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State-Level Projections of Cancer-Related Medical Care Costs: 2010 to 2020

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Abstract

Background—As the population ages, the financial amount spent on cancer care is expected to increase substantially. In this study, we projected cancer-related medical costs by state from 2010 through 2020.

Methods—We used pooled Medical Expenditure Panel Survey data for 2004 to 2008 and US Census Bureau population projections to produce state-level estimates of the number of people treated for cancer and the average cost of their treatment, from a health system perspective, by age group (18-44, 45-64, ≥65 years) and sex. In the base model, we assumed that the percentage of people in each of the 6 age-by-sex categories who had been treated for cancer would remain constant and that the inflation-adjusted average cancer treatment cost per person would increase at the same rate as Congressional Budget Office projections of overall medical spending.

Results—We projected that state-level cancer-related medical costs would increase by 34% to 115% (median = 72%) and that state-level costs in 2020 would range from $347 million to $28.3 billion in 2010 dollars (median = $3.7 billion).

Conclusions—The number of people treated for cancer and the costs of their cancer-related medical care are projected to increase substantially for each state. Effective prevention and early detection strategies are needed to limit the growing burden of cancer.

Healthcare costs continue to rise nationally and impose greater burdens on state budgets.[1] Since cancer-related medical care costs constitute a substantial portion of overall US medical care costs,[2-4] accurate projections of future cancer-related care costs are critical. Over the past 20 years, the cost of treating cancer has nearly doubled nationally.[2,5] As a result of an aging population and more expensive cancer treatments, the national costs of

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cancer care are expected to increase significantly in the near future.[6] Although previous increases in spending on cancer have occurred despite the decreases in cancer incidence rates and increases in average survival times for patients with many types of cancers,[7] researchers have noted many opportunities to further improve cancer detection and treatment while controlling costs.[8-10]

To take advantage of these opportunities, state-administered insurance providers such as Medicaid and public healthcare providers such as the National Breast and Cervical Cancer Early Detection Program[11] need state-level projections of future cancer care costs. Previous projections of cancer prevalence and cancer care costs have focused only on the national level.[6] This study produces state-level projections of cancer care costs through 2020. While our goal is not to explain differences across states, our projections do reflect projected changes in the distribution of state residents by age and sex during this period. They provide a useful baseline against which to gauge the impact of current and future cancer policies and could be useful for budget allocations for investments in cancer prevention and early detection.

DATA AND METHODS

Overview

First, we generated estimates of the number of adults who had been treated for cancer and the average cost of their treatment by age group (18-44, 45-64, ≥65 years) and sex (male, female). The small number of children with cancer in our data prevented reliable estimates for children. Second, in our base projections, we assumed that the treatment rate for cancer in each of the 6 age-by-sex groups would remain constant and that the inflation-adjusted initial average cancer treatment cost per person would increase at the same rate as Congressional Budget Office (CBO) projections of overall medical spending.[12,13] Third, we generated state-level projections of the total number of adults who will be treated for cancer and the costs of their treatment by multiplying treated cancer prevalence and average costs by the Census-projected population of each demographic cell. Therefore, the projections reflect expected changes in the distribution of state residents by sex and age group but assume that there will be no policy changes that could affect cancer treatment costs. For example, the projections do not account for possible changes in national healthcare policies mandated by the Affordable Care Act.

Projections of the Annual Number of US Adults Treated for Cancer

To estimate the number of adults in each state who will be treated for cancer, we used cancer prevalence data from the 2004 to 2008 Medical Expenditure Panel Survey (MEPS)[14] and the US Census Bureau's projections of state population counts for 2010 through 2020. The MEPS, a nationally representative survey of the civilian noninstitutionalized population administered by the Agency for Healthcare Research and Quality, provides data on participants' use of medical services and on the costs of those services. MEPS provides a single, consistent data source to link disease prevalence and expenditures. Medical conditions are identified in the MEPS medical condition files; we restricted our condition indicators to those for which respondents received care within the interview year. Medical conditions were classified using the International Classification of Diseases, Ninth Revision, Clinical Modification (*ICD-9-CM*) codes based on self-reported conditions that were transcribed by professional coders. Cancer was defined using clinical classification codes 11 through 43 and 45, which group *ICD-9-CM* codes into related groups.[15] We combined cancers of any site.

