

Influence of Health Care Systems on Mortality in Adult Patients With Cancer

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Inadequate health insurance coverage is a major contributor to disparities in cancer outcomes.¹⁻⁵ Other potential factors include tumor biology differences, health literacy, difficulties navigating the health care system, and providers' implicit bias.⁶⁻⁸ Optimal cancer care is complex, but integrated health care systems may provide advantages by facilitating care coordination among providers compared with other systems of care. For example, the Veterans Affairs health care system, an integrated health care system (IHS), has mitigated some of the racial/ethnic health disparities in its population.⁹ A study reported that patients treated in a National Cancer Institute Comprehensive Cancer Center (NCICCC) had better overall survival compared with those who received care in the community.¹⁰ However, that study also noted that less than 6% of patients in Los Angeles County receive care at NCICCCs and that this population includes fewer minorities and more affluent patients.¹⁰ Thus, we aimed to examine overall survival of insured patients diagnosed with cancer within the largest vertically integrated health care system in southern California, Kaiser Permanente Southern California (KPSC), compared with insured patients diagnosed in other hospitals, which included community, academic, and NCICCC hospitals in the same geographic region. We evaluated differences in overall mortality between the 2 patient groups and specifically by race/ethnicity and socioeconomic status (SES) groups.

METHODS

Subjects and Study Design

This retrospective cohort study included all insured adults (≥ 20 years) in southern California diagnosed with 8 common cancers (breast, prostate, lung, colon, melanoma, endometrium, kidney, and bladder) between January 1, 2009, and December 31, 2014, using data from the California Cancer Registry (CCR), and followed through December 31, 2017 (maximum of 9 years). Data were collected from 7 counties: Imperial, Kern, Los Angeles, Orange, Riverside, San Bernardino, and San Diego. Additional inclusion criteria included the cancer being diagnosed at invasive stages (American Joint Committee on Cancer tumor/node/metastasis stages 0-IV) and the patient having

ABSTRACT

OBJECTIVES: We compared all-cause mortality in insured patients with cancer who were diagnosed in Kaiser Permanente Southern California (KPSC), the largest integrated health care delivery system in southern California, with that in patients diagnosed in hospitals that serve other private insurance (OPI) plans.

STUDY DESIGN: Retrospective cohort study.

METHODS: Using the California Cancer Registry, we conducted a cohort analysis of all insured adults diagnosed between 2009 and 2014 with 8 common cancers (breast, prostate, lung, colon, melanoma, endometrium, kidney, and bladder) and followed them through December 2017. The cohort comprised 164,197 patients with cancer. We calculated person-year mortality rates by health care system (KPSC and OPI), and we estimated adjusted HRs for the association between overall mortality and health care system using Cox proportional hazards models accounting for race/ethnicity, demographics, cancer site, tumor characteristics, payer, cancer treatments, and socioeconomic status.

RESULTS: We observed 41,727 deaths during the 9 years of follow-up. We found that the patients diagnosed in KPSC had lower overall mortality rates than in the OPI group, a difference that also held within each age category, racial/ethnic group, and stage at diagnosis. In multivariable models adjusting for relevant covariates, African American/Black patients (adjusted HR, 1.14; 95% CI, 1.06-1.21) and Hispanic patients (adjusted HR, 1.23; 95% CI, 1.16-1.30) in the OPI group had dramatically higher mortality risks than those diagnosed in KPSC.

CONCLUSIONS: Among insured patients with cancer in southern California, those diagnosed within KPSC had lower overall mortality compared with the OPI group. Furthermore, this protective effect was greatest for African American/Black patients and Hispanic patients.

Am J Manag Care. 2021;27(5):182-185. doi:10.37765/ajmc.2021.88631

health insurance coverage. Health insurance coverage included those with the following: IHS/managed care, preferred provider organization, Medicare, Medicaid, dual coverage (Medicare and Medicaid), and other private insurance. The study was approved by internal review boards (IRBs) of KPSC and the State of California. Each IRB waived the requirement for written or verbal consent due to the deidentified nature of the data.

Independent Variable

We divided our data set of insured patients into (1) those whose cancers were diagnosed in the largest integrated health care delivery system in southern California, KPSC, which provides insurance and health care to approximately 25% of the insured population; and (2) those with other private insurance (OPI) whose cancers were diagnosed at other community, academic, NCICCC, and non-KPSC hospitals. KPSC includes 4.6 million patients, 13 hospitals, more than 200 clinics, and more than 8000 primary and specialty care physicians.

