Trends in Cancer Survival by Health Insurance Status in California From 1997 to 2014

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IMPORTANCE There have been substantial improvements in the early detection, treatment, and survival from cancer in the United States, but it is not clear to what extent patients with different types of health insurance have benefitted from these advancements.

OBJECTIVE To examine trends in cancer survival by health insurance status from January 1997 to December 2014.

DESIGN, SETTING, AND PARTICIPANTS California Cancer Registry (a statewide cancer surveillance system) data were used to estimate population-based survival by health insurance status in 3 calendar periods: January 1997 to December 2002, January 2003 to December 2008, and January 2009 to December 2014 with follow-up through 2014. Overall, 1149 891 patients diagnosed with breast, prostate, colorectal, or lung cancer, or melanoma in California were included in the study.

MAIN OUTCOMES AND MEASURES Five-year all-cause and cancer-specific survival probabilities by insurance category and calendar period for each cancer site and sex; hazard ratios (HRs) and 95% CIs for each insurance category (none, Medicare, other public) compared with private insurance in each calendar period.

RESULTS According to data from 1149 891 patients diagnosed with breast, prostate, colorectal, or lung cancer, or melanoma gathered from the California Cancer Registry, improvements in survival were almost exclusively limited to patients with private or Medicare insurance. For patients with other public or no insurance, survival was largely unchanged or declined. Relative to privately insured patients, cancer-specific mortality was higher in uninsured patients for all cancers except prostate, and disparities were largest from 2009 to 2014 for breast (HR, 1.72; 95% CI, 1.45-2.03), lung (men: HR, 1.18; 95% CI, 1.06-1.31 and women: HR, 1.32; 95% CI, 1.15-1.50), and colorectal cancer (women: HR, 1.30; 95% CI, 1.05-1.62). Mortality was also higher for patients with other public insurance for all cancers except lung, and disparities were largest from 2009 to 2014 for breast (HR, 1.25; 95% CI, 1.17-1.34), prostate (HR, 1.17; 95% CI, 1.04-1.31), and colorectal cancer (men: HR, 1.16; 95% CI, 1.08-1.23 and women: HR, 1.11; 95% CI, 1.03-1.20).

CONCLUSIONS AND RELEVANCE After accounting for patient and clinical characteristics, survival disparities for men with prostate cancer and women with lung or colorectal cancer increased significantly over time, reflecting a lack of improvement in survival for patients with other public or no insurance. To mitigate these growing disparities, all patients with cancer need access to health insurance that covers all the necessary elements of health care, from prevention and early detection to timely treatment according to clinical guidelines.
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Key Points

Question Have patients with different types of health insurance benefitted equally from recent improvements in cancer survival?

Findings In this large population-based study, improvements in survival between January 1997 and December 2014 were limited to patients with private or Medicare insurance. Survival disparities for uninsured or other publicly insured patients with prostate, lung, or colorectal cancer increased significantly over time.

Meaning To mitigate these growing disparities, patients with cancer need access to health insurance that covers all the necessary elements of health care, from prevention and early detection to timely treatment according to clinical guidelines.

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here have been substantial improvements in the early detection and treatment of cancer in the United States over the last 2 decades, with corresponding improvements in survival and reductions in cancer mortality. However, it is not clear to what extent patients with different types of health insurance have benefitted from these advancements.

Disparities in cancer outcomes by health insurance status have been well documented in the contemporary literature. Patients who are uninsured or insured through the Medicaid program are more likely to present with later stage disease, less likely to receive cancer-directed surgery and/or radiation therapy, and have lower survival than patients who are privately insured. Some of the largest disparities are seen among patients with cancers that have the potential to be diagnosed early through screening (breast and colorectal). The impact of health insurance on survival from cancer has also been shown to differ according to patient race/ethnicity and socioeconomic status (SES). For example, some of the largest differences in cancer survival for black patients vs white patients are seen among patients with private or Medicare insurance, but these disparities are absent among those with no insurance, suggesting that white patients derive greater benefit from health insurance than black patients. In contrast, health insurance has been shown to mediate the effects of poverty and social determinants on cancer survival and reduce disparities in outcome.

These studies are cross-sectional in nature and do not assess how temporal trends in cancer survival for patients with different types of health insurance are affecting the magnitude of these survival disparities. We leveraged population-based data from the California Cancer Registry (CCR) to examine trends in survival by health insurance status from January 1997 to December 2014, for the 5 most common cancers in California: breast, prostate, lung, colorectal, and melanoma. The CCR is 1 of only 5 population-based cancer registries in the United States to have collected payer information from as far back as the 1990s, enabling a comprehensive examination of trends in cancer survival disparities by health insurance status over a period spanning nearly 2 decades.