We estimated logit models for the probability of cancer treatment that controlled for survey year and survey participants' age, sex, and region of residence (northeast, south, midwest, and west). We used stepwise regressions to identify significant interactions among these variables to be included in the models. The significant interactions in the stepwise regressions represent age-by-sex-by-region categories with enough sample and power to detect differences in cancer treatment rates. We estimated cancer treatment rates (ie, the proportion of the population treated for cancer) for US adults in each age/sex/region group using coefficients from the logit regressions and adjusted these estimates to account for the nursing home care population using data from the 2004 National Nursing Home Survey.

We used the projected state population counts for 2010 through 2020 generated in 2008 by the US Census Bureau on the basis of data from the 2000 Census.[16] For each state, we multiplied the predicted percentage of people treated for cancer in each of the 6 age-by-sex categories by the projected number of state residents in the corresponding category for each year from 2010 through 2020. We then aggregated these projections to project the total number of people who will be treated for cancer in each state in each year.

Projections of Direct Medical Care Costs of Cancer

MEPS measures total annual medical spending, including payments by insurers and out-of-pocket spending by patients (copayments, deductibles, and payments for noncovered services). The costs captured by MEPS represent payments (not charges) from the payer to the provider. MEPS spending data are obtained through a combination of self-reports by the respondents and validation of the self-reports from payers.[17]

We projected direct cancer-related medical care costs of cancer in 6 steps. First, we estimated per-person medical costs as a function of cancer by using a 2-part regression model (a logit model to predict the probability of any expenditure and a generalized linear model with a gamma distribution and a log link to estimate total annual medical expenditures for people having any such expenditures). To choose among alternative nonlinear estimators, we used an algorithm recommended by Manning and Mullahy[18] and found the generalized linear model was the most appropriate for the data. All regressions included the following variables: age; age^2; sex; race/ethnicity; education; family income; other sources of health insurance; year indicators; and indicators for cancer, arthritis, asthma, back problems, congestive heart failure, chronic obstructive pulmonary disease, coronary heart disease, depression, diabetes, dyslipidemia, human immunodeficiency virus/acquired immunodeficiency syndrome, hypertension, injuries, other cardiovascular disease, other mental health/substance abuse, pneumonia, pregnancies, renal failure, skin disorders, and stroke.

Second, we calculated expenditures attributable to cancer by comparing predicted expenditures from the 2-part regression model. To ensure no double counting of expenditures for co-occurring diseases, we used the "complete classification" technique described in an earlier study.[19] We treated each disease and combination of diseases as a separate entity and, for each unique combination of diseases, compared predicted expenditures with and without the disease(s) holding all else constant. For example, we treated cancer alone and cancer with hyper-tension as 2 different "diseases." We then divided the total expenditures attributable to the combinations of diseases back to the constituent diseases using the parameters from the model to construct shares for each constituent disease within a combination (ie, a share of all cancer with hypertension disease costs that are attributable to cancer). The shares attribute a greater share of the joint expenditures to the disease with the larger coefficient in the main effect.[19] We estimated per-person costs attributable to cancer for each age/sex/region category on the basis of coefficients from the national model.

Third, we used the 2004 National Nursing Home Survey and National Health Accounts to adjust our per-person cost estimates to account for nursing home spending. We assumed that average per-person, non-nursing home expenditures attributable to cancer were the same for the nursing home population as for the non-institutionalized population.

Fourth, we used confidential MEPS data that identified the most populous 30 states and 9 Census divisions to generate state-specific per-person cost estimates. Sample sizes were not large enough for us to replicate the full analysis for each state. We regressed log (positive) medical expenditures on the variables in the model plus state/census division dummies. The coefficients on the dummies provided measures of the differences in average medical care costs across states that we used to scale the national estimates to make them state-specific.

