



RURAL-URBAN
VARIATIONS IN
CANCER INCIDENCE,
DETECTION, AND
SURVIVAL IN
CALIFORNIA



UCDAVIS
INSTITUTE FOR POPULATION
HEALTH IMPROVEMENT



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EXECUTIVE SUMMARY

- ❖ During the period 2005 to 2016, the overall, ten-year average, age-adjusted cancer incidence rate was significantly higher among persons residing in urban (433.8 per 100,000) versus rural (429.3 per 100,000) and frontier (374.5 per 100,000) areas of California.
- ❖ The risk of certain types of cancer was higher among rural and frontier populations. The incidence of lung cancer was significantly higher among persons residing in rural (53.1 per 100,000) and frontier (54.2 per 100,000) areas compared to those residing in urban areas (48.0 per 100,000).
- ❖ Rural males had significantly higher incidence of lung cancer (59.7 per 100,000), urinary bladder cancer (35.2 per 100,000), and melanoma of the skin (31.8 per 100,000) compared to urban males (55.9 per 100,000, 32.8 per 100,000, and 29.2 per 100,000, respectively).
- ❖ Rural and frontier females had significantly higher incidence of lung cancer (47.8 per 100,000 and 50.3 per 100,000, respectively) compared to urban females (42.1 per 100,000). Rural females also had significantly higher incidence rates of melanoma of the skin (19.8 per 100,000) and kidney cancer (10.5 per 100,000) compared to urban females (16.0 per 100,000 and 9.8 per 100,000, respectively).
- ❖ Among non-Hispanic white persons, those residing in rural areas had significantly higher incidence of lung cancer (59.7 per 100,000) compared to those residing in urban areas (56.1 per 100,000).
- ❖ Among Hispanic persons, those residing in rural areas had significantly higher incidence of lung (31.0 per 100,000) and kidney (17.8 per 100,000) cancers compared to those residing in urban areas (27.7 per 100,000 and 16.4 per 100,000, respectively).
- ❖ African American women residing in rural areas had significantly higher incidence rates of cervical cancer (12.1 per 100,000) compared to those residing in urban areas (8.1 per 100,000).
- ❖ Among Asian/Pacific Islanders, those residing in rural areas had significantly higher incidence of melanoma of the skin (2.4 per 100,000) compared to those residing in urban areas (1.3 per 100,000).
- ❖ Frontier populations had significantly higher percentages of late stage diagnoses compared to rural and urban populations for three screen-detectable cancers – colon and rectum, melanoma of the skin, and oropharyngeal.
- ❖ Among non-Hispanic white persons, frontier populations had significantly higher percentages of late stage diagnoses for colon and rectum cancer, melanoma of the skin, and oropharyngeal cancer compared to rural and urban populations. Rural populations had significantly higher percentages of late stage diagnoses for lung and female breast cancer compared to urban populations.
- ❖ Among Hispanics, frontier populations had a significantly higher percentage of late stage diagnoses for female breast cancer compared to urban and rural populations.
- ❖ Frontier and rural cancer patients with private/government insurance had significantly higher percentages of late stage diagnoses compared to urban patients with private/government insurance. Frontier patients with Medicaid/public insurance and rural patients with no health insurance also had significantly higher percentages of late stage diagnoses compared to urban patients with the same type of insurance.
- ❖ Overall, cancer patients residing in rural and frontier areas of California had significantly lower five-year relative survival (64.4% and 60.4%, respectively) compared to cancer patients residing in urban areas (66.6%).
- ❖ Rural and frontier non-Hispanic white persons had significantly lower survival (64.7% and 60.4%, respectively) than their urban counterparts, and rural Hispanic persons had significantly lower survival (63.9%) than urban Hispanics (65.9%).

- ❖ Rural and frontier cancer patients diagnosed at both early (i.e. *in situ* and localized) and late (i.e. regional and distant) stage had significantly lower survival than rural cancer patients.
- ❖ Patients residing in frontier areas had lower one-, two-, three-, four-, and five-year relative survival for five of the seven screen-detectable cancers – prostate, colon and rectum, melanoma of the skin, lung, and oropharyngeal – compared to those residing in urban areas.
- ❖ Women residing in frontier areas diagnosed with breast cancer had lower two-, three-, four-, and five-year relative survival than women residing in urban areas.
- ❖ Compared to those residing in urban areas, five-year relative survival among persons residing in rural and frontier areas was significantly lower for cancers of the liver (14.5% and 6.7%, respectively, versus 18.7%) and prostate (96.3% and 94.5%, respectively, versus 97.2%).
- ❖ Patients residing in urban areas were 2.5 times more likely to survive liver cancer for five years following diagnosis than those residing in frontier areas.
- ❖ Frontier populations had significantly lower survival of female breast (85.4% versus 90.2%), colon and rectum (56.6% versus 65.0%), and oropharyngeal (53.7% versus 64.9%) cancers compared to urban populations.
- ❖ Rural populations had significantly lower survival of lung cancer (15.7% versus 17.7%), melanoma (86.7% versus 89.6%), and kidney cancer (69.3% versus 72.5%) compared to urban populations.
- ❖ Males residing in frontier areas had significantly lower survival than males residing in urban areas for cancers of the colon and rectum (54.5% versus 65.1%), oropharynx (53.3% versus 63.6%), and liver (5.1% versus 18.5%).
- ❖ Compared to males living in urban areas, males living in rural areas had significantly lower survival of cancer of the liver (14.1% versus 18.5%), lung (13.8% versus 15.2%), urinary bladder (74.1% versus 77.5%), and kidney (68.7% versus 72.1%), as well as for melanoma (83.5% versus 87.4%) and leukemia (56.0% versus 60.0%).
- ❖ Females residing in frontier areas had significantly lower survival of oropharyngeal cancers compared to those residing in urban areas (54.3% versus 67.8%).
- ❖ Non-Hispanic white persons residing in rural and frontier areas had lower survival compared to those residing in urban areas for female breast cancer (90.2% and 85.5%, respectively, versus 91.5%), prostate cancer (96.2% and 94.4%, respectively, versus 98.1%), and leukemia (55.8% and 50.5%, respectively, versus 60.7%). Additionally, frontier non-Hispanic white persons had significantly lower survival compared to urban non-Hispanic white persons for cancers of the oropharynx (55.0% versus 66.3%), colon and rectum (55.5% versus 65.7%), liver (6.4% versus 17.2%), and thyroid (92.2% versus 97.8%). Rural non-Hispanic white persons also had significantly lower survival than urban non-Hispanic white persons for lung cancer (15.6% versus 17.9%) and melanoma of the skin (86.8% versus 90.5%).
- ❖ Rural African American persons had significantly lower survival for urinary bladder (47.3% versus 65.6%) and kidney (58.6% versus 73.5%) cancers compared to urban African American persons but had significantly higher survival for prostate cancer (98.7% versus 95.8%).
- ❖ Among Hispanic persons, those residing in rural areas had significantly lower survival for colon and rectum cancer (60.5% versus 65.4%) and kidney cancer (68% versus 73.8%) compared to Hispanics residing in urban areas.