Methods

This study received institutional review board approval and was included under the protocol for the Greater Bay Area Cancer Registries (ie, Surveillance, Epidemiology, and End Results/CCR Regions 1 and 8).

Data from the CCR were used to estimate trends in all-cause and cancer-specific survival by health insurance status for 5 common cancers. Analyses included all patients in California diagnosed between January 1997 and December 2014 with either female breast, prostate, colorectal, or lung cancer, or melanoma as a first, primary malignancy. Of the 1240571 cases eligible for inclusion, we excluded cases diagnosed at autopsy or from death certificate only (n = 11635) and those with unknown follow-up time (n = 7763). A further 65443 cases (5%) were excluded because of unknown health insurance status.

Three 6-year calendar periods of diagnosis were defined to allow 5-year survival to be estimated using the most contemporary data available: January 1997 to December 2002 (1997-2002), January 2003 to December 2008 (2003-2008), and January 2009 to December 2014 (2009-2014). Patient vital status was determined by routine linkage to state and national mortality files. Follow-up time for all-cause mortality was computed as the number of days between date of diagnosis and the earliest of: date of death, date of last known contact, or end date of follow-up (5 years after date of diagnosis for patients diagnosed during 1997-2009, or December 31, 2014, for patients diagnosed 2010-2014). In the 2009-2014 calendar period, only patients diagnosed in 2009 were able to be followed for 5 years; median follow-up for this period was 2.1 years. For the analysis of cancer-specific mortality, the underlying cause of death was obtained from death certificates, and follow-up time was censored at date of death for those who died from an underlying cause other than the primary cancer. Cases with an unknown cause of death were excluded from the analysis of cancer-specific mortality (n = 5839). There were 367543 deaths from any cause (32% of 1155730 included cases) and 256465 cancer-specific deaths (22% of the 1149891 included cases) within 5 years.

Patient-level health insurance status was based on primary and secondary payer source and categorized as no insurance; private insurance only; Medicare only or Medicare plus private insurance (Medicare); any public, military, or any Medicaid and/or Medi-Cal insurance (other public). The validity of health insurance status in the CCR has been independently verified, achieving over 80% agreement with 3 other data sources. Patient address at diagnosis was geocoded and assigned to a census block group then linked to an index of neighborhood SES (nSES). The nSES index uses principal components analysis of 2000 Census or 2007 to 2011 American Community Survey data on education, occupation, employment, household income, poverty, and rent and house values. The composite nSES score is categorized according to quintiles of the statewide distribution.

Statistical Analysis

All-cause and cancer-specific survival probabilities at 5 years since diagnosis were estimated at age 65 years for each cancer site, sex, and health insurance category in each calendar
Temporal trends in survival by insurance status were assessed using linear regression of survival by calendar period. Multivariable Cox proportional hazard regression models were used to examine the relative effect of insurance status on all-cause and cancer-specific mortality in each calendar period. Proportionality of hazards for key covariates was tested by examining the correlation between time and scaled Schoenfeld residuals. The assumption of proportional hazards was violated for age and/or stage at diagnosis for all cancers sites. Cox models were therefore age stratified and stage stratified to allow the baseline hazards to vary by these variables. Models were adjusted for possible prognostic factors including tumor characteristics, treatment (surgery, radiotherapy, chemotherapy), marital status, race/ethnicity, institutional-level factors, neighborhood-level characteristic (SES, racial/ethnic composition, urban/rural status), and diagnosis year.

For each cancer site and sex, factors that were statistically significantly (P < .05) associated with 5-year cancer-specific mortality in multivariable models in any of the 3 calendar periods were included in the models for all 3 periods. All models were adjusted for clustering by hospital, using a sandwich estimator of the covariance structure that accounts for intracluster dependence.22 Wald P values for individual cross-product interaction terms between insurance status and period (reference: 1997-2002) were computed from an overall model adjusted for all significant interactions between adjustment factors and period. All analyses were performed in SAS version 9.4 (SAS Institute, Inc).

Results

Approximately half of the patients included in the analysis had private health insurance only. From 1997 to 2014, the proportion of patients with Medicare fell by 5 percentage points while the proportion of patients with other public health insurance increased by 8 percentage points. Less than 2% of patients had no health insurance (eTable 1 in the Supplement). Patients with other public or no insurance were more likely to be diagnosis with later stage disease (eTable 2 in the Supplement). The majority of patients in the other public insurance category had Medicaid insurance (74%).