Fifth, we estimated future costs by inflating dollar values in the MEPS data to the equivalent of 2010 values in accordance with recommendations from the Agency for Healthcare Research and Quality[20] and then multiplied the projected per-person cost of cancer for people in each age/sex/state category by the number of people in the corresponding category that we projected will be treated for cancer in 2010 and in 2020. We then added the projections for each category to estimate total annual costs of cancer care.

Finally, we adjusted our cost projections on the basis of CBO assumptions that future healthcare costs not attributable to population growth and aging will increase by an average annual rate of 3.6% between 2010 and 2020.[12,13]

Sensitivity Analysis

We generated four 10-year projections of cancer care costs using the following assumptions about future US cancer prevalence rates: 1) no change in cancer incidence or survival rates (base projections), 2) continued trends in cancer incidence rates, 3) continued trends in cancer survival rates, and 4) continued trends in both incidence and survival rates. Incidence trends represent changes due to prevention and risk factor prevalence, and survival trends represent changes in early detection and treatment. We used trends in incidence and survival reported by Mariotto et al.[6]

First, using Census projections for the year 2020, we converted their estimates of the number of cancer survivors for all sites under the 4 modeling assumptions[6(Table 3)] to the implied cancer prevalence rates in each model. Second, we calculated the percentage difference in the predicted 2020 prevalence rates between the 3 alternative models and the base model. The differences between the alternative models and the base model hold the 2020 population constant and reflect differences due to the alternative assumptions. Third, we applied the percentage differences in 2020 prevalence rates between each of the 3 alternative assumptions and the base model at the national level to each of our age/sex/state categories in the year 2020. For years 2010 to 2020, we assumed linear growth from the 2010 value to the 2020 value by age, sex, and state.

We also generated cancer medical care cost projections using alternative assumptions of medical cost growth. Our baseline assumption was that per-person costs of cancer grew at the historical rate of growth of overall medical spending, 3.6% per year.[13] In the sensitivity analysis, we applied the following growth rates to per-person cancer costs: 0%, 2%, and 5%.[6]

RESULTS

In the base model, projected state-level changes in the number of residents treated for cancer between 2010 and 2020 ranged from −7% in the District of Columbia to 46% in Arizona (median = 17%; data not shown). The states with the largest projected increases in the number of people treated for cancer were Florida (353,000), California (351,000), and Texas (249,000). Projected percentage increases in cancer care costs between 2010 and 2020 ranged from 34% in the District of Columbia to 115% in Arizona (median = 72%) (Table 1). Projected actual increases in costs ranged from $347 million in the District of Columbia to $28.3 billion in California (median, $3.7 billion) (Figure 1).

Our projections of cancer-related medical costs were not sensitive to alternative assumptions about future cancer incidence and survival rates (Table 2). Accounting for trends in cancer incidence rates,[6] projected medical costs were 3% lower than in the base model. Accounting for trends in cancer survival rates,[6] projected medical costs were 10% higher than in the base model. However, accounting for both of these assumptions simultaneously, projected medical care costs were only 1% higher than in the base model.

Compared with our base model, projections based on the assumption of 0% increase in per capita medical care costs were 34% lower and those based on the assumption of 5% growth were 18% higher. Changes from 2010 to 2020 in projected state-level cancer care costs derived from the 0% cost-growth model, in which we assumed no change in treated cancer prevalence or inflation-adjusted per capita medical care costs, reflect solely the impact of projected changes in state populations and in the age and sex distribution of state residents (Figure 2). The combined impact of these 2 factors on projected changes in cancer-related medical costs between 2010 and 2020 ranged from a 12% decrease for the District of Columbia to a 41% increase for Arizona (median = 13% increase).