- ❖ Asian/Pacific Islander persons residing in rural areas had a significantly lower survival for kidney cancer (48.2%) compared to Asian/Pacific Islanders residing in urban areas (71.2%). Rural Asian/Pacific Islander persons also had significantly lower survival for oropharyngeal cancer (52.5%) compared to their urban counterparts (67.2%).
- ❖ Frontier populations had significantly lower survival for early stage colon and rectum cancer (79.9%) and early stage female breast cancer (93.9%) compared to urban populations (90.5% and 98.5%, respectively).
- ❖ Rural populations had significantly lower survival for early stage liver cancer (24.6%), lung cancer (50.3%), melanoma of the skin (95.1%), and urinary bladder cancer (81.7%) compared to urban populations (32.2%, 57.6%, 97.0%, and 84.4%, respectively).
- ❖ Frontier populations had significantly lower survival for late stage oropharyngeal cancer (47.5%) and liver cancer (1.6%) compared to urban populations (58.1% and 5.4%, respectively). Rural populations had significantly lower survival for late stage lung cancer (9.9%) compared to urban populations (11.0%).
- ❖ Among cancer patients in the lowest socioeconomic status tertile, those residing in frontier areas had significantly lower survival for liver cancer (3.9%) and leukemia (39.3%) compared to those residing in urban areas (15.2% and 53.0%, respectively).
- ❖ Urban women in the lowest socioeconomic status tertile had significantly lower survival of breast cancer (83.6%) compared to rural women in the lowest socioeconomic status tertile (86.0%).
- ❖ Among cancer patients in the middle socioeconomic status tertile, those residing in frontier areas had significantly lower survival for oropharyngeal (46.2%) and thyroid (87.5%) cancers compared to those in the middle socioeconomic status tertile residing in urban areas (63.4% and 96.7%, respectively).
- ❖ Cancer patients in the highest socioeconomic status tertile residing in rural areas had significantly lower survival for lung cancer (18.7%) compared to those in the highest socioeconomic status tertile residing in urban areas (21.7%).

INTRODUCTION

With over 37 million people, California is the most populous state in the nation.¹ Although more urbanized than the nation as a whole, California has a large rural land mass, with rural communities spread throughout multiple counties. Accounting for variations across rural classification schemes, the proportion of the statewide population living in rural areas ranges from three to 15 percent.²

On average, rural residents are older, more economically disadvantaged, and in generally poorer health than individuals living in urban areas.³ Multiple factors related to access to care, including the availability of appropriately trained healthcare providers in rural areas, transportation issues, financial barriers, and access to clinical trials have been identified in previous research studies as issues for rural cancer patients.⁴ Previous studies have also found that rural residents have lower cancer screening rates, later stage at diagnosis for screen-detectable cancers, and higher mortality rates.⁵ Limited local support services and declining number of health care facilities in rural areas nationwide contribute to a growing problem. In California, 20 rural hospitals have closed since 1995, and among the 50 remaining, four are at high risk of closing.⁶

The purpose of this report was to evaluate differences in cancer incidence, detection, and survival among persons residing in rural and urban areas of California. These analyses required a definition of urban and rural that adequately depicts the California population. Although several classification schemes exist, there is not a single, universally agreed-upon definition of rural. Several definitions employed by federal agencies are at the county-level, which is not appropriate for California. Forty-four of California's 58 counties have large rural populations. However, only four of these counties meet a federal definition as entirely rural. To adequately evaluate and compare the cancer burden among urban and rural populations in California, a subcounty-level definition was necessary. For this report, we used the classification scheme known as Medical Service Study Areas (MSSAs) to define urban and rural communities in California (see Technical Notes for detailed information on MSSAs).

Data for this report were obtained from the California Cancer Registry (CCR). The CCR is California's statewide cancer surveillance system and has been collecting information on all cancers diagnosed among California residents since January 1, 1988. Since July 2012, the California Department of Public Health has partnered with the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program within the University of California Davis, Institute for Population Health Improvement to manage the operations of the CCR.

TECHNICAL NOTES

Cases

Data presented in this report came from the California Cancer Registry (CCR). The CCR is California's statewide, population-based, cancer surveillance system. This report includes incident cancer cases diagnosed in California between January 1, 2005 and December 31, 2016 and reported to the CCR as of December 2018.

Geographic Unit of Analysis

The geographic unit of analysis used in this report was a subcounty classification scheme known as Medical Service Study Areas (MSSAs). MSSAs were developed by the California Office of Statewide Health Planning and Development (OSHPD) to identify medically underserved areas.⁷ MSSAs are aggregations of Census tracts that are categorized as urban, rural, or frontier areas. Frontier areas are the least populous and have a population density of less than 11 persons per square mile. Rural areas have a population density of less than 250 persons per square mile and do not have a Census-defined place with a population exceeding 50,000 within the area. Any MSSA that is neither frontier nor rural is considered urban. In 2010, there were 542 MSSAs in California of which 54 were classified as frontier, 173 were classified as rural, and 315 were classified as urban (Figure 1). According to this definition, approximately 261,000 persons (or < 1% of the California population) resided in frontier areas, 4.7 million persons (12%) resided in rural areas, and 32.3 million (87%) resided in urban areas.

Statistics

Incidence Rates

Age-adjusted incidence rates and their 95% confidence intervals were calculated. Age-adjusted rates are a weighted average of the crude rates, where the weights represent the age distribution of a standard population. Adjusting for age eliminates differences in rates resulting from differences in the age distribution between population groups. Rates were calculated per 100,000 persons and age-adjusted to the 2000 United States standard population. Rates based on fewer than 15 observations were suppressed.

Relative Survival

The measure of cancer survival used in this report was relative survival. Relative survival estimates the probability of surviving a particular type of cancer during a specified time period. Relative survival is the ratio (expressed as a percent) of cancer patients who survived for a given time period following diagnosis (observed survival rate) to the expected survival rate of a similar group of cancer-free individuals based on age, race/ethnicity, and sex. The expected survival rates used in this report were based on life tables specific to the California population. A relative survival of 100% means that patients diagnosed with a particular type of cancer are just as likely to survive the specified time period as a similar group of individuals in the general population without cancer. Survival was calculated when there were at least 25 cancer patients alive at the beginning of the time interval.

Variable Definitions

Stage at Diagnosis

Stage at diagnosis was defined according to the Surveillance, Epidemiology, and End Results (SEER) Program's Summary Stage classification scheme. In this scheme, tumors are classified as *in situ*, localized, regional, or distant. *In situ* tumors are non-invasive and do not penetrate the basement membrane. Localized tumors are confined entirely to the organ of origin. Regional tumors extend into surrounding organs, tissues, or regional lymph nodes. Distant tumors have metastasized to other parts of the body. In this report, *in situ* and localized tumors were defined as early stage and regional and distant tumors were defined as late stage.