Main Outcomes and Covariates

The main outcome was all-cause (overall) mortality, and subjects were followed through December 31, 2017. Dates of death and all variables were also ascertained from the CCR. A main covariate of interest included race/ethnicity (non-Hispanic White, African American/Black, Hispanic, Asian/Pacific Islander, Native American, other/mixed/unknown) coded according to the North American Association of Central Cancer Registries algorithm.¹¹ Other covariates extracted included age and stage at diagnosis, sex, diagnosis year, anatomic cancer site, primary cancer therapy (surgery), adjuvant therapy (receipt of chemotherapy, radiation therapy, and/or hormonal therapy), health insurance source, SES, and county of residence.

Statistical Analysis

We examined frequencies and percentages of all variables, then calculated person-year (PY) mortality rates (using patients' time at risk as the denominator) and 95% CIs by health care system. Multivariable adjusted HRs for the association between type of health care system (KPSC or OPI) and overall mortality were estimated using multivariable Cox proportional hazards models. In the Cox models, patients were followed up to date of death or December 31, 2017, whichever occurred first. The proportional hazards assumption was evaluated via Schoenfeld residuals; no significant violation was found. All analyses were performed using SAS version 9.4 (SAS Institute).

RESULTS

A total of 164,197 adults were diagnosed with cancers of the breast, prostate, lung, colon, melanoma, endometrium, kidney, and bladder in southern California between 2009 and 2014. A total of 41,727 deaths occurred during the ensuing 9 follow-up years. About 28.6% of patients were diagnosed at KPSC and 71.4% in the OPI group, reflecting approximately the baseline patient distributions within each group. **Table 1** shows the distribution of the patients

TABLE 1. Demographic Characteristics and Distribution of Cancers by Health Care System

	KPSC		OPI	
	n	%	n	%
Total	47,039		117,158	
Age at diagnosis in years				
20-39	1535	3.26	4200	3.58
40-64	23,325	49.59	54,737	46.72
≥ 65	22,179	47.15	58,221	49.69
Gender				
Male	22,778	48.43	50,307	42.95
Female	22,259	51.57	66,841	57.05
Other/unknown	2	–	10	–
Health insurance (payer)				
Managed care (HMO/PPO)	36,799	78.23	79,749	68.07
Other private	17	0.04	667	0.57
Medicare	10,069	21.41	32,488	27.73
Medicaid	141	0.30	4048	3.46
Socioeconomic status				
Lowest	6253	13.29	12,260	10.46
Lower-middle	9233	19.63	18,273	15.60
Middle	10,499	22.32	22,981	19.62
Upper-middle	11,715	24.90	28,286	24.14
Highest	9339	19.85	35,358	30.18
Race/ethnicity				
White, non-Hispanic	25,291	53.77	79,023	67.45
African American/Black	6345	13.49	6444	5.50
Hispanic	10,325	21.95	19,388	16.55
Asian/Pacific Islander	4497	9.56	10,772	9.19
American Indian	139	0.30	334	0.29
Other/unknown/mixed	442	0.94	1197	1.02
Most common solid tumors				
Breast	12,895	27.41	36,503	31.16
Prostate	11,785	25.05	22,214	18.96
Lung and bronchus	6027	12.81	17,943	15.32
Colon	4552	9.68	12,094	10.32
Melanoma (skin)	4701	9.99	9913	8.46
Endometrium	3018	6.42	7576	6.47
Kidney and renal pelvis	2634	5.60	6625	5.65
Bladder	1427	3.03	4290	3.66
Stage at diagnosis (AJCC TNM)				
0	437	0.93	551	0.47
I	19,472	41.40	44,919	38.34
II	13722	29.17	33,722	28.78
III	5706	12.13	16,151	13.79
IV	6163	13.10	16,468	14.06
Unknown	1539	3.27	5347	4.56

AJCC TNM, American Joint Committee on Cancer – tumor/node/metastasis; HMO, health maintenance organization; KPSC, Kaiser Permanente Southern California; OPI, other private insurance; PPO, preferred provider organization.