DISCUSSION

Our base model, which assumed no change in the cancer treatment rate and a 3.6% annual increase in inflation-adjusted per capita medical costs, showed that the state-level percentage change in the annual number of cancer cases treated between 2010 and 2020 will range from −7% to 46% (median = 17%; data not shown) across states and that the state-level percentage increase in cancer-related medical costs will range from 34% to 115% (median = 72%). Our projections of state-level percentage increases in the number of treated cancer cases between 2010 and 2020 varied significantly across states and closely paralleled projected increases in the number of residents 65 years or older. States with the largest projected percentage increases in number of residents 65 years or older also had the largest projected percentage increases in cancer-related medical costs.[16]

Accounting for a declining trend in the US cancer incidence rate and an increasing trend in the US cancer survival rate had little net effect on our cost projections. However, cost projections were sensitive to changes in assumptions about the annual rate of change in medical costs. Compared with projections derived from our base model (3.6% annual increase), projections based on assumptions of 0% cost growth and 5% cost growth were 34% lower and 18% higher, respectively. Projections derived from the 0% cost-growth model are interesting for at least 2 reasons: 1) they show the impact that population growth and aging will likely have on state cancer-related medical costs, and 2) given that recent evidence suggests that the average inflation-adjusted per-person cost of cancer treatment did not change much from 1987 to 2005,[2] projections of state-level cancer-related medical costs derived from this model may be more accurate than those derived from our base model. However, the relatively flat per-person cost of cancer treatment over this period was driven mainly by cancer treatment being provided more frequently in outpatient settings.[2] Unless this trend continues, we should expect future per-person cancer treatment costs to increase at a higher rate.

In a recent national-level projection of US cancer care costs based on assumptions of 0% cost growth and no change in cancer incidence or survival rates, Mariotto and colleagues estimated that costs would increase by 27% between 2010 and 2020,[6] which was substantially higher than the average projected increase in cancer treatment costs in our study (15%). This difference is likely attributable to differences in the data sources used in the 2 studies. Mariotto and colleagues,[6] used Surveillance Epidemiology and End Results-Medicare files, which provide clinical registry data about cancer prevalence linked to Medicare payments. However, because Medicare covers only people 65 years or older, Mariotto and colleagues, had to extrapolate these data to people younger than 65 years. In contrast, we used MEPS data, which were collected from self-reports of a cross section of US adults.

Limitations

MEPS has at least 4 limitations that may have affected our projections: 1) it is subject to sampling error; 2) participants' reports of their cancer status were not verified by chart review; 3) its small sample sizes precluded us from stratifying our projections of cancer costs by type of cancer or cancer stage; and 4) institutionalized populations were not sampled. We adjusted estimates to account for nursing home populations.

In addition, the accuracy of our projections is dependent on the accuracy of the many assumptions on which the projections were based. For example, we assumed that the initial prognosis of cancer patients would not change. To the extent that the percentage of cancer patients who adhere to recommended treatments increases, or new life-prolonging technologies are developed, cancer patients will live longer and the prevalence of cancer will be higher than we projected. Conversely, if the incidence of cancer at different sites increases or decreases, the number of people treated for cancer and cancer treatment costs could be either greater or less than we projected. In addition, the accuracy of our cost growth assumption could be affected by changes in the rate of investment in new cancer technologies or in the relative proportion of different cancer types.

Due to the number of data sources that were combined for the estimates, it was not possible to generate standard errors for the cost projections. The relative standard error (ie, standard error as a percentage of the estimate) for the estimate of treated cancer prevalence in MEPS was 8%. The relative standard error for the estimates of the per-person medical cost was 11%.

Finally, our projections do not reflect the true overall costs of cancer, which, in addition to medical treatment costs, also include patients' nonmedical costs for travel and child care, the costs of lost productivity, costs incurred by unpaid caretakers of cancer patients, and intangible costs associated with psychological pain and stress experienced by cancer patients and their families.[21,22] Even though medical costs are often the sole focus of economic research and debate concerning proposed policy changes affecting cancer patients, participants in such research and debate should also consider nonmedical costs.

CONCLUSIONS

We project that the cost of medical care for cancer patients will increase substantially through 2020 in all US states but that the rate of increase will vary by state. We hope that states find these projections useful as they try to make evidence-based decisions about the allocation of resources for cancer research and interventions as well as other policy decisions related to cancer prevention and treatment. These projections also provide a useful baseline against which to gauge the impact of current and future cancer policies.