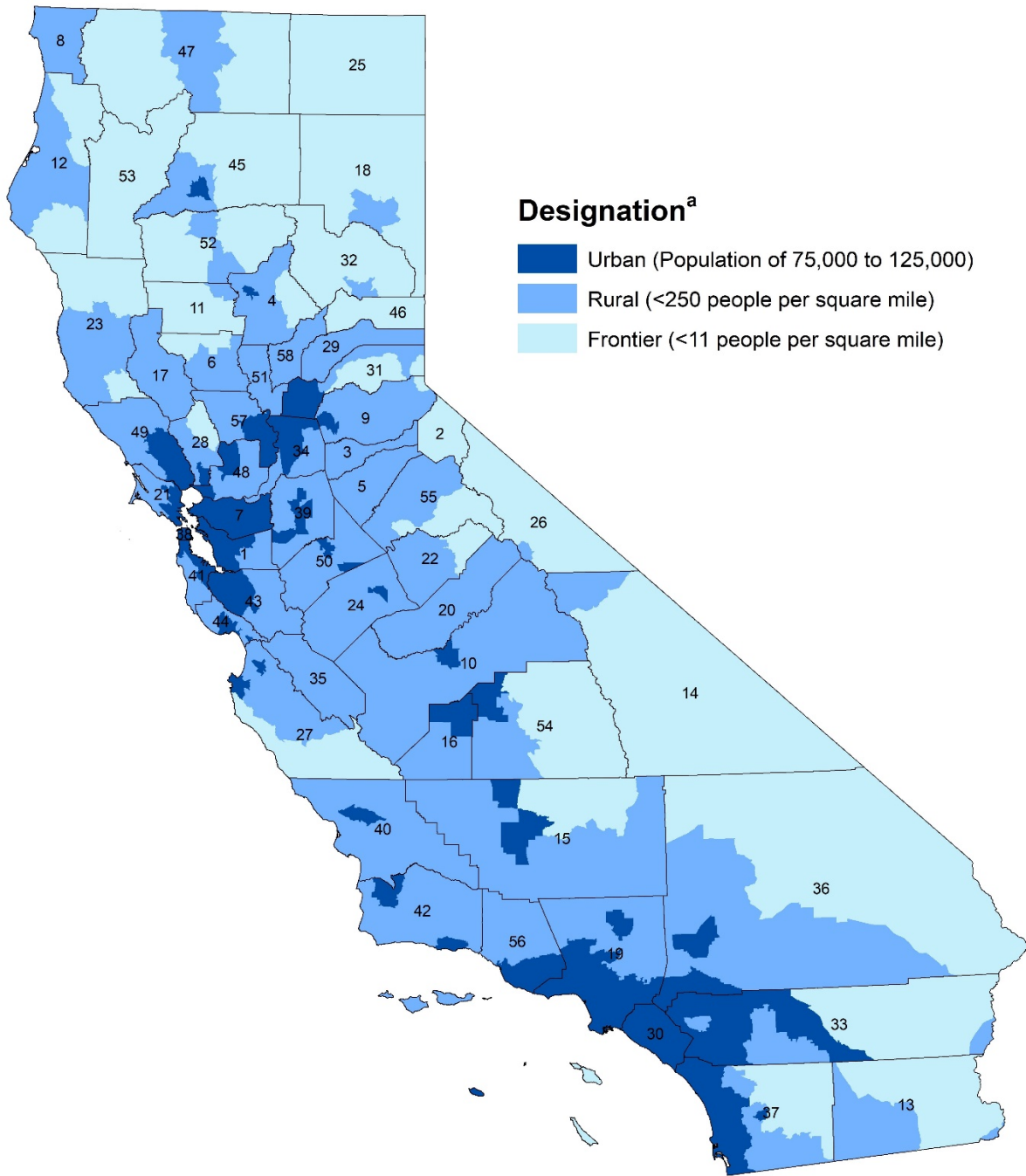
Socioeconomic Status

A neighborhood-level socioeconomic status (SES) measure was utilized in this report. This SES measure is a composite score created using principal component analysis and incorporates Census tract-level measures of employment, income, housing characteristics, and education. A SES score was calculated for each Census tract in California. A patient's SES is based on the Census tract in which they resided at the time of their cancer diagnosis. The SES score for all cancer patients was divided into tertiles representing low-, middle-, and high-socioeconomic status.

Type of Health Insurance

Patients' health insurance information was obtained from the latest report received by the CCR regarding the patient's tumor. Health insurance was categorized as either private/government, Medicare with no supplement, Medicaid/public, uninsured, or unknown. The Private/Government category included private managed care, HMO, PPO, and fee-for-service plans, as well as Medicare with private supplement, TRICARE, Military, and Veterans Affairs (VA). The Medicaid/Public category included Medicaid, Medicare without supplement, Medicare with Medicaid, Indian/Public Health Service plans, and county funded plans.

Figure 1. Urban, Rural, and Frontier Medical Service Study Areas (MSSAs) in California



^aDesignations based on Medical Service Study Areas, 2010.

1 Alameda	10 Fresno	19 Los Angeles	28 Napa	37 San Diego	46 Sierra	55 Tuolumne
2 Alpine	11 Glenn	20 Madera	29 Nevada	38 San Francisco	47 Siskiyou	56 Ventura
3 Amador	12 Humboldt	21 Marin	30 Orange	39 San Joaquin	48 Solano	57 Yolo
4 Butte	13 Imperial	22 Mariposa	31 Placer	40 San Luis Obispo	49 Sonoma	58 Yuba
5 Calaveras	14 Inyo	23 Mendocino	32 Plumas	41 San Mateo	50 Stanislaus	
6 Colusa	15 Kern	24 Merced	33 Riverside	42 Santa Barbara	51 Sutter	
7 Contra Costa	16 Kings	25 Modoc	34 Sacramento	43 Santa Clara	52 Tehama	
8 Del Norte	17 Lake	26 Mono	35 San Benito	44 Santa Cruz	53 Trinity	
9 El Dorado	18 Lassen	27 Monterey	36 San Bernardino	45 Shasta	54 Tulare	

RESULTS

Cancer Incidence

Overall

Between 2006 and 2015, 1,823,775 cancers were diagnosed in California. Of these, 1,568,373 (86.0%) were diagnosed among persons residing in urban areas, 240,347 (13.2%) were diagnosed among persons residing in rural areas, and 15,055 (0.8%) were diagnosed among persons residing in frontier areas. Cancer patients residing in urban, rural, and frontier areas of California differed regarding sociodemographic characteristics. In rural and frontier areas, a larger proportion of cancer patients were male, non-Hispanic white, diagnosed at age 55 years and older, in the lowest socioeconomic status tertile, and had Medicaid/public health insurance compared to cancer patients residing in urban areas (Table 1.1).

Table 1.1 Characteristics of cancer patients residing in urban, rural, and frontier areas of California, 2006-2015 (N=1,823,775)

Characteristic	Urban		Rural		Frontier	
	N	%	N	%	N	%
All Cases	1,568,373	86.0	240,347	13.2	15,055	0.8
Sex						
Male	755,063	48.1	123,084	51.2	8,379	55.7
Female	813,040	51.8	117,242	48.8	6,674	44.3
Other	270	0.0	21	0.0	2	0.0
Race/Ethnicity						
Non-Hispanic White	956,109	61.0	180,877	75.3	13,044	86.6
Hispanic	283,226	18.1	38,469	16.0	947	6.3
Asian/Pacific Islander	183,361	11.7	6,757	2.8	136	0.9
African American	109,443	7.0	5,706	2.4	191	1.3
Other/Unknown	36,234	2.3	8,538	3.6	737	4.9
Age (years)						
0-39	103,880	6.6	12,679	5.3	513	3.4
40-54	281,056	17.9	38,231	15.9	1,972	13.1
55-69	571,848	36.5	93,324	38.8	6,245	41.5
70+	611,589	39.0	96,113	40.0	6,325	42.0
Stage at Diagnosis						
<i>In Situ</i>	153,665	9.8	24,047	10.0	1,303	8.7
Localized	633,528	40.4	95,980	39.9	5,672	37.7
Regional	290,471	18.5	43,444	18.1	2,784	18.5
Distant	338,574	21.6	53,330	22.2	3,537	23.5
Unknown	152,135	9.7	23,546	9.8	1,759	11.7
Socioeconomic Status						
Low	373,730	23.8	86,686	36.1	8,209	54.5
Medium	525,893	33.5	104,488	43.5	6,545	43.5
High	668,750	42.6	49,173	20.5	301	2.0
Health Insurance						
Private/Government	980,069	62.5	136,640	56.9	8,204	54.5
Medicare, No Supplement	97,738	6.2	14,337	6.0	734	4.9
Medicaid/Public	371,661	23.7	68,776	28.6	4,644	30.9
Uninsured	25,443	1.6	2,870	1.2	225	1.5
Unknown	93,462	6.0	17,724	7.4	1,248	8.3

Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

During the period 2005 to 2016, the overall, ten-year average, age-adjusted cancer incidence rate was significantly higher among persons residing in urban (433.8 per 100,000) versus rural (429.3 per 100,000) and frontier (374.5 per 100,000) areas of California. However, the risk of certain types of cancer was higher among rural and frontier populations. The incidence of lung cancer was significantly higher among rural (53.1 per 100,000) and frontier (54.2 per 100,000) populations compared to the urban population (48.0 per 100,000). Urinary bladder and kidney cancers, as well as melanoma of the skin and leukemia were also significantly higher in the rural population compared to the urban population, although the differences for leukemia and kidney cancer were relatively small (Table 1.2). Persons residing in frontier areas also had higher incidence of urinary bladder and oropharyngeal cancers compared to persons residing in urban areas, but these differences were not statistically significant.

Table 1.2 Ten-year, age-adjusted incidence rates (AAIR) of the most commonly diagnosed cancers among persons residing in urban, rural, and frontier areas of California, 2005-2016

Cancer Type	Urban			Rural			Frontier		
	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval
All Cancer	1,362,743	433.8	433.0, 434.5	209,785	429.3	427.5, 431.2	13,406	374.5	367.9, 381.1
Prostate	180,368	126.2	125.6, 126.8	29,096	119.9	118.5, 121.4	1,973	99.8	95.3, 104.4
Female Breast	214,558	125.9	125.4, 126.4	29,956	118.5	117.1, 119.8	1,684	98.8	93.9, 104.0
Lung	145,023	48.0	47.7, 48.2	25,457	53.1	52.4, 53.8	1,992	54.2	51.8, 56.7
Colon and Rectum	127,567	40.8	40.6, 41.0	18,596	38.5	37.9, 39.1	1,212	34.1	32.2, 36.2
Uterus	43,760	25.1	24.9, 25.3	5,899	22.5	22.0, 23.1	356	19.7	17.6, 22.0
Melanoma of Skin	68,182	21.6	21.4, 21.8	12,243	25.2	24.7, 25.6	735	20.8	19.3, 22.4
Non-Hodgkin Lymphoma	60,894	19.5	19.4, 19.7	8,992	18.6	18.2, 19.0	530	15.3	14.0, 16.7
Urinary Bladder	56,147	18.5	18.3, 18.6	9,690	20.5	20.1, 20.9	694	19.7	18.3, 21.3
Kidney	45,965	14.6	14.4, 14.7	7,455	15.1	14.8, 15.5	451	12.7	11.5, 14.0
Leukemia	40,686	13.0	12.9, 13.2	6,458	13.6	13.3, 14.0	382	11.6	10.5, 12.9
Ovary	21,348	12.5	12.3, 12.6	2,985	11.8	11.4, 12.2	168	9.6	8.1, 11.3
Thyroid	40,085	12.4	12.3, 12.5	5,060	10.7	10.4, 11.1	233	7.6	6.6, 8.8
Pancreas	37,421	12.1	12.0, 12.3	5,640	11.6	11.3, 12.0	293	8.0	7.1, 9.1
Oropharynx	33,974	10.6	10.5, 10.7	5,601	11.0	10.7, 11.3	434	11.6	10.5, 12.8
Liver	32,564	10.1	10.0, 10.2	4,406	8.4	8.2, 8.7	269	6.7	5.9, 7.6
Cervix	12,796	7.8	7.6, 7.9	1,731	7.7	7.3, 8.1	98	7.9	6.3, 9.8

Rates are per 100,000 and age-adjusted to the 2000 U.S. Standard Population. Bold text indicates the AAIR is significantly higher in the rural and/or frontier population compared to the urban population. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Sex

Table 1.3 shows the risk of cancer among urban, rural, and frontier populations in California by sex. Overall, males residing in urban areas had significantly higher incidence of all cancers combined (485.8 per 100,000) compared to males residing in rural (476.1 per 100,000) and frontier (413.8 per 100,000) areas. However, rural males had significantly higher incidence of lung cancer (59.7 per 100,000), urinary bladder cancer (35.2 per 100,000), and melanoma of the skin (31.8 per 100,000) compared to urban males (55.9 per 100,000, 32.8 per 100,000, and

29.2 per 100,000, respectively). Frontier males also had higher incidence of lung cancer (58.9 per 100,000) and oropharyngeal cancer (16.8 per 100,000) compared to urban males (55.9 per 100,000 and 15.9 per 100,000, respectively), but these differences were not statistically significant.

Urban females had significantly higher incidence of all cancers combined (398.8 per 100,000) compared to rural (393.6 per 100,000) and frontier (340.1 per 100,000) females. However, rural and frontier females had significantly higher incidence of lung cancer (47.8 per 100,000 and 50.3 per 100,000, respectively) compared to urban females (42.1 per 100,000). Furthermore, rural females also had significantly higher incidence of melanoma of the skin (19.8 per 100,000) and kidney cancer (10.5 per 100,000) compared to urban females (16.0 per 100,000 and 9.8 per 100,000, respectively).

Table 1.3. Ten-year, age-adjusted incidence rates (AAIR) of the most commonly diagnosed cancers among persons residing in urban, rural, and frontier areas of California by sex, 2005-2016

