 0.67	< .001
Marital status			
Married	1		
Single	1.23	1.21 to 1.25	< .001
Disease site			
Breast	1		
Prostate	0.42	0.39 to 0.45	< .001
Lung	8.05	7.76 to 8.36	< .001
Colorectal	2.63	2.52 to 2.74	< .001
Head and neck	3.44	3.28 to 3.61	< .001
NHL	0.83	0.79 to 0.88	< .001
Liver	13.18	12.59 to 13.79	< .001
Pancreas	11.74	11.24 to 12.26	< .001
Ovary	4.01	3.78 to 4.24	< .001
Esophagus	9.01	8.53 to 9.51	< .001
Disease stage			
Local	1		
Regional	2.59	2.52 to 2.67	< .001
Distant	7.32	7.13 to 7.51	< .001
Residence			
Urban	1		
Rural	1.06	1.04 to 1.09	< .001
Percent of county below federal poverty level			
Continuous	1.01	1.01 to 1.02	< .001
Cancer-directed surgery and/or radiation therapy			
Yes	1		
No	1.63	1.60 to 1.67	< .001

Abbreviations: HR, hazard ratio; NHL, non-Hodgkin lymphoma.

worse survival, even after controlling for demographic information, stage at diagnosis, and undergoing cancer-directed surgery and/or receiving RT.

It has been estimated that among adults age 19 to 64 years surveyed in 2010, 16% were underinsured and 28% were uninsured in the United States.¹⁸ Underinsured status is designated based on a patient's having high out-of-pocket medical costs in relation to his or her income. In total, 44% of adults age 19 to 64 years are uninsured or underinsured, amounting to 81 million individuals. As a result of the ACA, subsidies will expand access to public and private health insurance for individuals with lower incomes, and limitations to coverage resulting from preexisting conditions will be removed. In addition,

dependents can retain their parents' insurance plans until their 26th birthday. It is estimated that the ACA could result in a 70% reduction in the number of underinsured individuals as well as a 60% drop in the number of uninsured individuals.¹⁸ Expanded access to insurance coverage and expanded services available through participating state Medicaid plans will likely affect cancer care.

Our study found that patients with Medicaid coverage seemed to have intermediate proportions presenting with later stages of disease and receiving local treatment as compared with the insured and uninsured cohorts; however, although there was some variability by cancer site, those with Medicaid seemed to have only marginally improved survival as compared with those who were uninsured after accounting for stage at presentation and undergoing cancer-directed surgery and/or receiving RT. Some of this survival discrepancy may be attributed to the interruptions in coverage to which Medicaid patients can be subject. That said, previous research has demonstrated that on a more global scale, the expansion of Medicaid programs is associated with improved self-reported health and reduced mortality.¹⁹ This suggests that the implementation of Medicaid may have differential effects on survival outcomes from cancer and noncancer diagnoses.

Nonetheless, as part of the ACA, enrollment in Medicaid is expected to expand. Currently, only 63% of eligible adults age 19 to 64 year enroll in Medicaid, with wide geographic differences in use.²⁰ With the expansions under the ACA, enrollment is expected to increase from approximately 55 million to 105 million by 2019.²¹ The Breast and Cervical Cancer Prevention and Treatment Act of 2000 allowed states to extend Medicaid eligibility to women diagnosed with breast or cervical cancer through federally funded screening programs. Since its adoption, every state has adopted this optional Medicaid expansion, although there has been some variation in timing and implementation.²² No other patients with a particular cancer type have expanded access to Medicaid. However, despite this expanded access, we found that although patients with breast cancer with Medicaid coverage presented with earlier-stage disease and more often underwent cancer-directed surgery and/or received RT as compared with uninsured patients with breast cancer, cause-specific survival among patients with breast cancer with Medicaid was similar to that among those who were uninsured (after accounting for stage at presentation and undergoing cancer-directed surgery and/or receiving RT).

Data from the National Cancer Database (NCDB), a hospital-based cancer registry, have previously shown that uninsured patients are more likely to present with advanced-stage disease in lung,⁷ breast,²³ prostate,²⁴ cervical,²⁵ head and neck,^{8,26} and other cancer types.^{5,6} Uninsured patients are less likely to receive definitive treatment in lung,⁷ breast,⁹ and bladder cancers.²⁷ In addition, worse survival among those without insurance has been demonstrated for a variety of cancer types.¹⁰⁻¹² However, these studies looked only at specific cancers and were not as broad in scope as our work. Moreover, the NCDB represents only patients treated in a hospital setting and does not capture patients treated exclusively as outpatients. It is possible that patients with early-stage disease are more likely to be diagnosed and treated exclusively in freestanding centers and thus would not be captured by the NCDB. In addition, a significant portion of patients without health insurance may not be treated at participating centers accredited by the Commission on Cancer of the American College of Surgeons and thus would not be included in these studies. Finally, it is not known how representative the population included in

the NCDB is of the entire US population. Conversely, the SEER data set has been shown to be representative of the US population with regard to income and education, although it does tend to have a higher proportion of foreign-born individuals.²⁸ One study from 2013 did look at the association of insurance status with outcomes in the SEER data set; however, it used county-level data to estimate insurance rates.²⁹