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Take-Away Points

- ■ We project that the cost of medical care for cancer patients will increase substantially through the year 2020 in all US states.
- ■ Effective prevention and early detection strategies are needed to limit the growing burden of cancer.
- ■ These estimates provide a useful baseline against which to gauge the impact of current and future cancer policies.
- ■ These estimates could be useful for budget allocations for investments in cancer prevention and early detection.

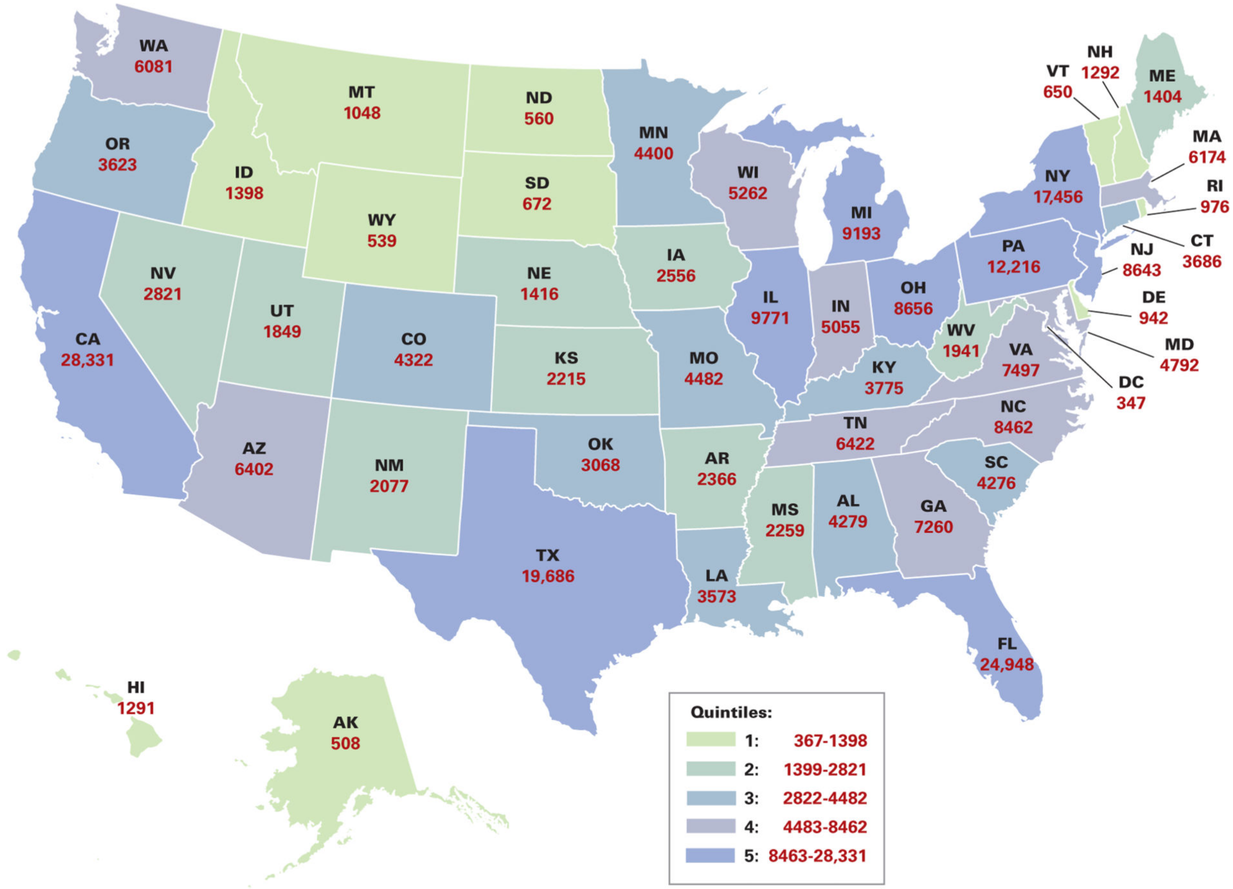

Figure 1.