Trends in 5-Year Survival

Five-year cancer-specific survival for men with prostate cancer was over 90%, and improvements in survival from 1997 to 2014 were negligible (Figure, A). Survival for women with breast cancer was similarly high, with small improvements for those with private insurance only and evidence of a decline in survival for those with no insurance (Figure, B). For patients with lung cancer, survival improved for those with private, Medicare, and to a lesser extent, other public insurance, but there was no change in survival for the patients who were uninsured (Figure, C). For patients with colorectal cancer, improvements in survival were seen for those with private insurance (men and women) and for uninsured men. In contrast, survival for uninsured women with colorectal cancer
declined (Figure, D). There was little change in survival for patients with melanoma from January 1997 to December 2014, with the exception of uninsured men, for whom survival improved slightly, and uninsured women, for whom survival declined (eTable 3 in the Supplement for estimates of 5-year cancer-specific survival by insurance status and calendar period for each cancer site and sex).

**Disparities by Insurance Status**

Differences in all-cause and cancer-specific mortality between patients with Medicare, other public, or no insurance, relative to those with private insurance, were assessed in each calendar period and adjusted for a number of potential prognostic factors. Among men with prostate cancer, disparities in cancer-specific mortality for those with other public insurance compared with private insurance increased from nonsignificant levels in 1997-2002 to 17% among those diagnosed during 2009-2014 (HR, 1.16; 95% CI, 1.08-1.23) (Table). There were no significant differences in cancer-specific mortality between men with prostate cancer who were uninsured or privately insured.

In contrast, uninsured men with lung cancer had 14% higher cancer-specific mortality in 1997-2002 (HR, 1.14; 95% CI, 1.03-1.26) and 18% higher mortality in 2009-2014 (HR, 1.18; 95% CI, 1.06-1.31) relative to men who were privately insured. There were no differences in lung cancer survival between men with Medicare, other public, or private insurance in any calendar period. Uninsured men with colorectal cancer had 32% higher cancer-specific mortality than privately insured men in both 2003-2008 (HR, 1.32; 95% CI, 1.10-1.57) and 2009-2014 (HR, 1.32; 95% CI, 1.13-1.54). Men with other public insurance also had higher mortality from colorectal cancer than those with private insurance; disparities were evident in each calendar period but were widest in 2009-2014 (HR, 1.16; 95% CI, 1.08-1.23).

Uninsured and other publically insured men with melanoma experienced some of the largest survival disparities with little change over time. Among those diagnosed during 2009-2014, cancer-specific mortality was 92% higher in uninsured men (HR, 1.92; 95% CI, 1.38-2.67) and 37% higher in those with other public insurance (HR, 1.37; 95% CI, 1.14-1.64) relative to privately insured men.

Among women with breast cancer, disparities in cancer-specific mortality between those with no insurance and those with private insurance increased from 45% in 1997-2002 (HR, 1.45; 95% CI, 1.26-1.67) to 72% in 2009-2014 (HR, 1.72; 95% CI, 1.45-2.03) (Table). For women with lung cancer, disparities in cancer-specific mortality between the uninsured and privately insured increased from nonsignificant levels in 1997-2002 and 2003-2008 to 32% among those diagnosed during 2009-2014 (HR, 1.32; 95% CI, 1.15-1.50). Similarly for colorectal cancer, significant disparities in mortality for women who