Male										
Cancer Type	Urban			Rural			Frontier			
	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval	
All Cancer	682,214	485.8	484.6, 486.9	110,887	476.1	473.2, 479.0	7,646	413.8	404.2, 423.6	
Prostate	180,368	126.2	125.6, 126.8	29,096	119.9	118.5, 121.4	1,973	99.8	95.3, 104.4	
Lung	73,834	55.9	55.5, 56.3	13,321	59.7	58.7, 60.8	1,077	58.9	55.3, 62.7	
Colon and Rectum	65,961	47.1	46.7, 47.5	9,987	43.5	42.6, 44.4	726	39.8	36.8, 42.9	
Urinary Bladder	42,818	32.8	32.5, 33.2	7,612	35.2	34.4, 36.0	551	31.9	29.2, 34.8	
Melanoma of Skin	40,903	29.2	28.9, 29.4	7,370	31.8	31.1, 32.6	462	25.4	23.0, 27.9	
Non-Hodgkin Lymphoma	33,599	23.9	23.7, 24.2	5,068	22.0	21.4, 22.6	328	18.7	16.7, 21.0	
Kidney	29,261	20.3	20.0, 20.5	4,810	20.1	19.5, 20.7	295	15.9	14.1, 18.0	
Leukemia	23,484	16.7	16.5, 16.9	3,902	17.3	16.8, 17.9	247	14.5	12.7, 16.6	
Oropharynx	23,622	15.9	15.7, 16.1	4,059	16.3	15.8, 16.8	328	16.8	14.9, 18.8	
Liver	23,141	15.4	15.2, 15.6	3,250	12.5	12.1, 13.0	216	10.3	8.9, 11.8	
Pancreas	18,748	13.7	13.5, 13.9	2,984	13.1	12.6, 13.6	167	9.1	7.7, 10.7	
Thyroid	9,644	6.3	6.2, 6.4	1,213	5.0	4.7, 5.3	61	3.3	2.5, 4.3	
Female										
All Cancer	680,529	398.8	397.8, 399.7	98,898	393.6	391.1, 396.1	5,760	340.1	330.9, 349.5	
Female Breast	214,558	125.9	125.4, 126.4	29,956	118.5	117.1, 119.8	1,684	98.8	93.9, 104.0	
Lung	71,189	42.1	41.8, 42.5	12,136	47.8	47.0, 48.7	915	50.3	47.0, 53.8	
Colon and Rectum	61,606	35.6	35.3, 35.9	8,609	34.0	33.3, 34.7	486	28.6	26.0, 31.4	
Uterus	43,760	25.1	24.9, 25.3	5,899	22.5	22.0, 23.1	356	19.7	17.6, 22.0	
Thyroid	30,441	18.3	18.1, 18.5	3,847	16.8	16.3, 17.4	172	13.0	11.0, 15.3	
Melanoma of Skin	27,279	16.0	15.8, 16.2	4,873	19.8	19.2, 20.4	273	16.9	14.8, 19.3	
Non-Hodgkin Lymphoma	27,295	16.0	15.8, 16.2	3,924	15.6	15.1, 16.1	202	11.7	10.1, 13.6	
Ovary	21,348	12.5	12.3, 12.6	2,985	11.8	11.4, 12.2	168	9.6	8.1, 11.3	
Pancreas	18,673	10.8	10.7, 11.0	2,656	10.4	10.0, 10.8	126	6.9	5.7, 8.3	
Leukemia	17,202	10.2	10.0, 10.3	2,556	10.4	10.0, 10.8	135	8.8	7.3, 10.6	
Kidney	16,704	9.8	9.7, 10.0	2,645	10.5	10.1, 10.9	156	9.1	7.6, 10.7	
Cervix	12,796	7.8	7.6, 7.9	1,731	7.7	7.3, 8.1	98	7.9	6.3, 9.8	
Urinary Bladder	13,329	7.7	7.6, 7.9	2,078	8.2	7.8, 8.5	143	8.0	6.7, 9.5	
Oropharynx	10,352	6.0	5.9, 6.2	1,542	6.0	5.7, 6.3	106	6.0	4.9, 7.4	
Liver	9,423	5.5	5.4, 5.6	1,156	4.5	4.2, 4.7	53	2.9	2.2, 3.9	

Rates are per 100,000 and age-adjusted to the 2000 U.S. Standard Population. Bold text indicates the AAIR is significantly higher in the rural and/or frontier population compared to the urban population. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Race/Ethnicity

Overall, non-Hispanic white, Hispanic, and African American persons residing in urban areas had significantly higher cancer incidence (491.1 per 100,000, 351.2 per 100,000, and 501.1 per 100,000, respectively) compared to their counterparts residing in rural (458.5 per 100,000, 344.2 per 100,000, and 476.5 per 100,000, respectively) and frontier areas (390.9 per 100,000, 281.8 per 100,000, and 419.5 per 100,000, respectively). Among non-Hispanic white persons, those residing in rural areas had significantly higher incidence of lung cancer (59.7 per 100,000) compared to those residing in urban areas (56.1 per 100,000) (Table 1.4). Among Hispanic persons, those residing in rural areas had significantly higher incidence of lung (31.0 per 100,000) and kidney (17.8 per 100,000) cancers compared to those residing in urban areas (27.7 per 100,000 and 16.4 per 100,000, respectively) (Table 1.5). African American women residing in rural areas had significantly higher incidence of cervical cancer (12.1 per 100,000) compared to those residing in urban areas (8.1 per 100,000) (Table 1.6). Among Asian/Pacific Islander individuals, those residing in rural areas had significantly higher incidence of melanoma of the skin (2.4 per 100,000) compared to those residing in urban areas (1.3 per 100,000) (Table 1.7). All other differences by geography and race/ethnicity were not significant.

Table 1.4. Ten-year, age-adjusted incidence rates (AAIR) of the most commonly diagnosed cancers among non-Hispanic white persons residing in urban, rural, and frontier areas of California, 2005-2016

Cancer Type	Urban			Rural			Frontier		
	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval
All Cancer	825,426	491.1	490.0, 492.2	158,106	458.5	456.2, 460.9	11,663	390.9	383.4, 398.6
Female Breast	128,062	148.2	147.4, 149.0	22,496	127.8	126.0, 129.5	1,477	103.8	98.1, 109.8
Prostate	107,252	131.0	130.2, 131.8	21,598	120.4	118.7, 122.0	1,707	101.0	96.1, 106.2
Lung	97,135	56.1	55.8, 56.5	21,243	59.7	58.9, 60.5	1,807	57.5	54.8, 60.4
Colon and Rectum	72,266	41.9	41.6, 42.2	13,704	39.7	39.0, 40.4	1,037	34.5	32.4, 36.8
Melanoma of Skin	59,185	36.6	36.2, 36.9	10,454	31.8	31.1, 32.4	655	22.9	21.0, 24.9
Uterus	24,760	27.2	26.8, 27.5	4,410	23.7	23.0, 24.5	310	20.3	17.9, 22.9
Urinary Bladder	41,856	23.9	23.6, 24.1	8,219	23.3	22.8, 23.8	646	21.4	19.8, 23.2
Non-Hodgkin Lymphoma	36,303	21.8	21.6, 22.1	6,572	19.3	18.8, 19.8	440	15.2	13.8, 16.9
Kidney	25,435	15.2	15.0, 15.4	5,107	14.9	14.5, 15.3	368	12.5	11.1, 13.9
Leukemia	24,316	15.1	14.9, 15.3	4,612	14.3	13.8, 14.7	333	12.4	10.9, 13.9
Thyroid	19,963	14.0	13.8, 14.2	3,232	11.7	11.2, 12.1	190	8.4	7.1, 9.9
Ovary	12,188	13.9	13.6, 14.1	2,171	12.4	11.8, 12.9	152	10.2	8.5, 12.1
Oropharynx	22,574	13.2	13.1, 13.4	4,593	12.9	12.5, 13.3	389	12.3	11.0, 13.7
Pancreas	22,340	12.7	12.5, 12.9	4,229	11.8	11.5, 12.2	255	8.3	7.3, 9.5
Liver	12,356	7.0	6.9, 7.1	2,552	6.8	6.5, 7.1	195	5.8	5.0, 6.8
Cervix	4,834	7.0	6.8, 7.2	936	7.2	6.7, 7.7	76	8.0	6.1, 10.3

Rates are per 100,000 and age-adjusted to the 2000 U.S. Standard Population. Bold text indicates the AAIR is significantly higher in the rural and/or frontier population compared to the urban population. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Table 1.5. Ten-year, age-adjusted incidence rates (AAIR) of the most commonly diagnosed cancers among Hispanic persons residing in urban, rural, and frontier areas of California, 2005-2016