Projected State Costs of Cancer Care in 2020

Estimates of state expenditures for cancer care in 2020 are based on the assumptions that the percentage of people treated for cancer remains constant within age, sex, and state categories but that state population counts and population distributions by age and sex will change as projected by the Census and that the inflation-adjusted cost of cancer care per person will increase by 3.6% per year. Costs in 2010 million US dollars. Color-coded categories represent quintiles.

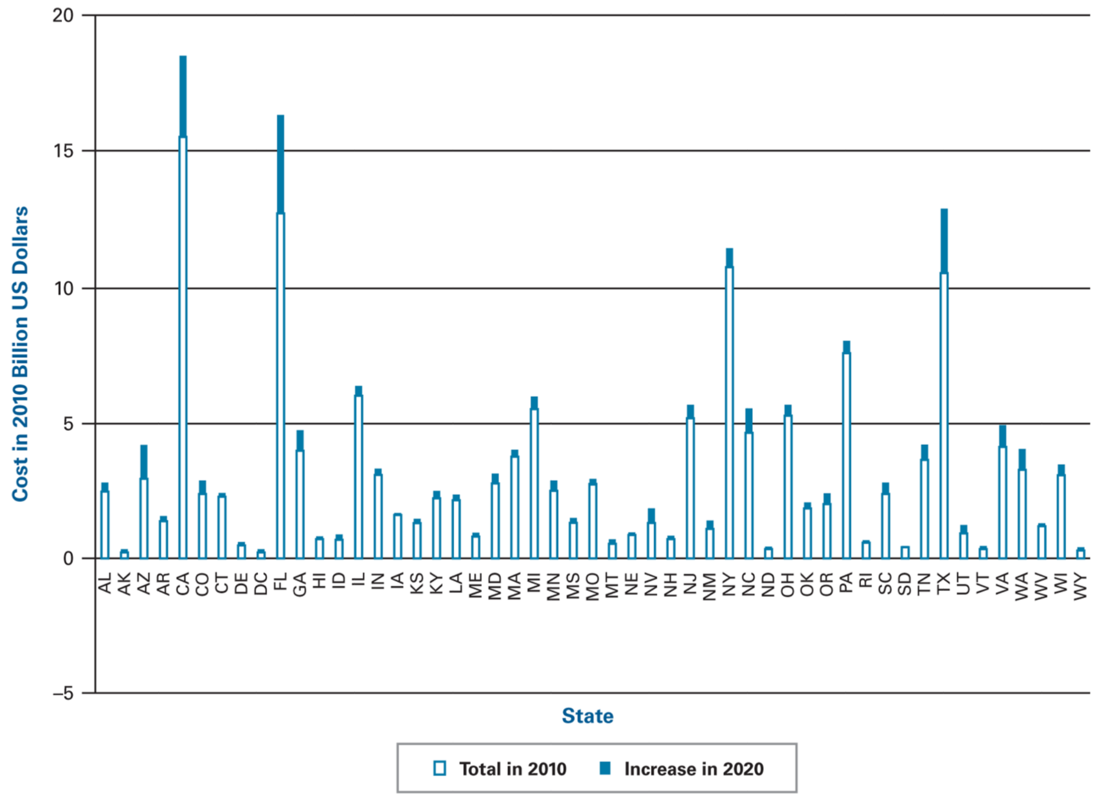

Figure 2.

Projected Increase in State Costs of Cancer Care Between 2010 and 2020

Estimates of state expenditures for cancer care in 2010 (white) and the estimated increase in these expenditures between 2010 and 2020 (blue) are based on assumptions that the percentage of people treated for cancer remains constant within age, sex, and state categories; that the inflation-adjusted cost of cancer care is unchanged; and that state populations and the population distributions by age and sex will change as projected by the Census. Costs in 2010 billion US dollars.