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| Table. Five-Year Cause-Specific Mortality by Health Insurance Status in Each Calendar Period of Diagnosis, by Cancer Site and Sex in California From 1997 to 2014 |
|---|---|---|---|
| Breast cancer | | | | |
| No insurance | ND | ND | ND | 1.45 (1.26-1.67) |
| Medicare | ND | ND | ND | 1.61 (1.37-1.89) |
| Other public | ND | ND | ND | 1.72 (1.45-2.03) |
| Prostate cancer | | | | |
| No insurance | 0.89 (0.73-1.09) | 1.08 (0.81-1.43) | 1.17 (0.88-1.56) | ND |
| Medicare | 0.88 (0.81-0.96) | 0.94 (0.87-1.01) | 1.03 (0.94-1.13) | ND |
| Other public | 1.02 (0.91-1.13) | 1.06 (0.97-1.16) | 1.17 (1.04-1.31) | ND |
| Lung cancer | | | | |
| No insurance | 1.14 (1.03-1.26) | 1.14 (0.99-1.31) | 1.18 (1.06-1.31) | 1.08 (0.97-1.21) |
| Medicare | 1.00 (0.97-1.03) | 1.02 (0.98-1.05) | 1.02 (0.98-1.07) | 1.00 (0.96-1.03) |
| Other public | 1.00 (0.96-1.05) | 1.03 (0.98-1.08) | 1.00 (0.95-1.05) | 1.00 (0.95-1.04) |
| Colorectal cancer | | | | |
| No insurance | 1.17 (1.03-1.32) | 1.32 (1.10-1.57) | 1.32 (1.13-1.54) | 1.15 (0.95-1.39) |
| Medicare | 1.02 (0.96-1.07) | 1.05 (0.99-1.11) | 1.06 (0.99-1.14) | 1.01 (0.96-1.06) |
| Other public | 1.11 (1.04-1.20) | 1.11 (1.04-1.20) | 1.16 (1.08-1.23) | 1.00 (0.92-1.08) |
| Melanoma | | | | |
| No insurance | 2.04 (1.56-2.67) | 1.66 (1.22-2.25) | 1.92 (1.38-2.67) | 0.81 (0.45-1.46) |
| Medicare | 1.10 (0.94-1.28) | 1.11 (0.95-1.29) | 1.03 (0.86-1.23) | 0.99 (0.79-1.24) |
| Other public | 1.53 (1.18-1.98) | 1.30 (1.07-1.59) | 1.37 (1.14-1.64) | 1.66 (1.21-2.27) |

Abbreviations: HR, hazard ratio; ND, no data. * Patients with private insurance only were used as the reference throughout. This table is expanded and includes specification of stratification and adjustment variables as eTable 4 in the Supplement. ** The HR is statistically significantly (P < .05) different to the reference group. □ Wald P value for individual cross-product interaction terms between health insurance category and time-period (reference, 1997-2002) was P < .05 in the overall model.
Discussion

In a contemporary, population-based sample of 1149 891 patients with cancer diagnosed over a 18-year period, we found substantial and persistent disparities in survival for patients with either no or other public insurance compared with patients with private insurance for all 5 of the cancer sites examined. With few exceptions, survival disparities were largest among those diagnosed during 2009-2014 relative to the 2 earlier time periods. For men with prostate cancer and women with lung or colorectal cancer, this represents a significant increase in survival disparities over time. To our knowledge, this is the first study to examine survival disparities by type of health insurance over time, for a number of different cancer sites.

Examination of the survival trends revealed that improvements in survival from January 1997 to December 2014 were almost exclusively limited to patients with private or Medicare insurance. For patients with other public or no insurance, survival was often stubbornly unchanged, or in some cancers, declining. While these survival trends were not fully adjusted for the various prognostic factors included in the multivariable analysis, they provide insight into which patient groups are benefitting from recent advances in cancer care, and which are not.

The finding that patients who are uninsured or have Medicaid have higher cancer-specific mortality than patients with private insurance or Medicare has been replicated for cancers of the breast, prostate, lung, and colorectum.13-19 Survival disparities among patients with melanoma have been less well studied, but similarly high cancer-specific mortality in patients who are uninsured or have Medicaid has been noted previously.20 For the first time, we show that the overall lack of improvement in survival for uninsured and other publicly insured patients has resulted in increasing disparities for some cancers.

There are numerous mechanisms through which lack of adequate health insurance can lead to poorer survival outcomes, including higher prevalence of comorbidities and behavioral risk factors (poor diet, obesity, smoking),21 lower uptake of cancer screening,22 and lack of access to health care and recommended treatment regimens.2,23-25

Lack of access to preventive health care is likely to have played a key role in the survival disparities reported here, especially for breast and colorectal cancer, for which established screening practices exist. Cancer screening rates among patients who are uninsured and patients with Medicaid are substantially lower than among patients who are privately insured,22,26-28 with estimates suggesting that patients who are uninsured are half as likely to receive breast or colorectal cancer screening.29

In our study, patients with other public insurance (74% of whom had Medicaid) had significantly lower survival than patients who were privately insured for all cancers except lung, though disparities were smaller than for patients who were uninsured. Previous studies have reported findings of equivalent,13,14 or only marginally improved2 survival in patients with cancer who have Medicaid compared with patients who are uninsured after accounting for differences in stage and treatment. Medicaid insurance is not uniformly accepted by many health care providers because of low reimbursement levels, potentially making it difficult for these patients to access the same high-quality cancer care as those with private insurance.30,31 Rising cancer drug costs and formulary restrictions may also result in patients who are publicly insured being denied access to novel and/or high-cost therapeutics. Our findings suggest that, while survival falls short of that achieved by patients with private insurance, public insurance such as Medicaid does confer a survival benefit over no insurance for breast, prostate, and lung cancer. However, there was little or no benefit of public insurance over no insurance for colorectal cancer or melanoma, and the lack of improvement in survival is a concern. These findings suggest that the health care provided to publicly insured patients with cancer in California is not adequately meeting their needs.