Cancer Type	Urban			Rural			Frontier		
	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval
All Cancer	250,938	351.2	349.8, 352.7	34,449	344.2	340.3, 348.1	848	281.8	261.5, 303.2
Prostate	30,581	111.4	110.1, 112.7	4,506	106.7	103.4, 110.0	101	74.0	58.9, 91.5
Female Breast	39,081	92.7	91.8, 93.7	5,099	91.4	88.9, 94.1	113	75.5	61.8, 91.3
Colon and Rectum	24,152	35.9	35.4, 36.4	3,315	34.6	33.3, 35.9	96	31.9	25.3, 39.5
Lung	16,075	27.7	27.3, 28.2	2,543	31.0	29.8, 32.3	80	31.9	24.9, 40.0
Uterus	9,282	21.9	21.4, 22.3	1,034	18.6	17.4, 19.8	19	13.8	8.1, 21.8
Non-Hodgkin Lymphoma	12,946	18.4	18.0, 18.7	1,721	17.3	16.4, 18.2	51	18.6	13.4, 24.9
Kidney	11,899	16.4	16.1, 16.7	1,823	17.8	16.9, 18.7	49	16.6	11.9, 22.4
Liver	9,456	13.8	13.6, 14.1	1,327	13.1	12.3, 13.8	38	12.0	8.2, 16.9
Pancreas	6,942	11.4	11.1, 11.7	965	11.3	10.6, 12.1	22	9.0	5.5, 13.7
Ovary	4,817	11.3	11.0, 11.6	609	10.8	9.9, 11.7	^	^	^
Thyroid	10,669	11.1	10.9, 11.3	1,356	10.1	9.5, 10.7	27	5.7	3.7, 8.4
Urinary Bladder	6,250	10.8	10.5, 11.1	893	11.0	10.2, 11.8	23	8.6	5.1, 13.2
Leukemia	9,414	10.5	10.3, 10.8	1,368	11.0	10.4, 11.7	23	6.5	3.8, 10.4
Cervix	4,847	10.0	9.7, 10.3	582	9.3	8.6, 10.2	^	^	^
Oropharynx	4,665	6.5	6.3, 6.7	605	5.8	5.3, 6.3	20	6.6	3.8, 10.4
Melanoma of Skin	3,563	4.7	4.6, 4.9	511	4.9	4.5, 5.4	24	7.5	4.6, 11.5

Rates are per 100,000 and age-adjusted to the 2000 U.S. Standard Population. Bold text indicates the AAIR is significantly higher in the rural and/or frontier population compared to the urban population. ^Rates/counts were suppressed when there were fewer than 15 cases. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Table 1.6. Ten-year, age-adjusted incidence rates (AAIR) of the most commonly diagnosed cancers among African American persons residing in urban, rural, and frontier areas of California, 2005-2016

Cancer Type	Urban			Rural			Frontier		
	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval
All Cancer	98,409	501.1	497.9, 504.3	5,121	476.5	462.8, 490.5	171	419.5	351.7, 496.0
Prostate	18,838	206.9	203.8, 210.0	1,061	179.8	168.1, 192.1	44	117.7	80.5, 167.1
Female Breast	15,238	138.7	136.5, 141.0	681	140.0	129.5, 151.2	^	^	52.1, 200.0
Lung	12,422	66.2	65.0, 67.4	683	69.9	64.5, 75.6	31	86.2	55.9, 125.8
Colon and Rectum	10,498	55.0	54.0, 56.1	529	50.1	45.7, 54.9	^	^	^
Uterus	2,994	26.6	25.7, 27.6	119	23.9	19.7, 28.7	^	^	^
Kidney	3,839	19.2	18.6, 19.9	188	16.6	14.2, 19.3	^	^	^
Pancreas	3,083	16.4	15.8, 17.0	185	18.7	16.0, 21.8	^	^	^
Non-Hodgkin Lymphoma	3,189	16.3	15.7, 16.9	185	16.8	14.3, 19.6	^	^	^
Urinary Bladder	2,671	14.9	14.3, 15.5	143	15.1	12.6, 17.9	^	^	^
Liver	2,621	12.3	11.8, 12.8	154	13.8	11.6, 16.2	^	^	^
Leukemia	2,251	11.9	11.4, 12.4	130	12.9	10.7, 15.4	^	^	^
Ovary	1,179	10.8	10.2, 11.5	56	11.5	8.6, 15.0	^	^	^
Oropharynx	2,028	9.8	9.4, 10.2	96	7.9	6.3, 9.8	^	^	^
Thyroid	1,671	8.2	7.8, 8.6	84	6.8	5.4, 8.5	^	^	^
Cervix Uteri	881	8.1	7.6, 8.7	57	12.1	9.1, 15.7	^	^	^
Melanoma of Skin	222	1.2	1.0, 1.4	16	1.7	0.9, 2.8	^	^	^

Rates are per 100,000 and age-adjusted to the 2000 U.S. Standard Population. Bold text indicates the AAIR is significantly higher in the rural and/or frontier population compared to the urban population. ^Rates/counts were suppressed when there were fewer than 15 cases. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Table 1.7. Ten-year, age-adjusted incidence rates (AAIR) of the most commonly diagnosed cancers among Asian/Pacific Islander persons residing in urban, rural, and frontier areas of California, 2005-2016

Cancer Type	Urban			Rural			Frontier		
	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval	N	AAIR	95% Confidence Interval
All Cancer	161,269	334.5	332.8, 336.1	6,006	326.0	317.6, 334.5	121	357.5	294.8, 429.9
Female Breast	29,731	106.4	105.2, 107.6	1,126	104.8	98.6, 111.2	^	^	^
Prostate	15,488	74.2	73.0, 75.4	607	76.2	70.1, 82.8	^	^	^
Lung	18,551	40.2	39.6, 40.8	656	37.5	34.6, 40.5	^	^	^
Colon and Rectum	18,953	39.5	38.9, 40.1	660	36.1	33.3, 39.0	18	55.2	32.3, 88.3
Uterus	6,157	21.4	20.9, 22.0	212	19.2	16.7, 22.1	^	^	^
Liver	7,801	16.2	15.8, 16.6	241	13.1	11.5, 14.9	^	^	^
Non-Hodgkin Lymphoma	7,198	15.2	14.8, 15.5	263	15.0	13.2, 16.9	^	^	^
Thyroid	7,188	14.2	13.9, 14.5	264	13.5	11.9, 15.2	^	^	^
Ovary	2,991	10.8	10.4, 11.2	113	10.8	8.9, 13.0	^	^	^
Pancreas	4,838	10.5	10.2, 10.8	182	10.5	9.0, 12.1	^	^	^
Urinary Bladder	4,365	9.6	9.4, 9.9	164	9.5	8.1, 11.1	^	^	^
Kidney	4,319	8.9	8.6, 9.2	157	8.3	7.1, 9.8	^	^	^
Leukemia	3,904	8.5	8.3, 8.8	148	8.4	7.0, 9.8	^	^	^
Oropharynx	4,157	8.4	8.1, 8.6	137	6.9	5.7, 8.1	^	^	^
Cervix	2,025	7.3	7.0, 7.7	98	9.3	7.5, 11.4	^	^	^
Melanoma of Skin	632	1.3	1.2, 1.4	43	2.4	1.7, 3.2	^	^	^

Rates are per 100,000 and age-adjusted to the 2000 U.S. Standard Population. Bold text indicates the AAIR is significantly higher in the rural and/or frontier population compared to the urban population. ^Rates/counts were suppressed when there were fewer than 15 cases. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