CLINICAL

TABLE 2. Overall Mortality Rates per 1000 Person-Years by Health Care System Stratified by Stage, Age at Diagnosis, and Race/Ethnicity^a

	KPSC	OPI
	Rate (95% CI)	Rate (95% CI)
Overall	74.4 [73.0-75.8]	87.8 [86.8-88.8]
Gender		
Male	78.8 [76.6-80.9]	99.3 [97.7-100.9]
Female	70.2 [68.3-72.1]	79.2 [78.0-80.5]
Stage		
0-II	30.6 [29.6-31.6]	36.6 [35.9-37.4]
III-IV	271.6 [265.2-278.1]	284.9 [280.8-289.0]
Unknown	134.0 [123.3-145.3]	144.1 [138.0-150.5]
Age at diagnosis in years		
20-39	27.9 [23.6-32.8]	31.4 [28.6-34.5]
40-64	39.3 [37.9-40.7]	46.2 [45.2-47.2]
≥ 65	122.4 [119.7-125.1]	139.4 [137.5-141.2]
Race/ethnicity		
White, non-Hispanic	83.5 [81.5-85.5]	91.8 [90.6-93.1]
African American/Black	88.5 [84.3-92.8]	108.2 [103.5-113.1]
Hispanic	52.5 [50.0-55.0]	78.1 [75.8-80.4]
Asian/Pacific Islander	61.8 [57.7-66.1]	73.0 [70.0-76.0]
Cancer site		
Breast	32.3 [30.7-34.0]	33.8 [32.8-34.8]
Prostate	26.7 [25.2-28.3]	25.2 [24.2-26.4]
Lung and bronchus	493.3 [479.0-507.9]	484.8 [476.6-493.2]
Colon	103.8 [98.5-109.3]	139.3 [135.2-143.4]
Melanoma (skin)	45.9 [42.7-49.4]	53.6 [51.1-56.1]
Endometrium	58.8 [54.0-63.9]	57.7 [54.7-60.9]
Kidney and renal pelvis	74.8 [68.9-81.0]	90.7 [75.8-80.4]
Bladder	156.8 [144.5-169.8]	187.0 [178.9-195.4]

KPSC, Kaiser Permanente Southern California; OPI, other private insurance.

^aMortality rates could not be estimated for the Native American and other/mixed/unknown race/ethnicity groups due to small numbers of deaths ($n < 5$ for each group).

by demographics and health care system (KPSC or OPI). The KPSC group had more African American patients (13.5% vs 5.5%) and more Hispanic patients (21.9% vs 16.6%) but fewer patients in the highest SES group (19.9% vs 30.2%) compared with the OPI group, respectively.

Of the 8 cancers in the analysis, breast (30.0%) and prostate (20.7%) cancers accounted for half of the cancers diagnosed in the full cohort, but we found a higher percentage of prostate cancer (25.0% vs 18.9%) and a slightly lower percentage of breast (27.4% vs 31.2%) and lung (12.8% vs 15.3%) cancers in KPSC vs the OPI group, respectively. The KPSC group had a slightly higher percentage of patients diagnosed with stage I cancers (41.4% vs 38.3%).

Table 2 shows that the KPSC patients had lower overall mortality rates by cancer stage, age at diagnosis, sex, and race/ethnicity compared with OPI patients. For example, the mortality rates were lower for those with stage III to IV disease in KPSC (271.6 per 1000 PY

vs OPI (284.9 per 1000 PY). Mortality rates for patients 65 years and older were also lower in KPSC (122.4 per 1000 PY vs 139.4 per 1000 PY in the OPI group). For both sexes, the mortality rates were lower in the KPSC group (eg, women: 70.2 per 1000 PY) than in the OPI group (women: 79.2 per 1000 PY). The mortality rates in Table 2 also demonstrate that overall mortality rates were lower in all racial/ethnic groups in KPSC than in the OPI group. Notably, mortality rates were dramatically lower in African American/Black patients (88.5 per 1000 PY vs 108.2 per 1000 PY) and Hispanic patients (52.5 per 1000 PY vs 78.1 per 1000 PY) in KPSC than in the OPI group, respectively.

Table 3 shows the association between overall mortality and health care system by race/ethnicity. In these multivariable models, the adjusted overall mortality risk was statistically significantly higher in African American/Black patients (adjusted HR, 1.14; 95% CI, 1.06-1.21) and Hispanic patients (adjusted HR, 1.23; 95% CI, 1.16-1.29) in the OPI group than in the KPSC group. These models were adjusted for age and stage at diagnosis, sex, year of diagnosis, anatomic cancer site, primary cancer therapy (surgery), adjuvant therapy (receipt of chemotherapy, radiation therapy, and/or hormonal therapy), SES, and county of residence. We could not calculate the HRs for Native Americans and those in the other/mixed/unknown group due to small numbers of deaths.

DISCUSSION

In an insured group of patients, we determined that although KPSC had a higher proportion of minority patients and of patients in the lower SES groups, the overall mortality rates in KPSC were lower than in the OPI group. We also observed markedly lower mortality across all age groups and diagnosis stages in the KPSC cohort. Furthermore, the adjusted mortality risks were significantly higher in African American/Black patients and Hispanic patients in the OPI group compared with KPSC.