The Patient Protection and Affordable Care Act (ACA), signed into law in March 2010, provided insurance coverage for an estimated 30 million previously uninsured Americans through subsidized private health insurance and an expansion of the Medicaid program.32 The proportion of the US population with no health insurance fell from 16% in 2010 to 10% in 2014 and continues to fall.33 In California, Medicaid expansion began in late 2013 and enrolled an additional 4.9 million people over the following 3 years (a 57% increase).34 An extra 1.4 million people gained private insurance through the health care marketplace. It remains to be seen what impact the ACA will have on long-term outcomes for patients with cancer at a population level, but our findings of persistently inferior survival for patients with public insurance in California suggests that a more widespread redesign of cancer care delivery, as opposed to insurance expansion, may need to be considered as an alternative solution to the disparities reported here.
Research Original Investigation

We found that survival disparities for patients who were uninsured or other publically insured patients with breast, prostate, lung, and colorectal cancer were largest in the most recent calendar period, but our ability to assess whether this represents a statistically significant increase in disparity over time was limited. For the period 2009-2014, only patients diagnosed in 2009 had complete follow-up for 5 years, resulting in greater variance of survival estimates, and potentially a lack of power to detect a significant change from the previous calendar period. Our study may also be affected by limitations inherent to survival analysis. For breast and colorectal cancer, the differential uptake of screening by insurance status may introduce lead-time bias (the artificial lengthening of survival time consequent to earlier detection with no additional life span), though any effect is likely to have been minimized through adjustment for stage at diagnosis.

Conclusions

Despite these limitations, we found significant differences in cancer survival by type of health insurance. From January 1997 to December 2014, survival disparities for uninsured and other publically insured patients were static at best and, at worst, increasing. To address the stark disparities in cancer survival reported here, patients need access to health insurance that covers all the necessary elements of healthcare, from prevention and early detection, through to timely treatment according to clinical guidelines and long-term follow-up.

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Drafting of the manuscript: Ellis. Critical revision of the manuscript for important intellectual content: All authors. Statistical analysis: Ellis, Changhola. Obtained funding: Ellis, Gomez. Administrative, technical, or material support: Ladabaum, Gomez. Study supervision: Spiegel, Gomez.

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Disclaimer: The ideas and opinions expressed herein are those of the author(s) and endorsement by the State of California, Department of Public Health the National Cancer Institute, and the Centers for Disease Control and Prevention or their Contractors and Subcontractors is not intended nor should be inferred.

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Efficacy of Medicaid for Patients With Cancer in California

Douglas W. Blayney, MD

Medicaid in California (MediCal) is neither safe nor effective. If MediCal were a drug, a responsible regulator should consider pulling it from the market. In their Original Investigation published in this issue of JAMA Oncology, Ellis and colleagues1 analyze survival from California’s population-based California Cancer Registry and demonstrate that MediCal is a disaster for Californians. MediCal and the related Children’s Health Insurance Program provide health care coverage to nearly 12.3 million of California’s 39.3 million residents.2

Cancer Outcomes for Californians With MediCal

Because the California Cancer Registry has been collecting data on insurance status since the mid-1990s, Ellis et al1 had the opportunity to analyze outcomes by patient insurance type. They chose 3 consecutive periods to examine survival trends between 1997 and 2014 and included the 5 most common cancers in their analysis: breast, prostate, lung, colorectal, and melanoma. Ellis et al1 discovered that 52% of decedents had some form of health insurance, publicly insured care or private insurance and between other public insurance (of whom 74% had MediCal). Remarkably, less than 2% of cancer deaths during this period were not covered by some form of third-party insurance.

The major findings of the study by Ellis et al1 were the disparity (difference) in survival outcomes between MediCare or private insurance and between other public insurance or no insurance. Focusing on the 98% of cancer deaths with some form of health insurance, publicly insured patients had poorer cancer-specific survival than patients with private insurance or Medicare. For 7 of 8 tumor types evaluated, other public insurance (again, 74% MediCal) had

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