Table 1

Projected State Costs of Cancer Care in 2010 US Dollars

State	2010, Million $	2015, Million $	2020, Million $	% Change 2010 to 2020
Alabama	2527	3289	4279	69
Alaska	261	366	508	95
Arizona	2981	4363	6402	115
Arkansas	1394	1816	2366	70
California	15,532	21,041	28,331	82
Colorado	2368	3211	4322	83
Connecticut	2252	2897	3686	64
Delaware	518	703	943	82
District of Columbia	259	300	347	34
Florida	12,742	17,723	24,948	96
Georgia	3926	5371	7260	85
Hawaii	734	978	1,291	76
Idaho	732	1008	1398	91
Illinois	5969	7627	9771	64
Indiana	3060	3927	5055	65
Iowa	1572	1993	2556	63
Kansas	1329	1706	2215	67
Kentucky	2228	2900	3775	69
Louisiana	2124	2751	3573	68
Maine	793	1060	1404	77
Maryland	2781	3675	4792	72
Massachusetts	3702	4793	6174	67
Michigan	5505	7116	9193	67
Minnesota	2507	3310	4400	75
Mississippi	1322	1725	2259	71
Missouri	2676	3456	4482	67
Montana	570	769	1048	84
Nebraska	857	1096	1416	65
Nevada	1330	1952	2821	112
New Hampshire	701	957	1292	84
New Jersey	5169	6707	8643	67
New Mexico	1096	1516	2077	90
New York	10,778	13,780	17,456	62
North Carolina	4635	6279	8462	83
North Dakota	337	430	560	66
Ohio	5316	6779	8656	63
Oklahoma	1857	2380	3068	65
Oregon	1992	2680	3623	82
Pennsylvania	7567	9587	12,216	61

State	2010, Million $	2015, Million $	2020, Million $	% Change 2010 to 2020
Rhode Island	594	761	976	64
South Carolina	2334	3175	4276	83
South Dakota	399	514	672	68
Tennessee	3650	4858	6422	76
Texas	10,516	14,384	19,686	87
Utah	977	1334	1849	89
Vermont	357	484	650	82
Virginia	4142	5608	7497	81
Washington	3273	4463	6081	86
West Virginia	1181	1513	1941	64
Wisconsin	3057	3999	5262	72
Wyoming	290	394	539	86
Median	**2228**	**2897**	**3686**	**72**

Note: Cost projections were based on the following assumptions: 1) the annual percentage of state residents treated for cancer will remain constant within age and sex categories; 2) the distribution of state residents by sex and age group will change as projected by the Census; 3) annual medical care costs will increase by 3.6% (in inflation-adjusted 2010 dollars).

Table 2

Projected State Costs of Cancer Care Based on 4 Sets of Assumptions About Future Cancer Incidence Rates, Cancer Survival Rates, and Annual Increases in the Cost of Medical Care