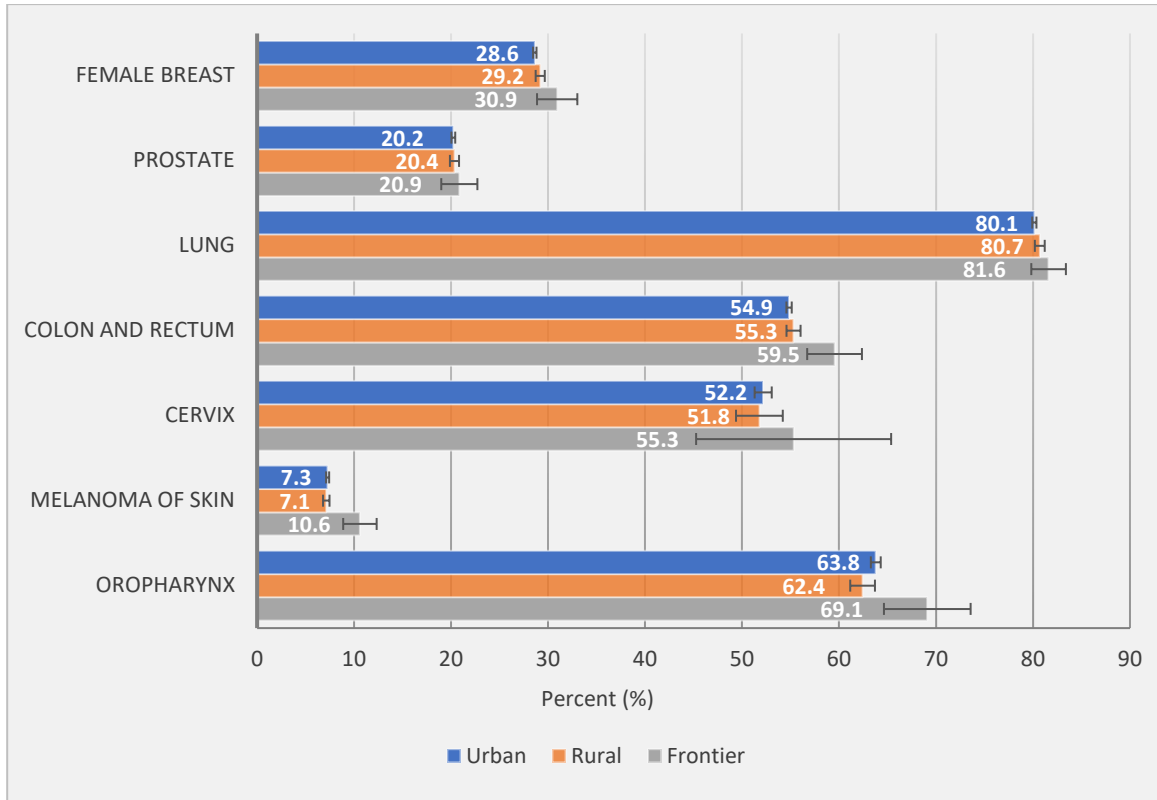
Cancer Detection

This section presents data on seven types of cancer that have the greatest potential for early diagnosis through screening. These cancers (female breast, prostate, lung, colon and rectum, cervix, melanoma of the skin, and oropharynx) can be screened through visual inspection (oral cancer and melanoma) or procedures/tests such as mammography (breast), colonoscopy (colon and rectum), fecal testing (colon and rectum), Pap smears (cervix), prostate-specific antigen (PSA) tests, or low dose CT screening (lung). Figures show the percentage of cases diagnosed at late stage for each cancer site. Late stage is defined as regional or distant spread of the cancer at the time of diagnosis based on SEER summary stage groupings. Results are presented as percentages with 95% confidence intervals.

Overall

Figure 2.1 shows the percent of patients diagnosed at late stage in urban, rural, and frontier areas for the seven cancers that have screening tests. There were substantial differences between cancer sites in the overall percentage of patients diagnosed at late stage, with lung cancer having the greatest percentage followed by oropharyngeal and colon and rectum cancers. For each cancer site, frontier populations had the greatest percentage of late stage diagnoses, but for most sites the differences were not significant. However, for colon and rectum cancer, melanoma of the skin, and oropharyngeal cancer, frontier populations had significantly increased percentages of late stage diagnoses compared to rural and urban populations. For each site, the difference between rural and urban populations was not significant.

Figure 2.1. Percent of screen-detectable cancers diagnosed at late stage among persons residing in urban, rural, and frontier areas of California with 95% confidence intervals, 2006-2015