In 2013, the Institute of Medicine (IOM) published a framework of an effective cancer care delivery system,¹² which leverages an electronic health record, systematic quality measurement with performance improvement, robust safety nets, and use of tumor board review, which can lead to accessible, affordable cancer care. All these components, including access to clinical trials, are present within KPSC, but the present analysis did not have data on quality care metrics to determine which of these factors, if any, contributed to the lower overall mortality rates in the KPSC group compared with the OPI group. It is also possible that the higher fraction of patients diagnosed with stage I cancer (Table 1) may be due to differences resulting from greater access to screening in the KPSC group, which might have contributed to the lower mortality rates for breast cancer and colorectal cancer as shown in Table 2. Moreover, a system such as that described by the IOM would overcome health disparities related to race/ethnicity and SES. The Veterans Affairs health care system embodies many of the systems described in the IOM and has already reported reduced cancer outcomes disparities when adjusted for covariates.⁹ A study by Rhoads et al showed that the

African American/White differences in colorectal cancer survival have been reduced in California and that African American patients actually had better survival than White patients within IHSs like KPSC¹³; this may be attributed to better care coordination. However, another national study suggested that colorectal cancer screening was lower in non-White patients and that systems seeking to reduce this disparity need to employ targeted approaches to encourage screening across different racial/ethnic groups.¹⁴ We suggest that the IOM's guideline for optimal cancer care delivery, with its emphasis on the benefits of care integration, should serve as a foundation for reducing outcome disparities.

Limitations

Certain study limitations must be considered. There was no review of the hospital where care was delivered after diagnosis. It is possible that some patients diagnosed in KPSC received care in the OPI setting and vice versa. However, in a prior study, we determined that many patients with cancer remained enrolled within the KPSC health plan several years post diagnosis; for example, 80% of women diagnosed with breast cancer stayed within the KPSC health plan 20 years after initial diagnosis.¹⁵ There are also possibly covariates outside those considered within this study that could affect outcomes. However, we adjusted for the most traditional covariates known to affect cancer care outcomes. Further, we could not compare cancer incidence between the 2 cohorts because we did not have denominator data for the OPI group; it is possible that the longer postdiagnosis survival in KPSC could have been due to the increased early-stage cancer incidence, given KPSC's screening programs.

CONCLUSIONS

Our data suggest that KPSC, an example of a vertically integrated health care system, may be well positioned to help reduce overall mortality and specifically mitigate racial/ethnic disparity gaps in cancer care outcomes. Based on our analyses, other private insurers might better serve their insured populations, especially minority patients, by integrating core elements of the KPSC cancer care program into their repertoire. The issue of assessing quality of care, along with the impact of the health care system on outcomes, merits continued study. ■

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Source of Funding: Kaiser Permanente Southern California.

Author Disclosures: The authors report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (RMC, RH); acquisition of data (RMC, RH); analysis and interpretation of data (RMC, JC, TH, RH); drafting of the manuscript (RMC, TH, RH); critical revision of the manuscript for important intellectual content (RMC, JC, TH, RH); statistical analysis (JC, RH); provision of patients or study materials (RH); obtaining funding (RMC); administrative, technical, or logistic support (RH); and supervision (RMC).

TABLE 3. Overall and Adjusted HRs for Mortality and Health Care System by Race/Ethnicity

	Overall		Adjusted ^a	
	HR	95% CI	HR	95% CI
Non-Hispanic White				
KPSC	1.00	Ref	1.00	Ref
OPI	1.09	(1.06-1.12)	1.08	(1.05-1.11)
African American/Black				
KPSC	1.00	Ref	1.00	Ref
OPI	1.21	(1.13-1.29)	1.14	(1.06-1.21)
Hispanic				
KPSC	1.00	Ref	1.00	Ref
OPI	1.47	(1.39-1.55)	1.23	(1.16-1.30)
Asian/Pacific Islander				
KPSC	1.00	Ref	1.00	Ref
OPI	1.17	(1.08-1.26)	1.06	(0.98-1.14)

KPSC, Kaiser Permanente Southern California; OPI, other private insurance; ref, reference.

^aAdjusted for age and stage at diagnosis, sex, year of diagnosis, anatomic cancer site, primary cancer therapy (surgery), adjuvant therapy (receipt of chemotherapy, radiation therapy, and/or hormonal therapy), socioeconomic status, and county of residence.

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