Our study has certain limitations as a function of the data set used. For one, the SEER database does not report patient-level income, and therefore, we used county-level income data as a surrogate for patient socioeconomic status. Moreover, the SEER registry does not contain information on comorbid conditions or performance status, staging workup, or use of systemic therapy, which influence cause-specific survival and for which we could not adjust our analysis. Nonetheless, it is unlikely that insurance status is merely a surrogate for receipt of chemotherapy, because 52% of patients underwent surgery and 39% received RT in our cohort despite not having insurance coverage. Of note, patients who undergo definitive surgery may undergo more extensive preoperative workup as well more complete intraoperative and pathologic staging, which could have influenced the results of this analysis. In addition, the SEER insurance variable does not further subdivide those with insurance (managed care, health maintenance organization, or preferred provider organization), Medicare, and coverage from the military or Veterans Affairs. Some patients who may have enrolled in Medicaid or other insurance after their diagnosis may not have been correctly captured in this data set. This could potentially dilute the discrepancies in presentation, treatment, and survival among those who have Medicaid coverage and the uninsured. There is evidence that those who enroll in Medicaid around the time of diagnosis present with more-advanced disease³⁰ and display worse survival³¹ compared with those who were previously enrolled in Medicaid. In addition, 5.2% of patients had unknown insurance status, although on sensitivity analysis, this did not influence the results of the multivariable survival model. Finally, given the lack of specificity in Medicare designation in the SEER data set, we were unable to make conclusions about patients age ≥ 65 years.

Despite our findings, it is unknown to what degree the expansion of private and public health insurance will improve cancer outcomes. Some patients who do not have access to health insurance or who do not actively enroll in Medicaid may be subject to other barriers (lack of transportation, poor social support, and so on) that may limit their ability to receive care. Similarly, they may have financial barriers that limit their ability to pay rising deductibles and copays, which are required to use insurance. Moreover, these patients are more likely to be disabled and suffer from psychiatric or other comorbidities.³¹ Such factors may contribute to more-advanced disease presentation, inadequate treatment, and ultimately worse survival. Thus, providing health insurance among some members of the population may not inherently lead to improved outcomes. Moreover, it is quite possible

that different types of cancer will be differentially affected by the proposed expansions to private and public health insurance. At least among the top 10 causes of cancer death, we noted that lung cancer had the highest proportion of uninsured patients (22.4%; Table 1).

Nonetheless, further research to explore the interaction between insurance status and cancer outcomes is undoubtedly warranted. Given the poor outcomes noted among patients with cancer with Medicaid, it would be helpful to know to what degree this is a result of patient, tumor, or treatment-related factors. Such information will be key in the improvement of cancer outcomes in this cohort of patients. Similarly, given the barriers to cancer care that many patients experience, further research is needed to identify ways to improve cancer detection, increase the rate of cancer-directed therapy, and improve outcomes.

In summary, lack of insurance is associated with advanced disease stage at presentation, less use of cancer-directed surgery and/or RT, and worse survival among patients diagnosed with one of the 10 most deadly cancers in this large, population-based data set. Upcoming changes resulting in the expansion of private insurance and Medicaid will likely alter cancer care in the United States. Further research will be required to determine if and to what degree the presentation, treatment, and outcomes of cancer are affected.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

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GLOSSARY TERMS

Surveillance, Epidemiology, and End Results

(SEER): a national cancer registry that collects information from all incident malignancies in multiple geographic areas of the United States.

Appendix

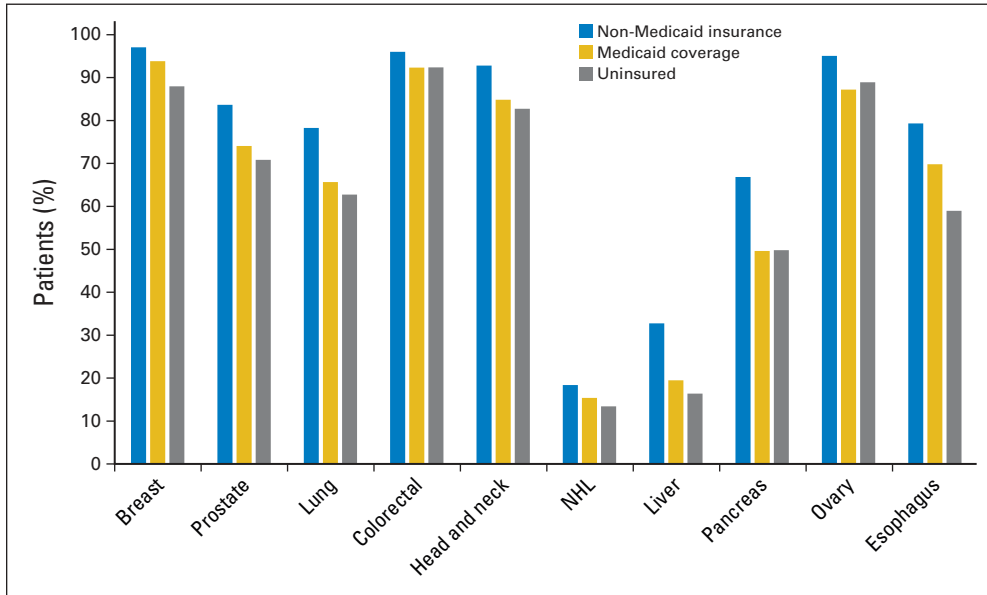


Fig A1. Proportion of patients with nonmetastatic disease treated with cancer-directed surgery and/or radiation therapy by insurance status. NHL, non-Hodgkin lymphoma.