	Projected State-Level Costs of Cancer Care in 2010 US Dollars (Millions), by Assumptions Used							
	2010	2020						
State	Base	Base	Trend Incidence	Trend Survival	Trend Incidence and Survival	Under Base: Cost Increase		
						0%	2%	5%
Alabama	2527	4279	4135	4706	4316	2807	3560	5041
Alaska	261	508	491	559	512	333	422	598
Arizona	2981	6402	6187	7042	6457	4200	5326	7542
Arkansas	1394	2366	2286	2602	2386	1552	1968	2787
California	15,532	28,331	27,382	31,164	28,577	18,586	23,571	33,377
Colorado	2368	4322	4178	4755	4360	2836	3596	5092
Connecticut	2252	3686	3562	4054	3718	2418	3066	4342
Delaware	518	943	911	1037	951	618	784	1111
District of Columbia	259	347	336	382	350	228	289	409
Florida	12,742	24,948	24,112	27,443	25,165	16,367	20,757	29,392
Georgia	3926	7260	7017	7986	7323	4763	6040	8553
Hawaii	734	1291	1248	1420	1302	847	1074	1521
Idaho	732	1398	1351	1538	1410	917	1163	1647
Illinois	5969	9771	9443	10,748	9856	6410	8129	11,511
Indiana	3060	5055	4886	5561	5099	3316	4206	5956
Iowa	1572	2556	2471	2812	2579	1677	2127	3012
Kansas	1329	2215	2141	2437	2234	1453	1843	2610
Kentucky	2228	3775	3648	4152	3808	2476	3141	4447
Louisiana	2124	3573	3454	3931	3605	2344	2973	4210
Maine	793	1404	1357	1545	1417	921	1168	1655
Maryland	2781	4792	4631	5271	4834	3144	3987	5646
Massachusetts	3702	6174	5967	6791	6227	4050	5136	7273
Michigan	5505	9193	8885	10,112	9273	6031	7648	10,830
Minnesota	2507	4400	4253	4840	4438	2887	3661	5184
Mississippi	1322	2259	2183	2485	2278	1482	1879	2661
Missouri	2676	4482	4332	4930	4521	2940	3729	5280
Montana	570	1048	1013	1153	1057	687	872	1234
Nebraska	857	1416	1368	1557	1428	929	1178	1668
Nevada	1330	2821	2726	3103	2845	1851	2347	3323
New Hampshire	701	1292	1248	1421	1303	847	1075	1522
New Jersey	5169	8643	8353	9507	8718	5670	7191	10,182
New Mexico	1096	2077	2007	2285	2095	1363	1728	2447
New York	10,778	17,456	16,871	19,202	17,608	11,452	14,523	20,565
North Carolina	4635	8462	8178	9308	8535	5551	7040	9969
North Dakota	337	560	541	616	564	367	466	659

	Projected State-Level Costs of Cancer Care in 2010 US Dollars (Millions), by Assumptions Used							
	2010	**2020**						
State	**Base**	**Base**	**Trend Incidence**	**Trend Survival**	**Trend Incidence and Survival**	**Under Base: Cost Increase**		
						0%	**2%**	**5%**
Ohio	5316	8656	8366	9522	8731	5678	7202	10,198
Oklahoma	1857	3068	2965	3375	3095	2013	2553	3614
Oregon	1992	3623	3502	3985	3654	2377	3014	4268
Pennsylvania	7567	12,216	11,807	13,438	12,322	8014	10,164	14,392
Rhode Island	594	976	943	1073	984	640	812	1150
South Carolina	2334	4276	4133	4703	4313	2805	3558	5037
South Dakota	399	672	650	740	678	441	559	792
Tennessee	3650	6422	6207	7064	6478	4213	5343	7566
Texas	10,516	19,686	19,027	21,655	19,857	12,914	16,379	23,193
Utah	977	1849	1787	2034	1865	1213	1538	2178
Vermont	357	650	628	715	656	426	541	766
Virginia	4142	7497	7246	8247	7562	4918	6237	8832
Washington	3273	6081	5878	6690	6134	3990	5060	7165
West Virginia	1181	1941	1876	2135	1958	1273	1615	2287
Wisconsin	3057	5262	5086	5789	5308	3452	4378	6200
Wyoming	290	539	521	593	544	354	449	635
Median	**2228**	**3686**	**3562**	**4054**	**3718**	**2418**	**3066**	**4342**

Note: Cost projections under the base scenario were based on the following assumptions: 1) the annual percentage of state residents treated for cancer will remain constant within age and sex categories; 2) the distribution of state residents by sex and age groups will change as projected by the Census; 3) annual medical care costs will increase by 3.6% (in inflation-adjusted 2010 dollars). Incidence trend and survival trend cost projections are based on assumptions that trends in cancer survival and cancer incidence rates will continue as modeled by Mariotto and colleagues.[6] Specifically, the implied difference in 2020 all-site prevalence between the base scenario and the alternative prevalence scenarios in Mariotto and colleagues[6] was applied to the treated prevalence estimates by age, sex, and state categories. Cost scenarios were 0%, 2%, and 5% annual increases in real costs per person starting in 2008, the last year of source data.