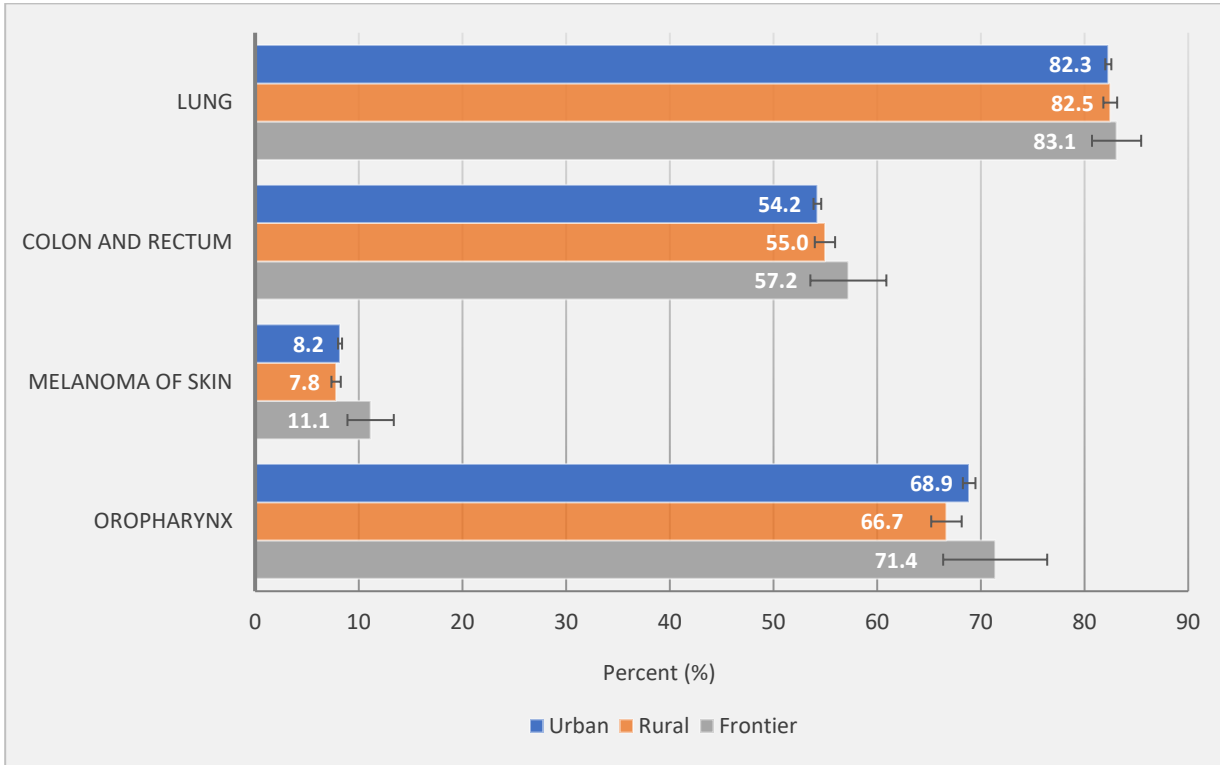


I—I: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Sex

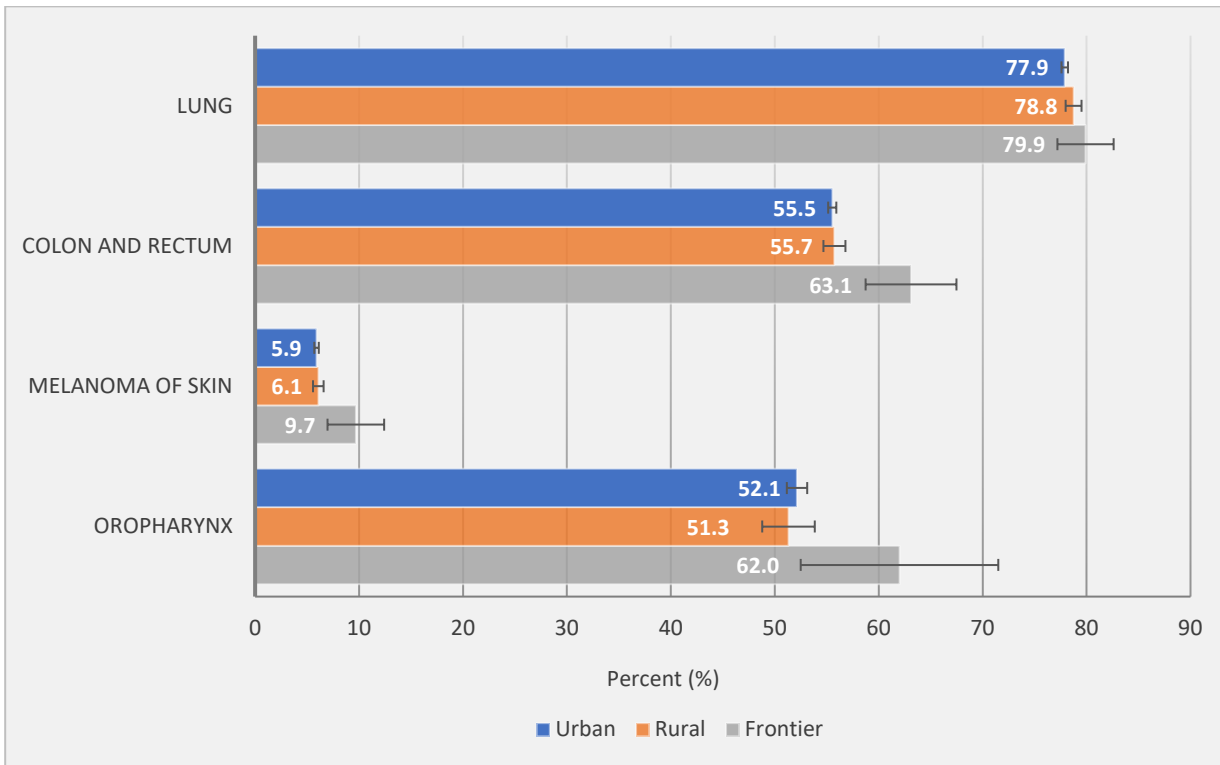
Figures 2.2 and 2.3 show the percent of patients diagnosed at late stage in urban, rural, and frontier areas by sex. For each site except colon and rectum, males had greater percentages than females of late stage diagnoses. For each site for both males and females, frontier populations had the greatest percentage of late stage diagnoses. However, these differences were only significant for melanoma of the skin in males and females and colon and rectum cancer in females. Differences between urban and rural populations were approximately one percentage point or less for all cancer sites except oropharyngeal cancer in males where rural populations had a small (2.2%) but significantly decreased percentage of late stage diagnoses compared to urban populations.

Figure 2.2. Percent of screen-detectable cancers diagnosed at late stage among males residing in urban, rural, and frontier areas of California with 95% confidence intervals, 2006-2015



I-I: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 2.3. Percent of screen-detectable cancers diagnosed at late stage among females residing in urban, rural, and frontier areas of California with 95% confidence intervals, 2006-2015

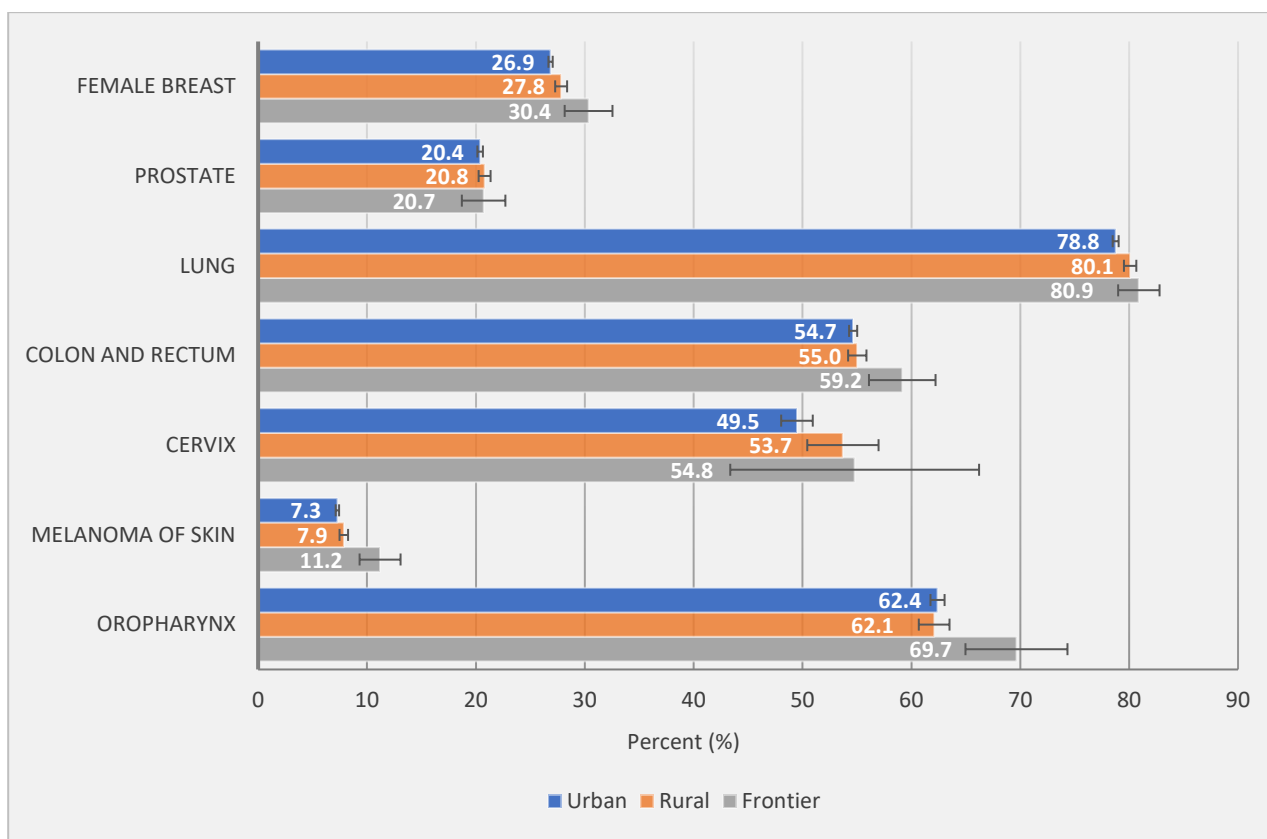


I-I: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Race/Ethnicity

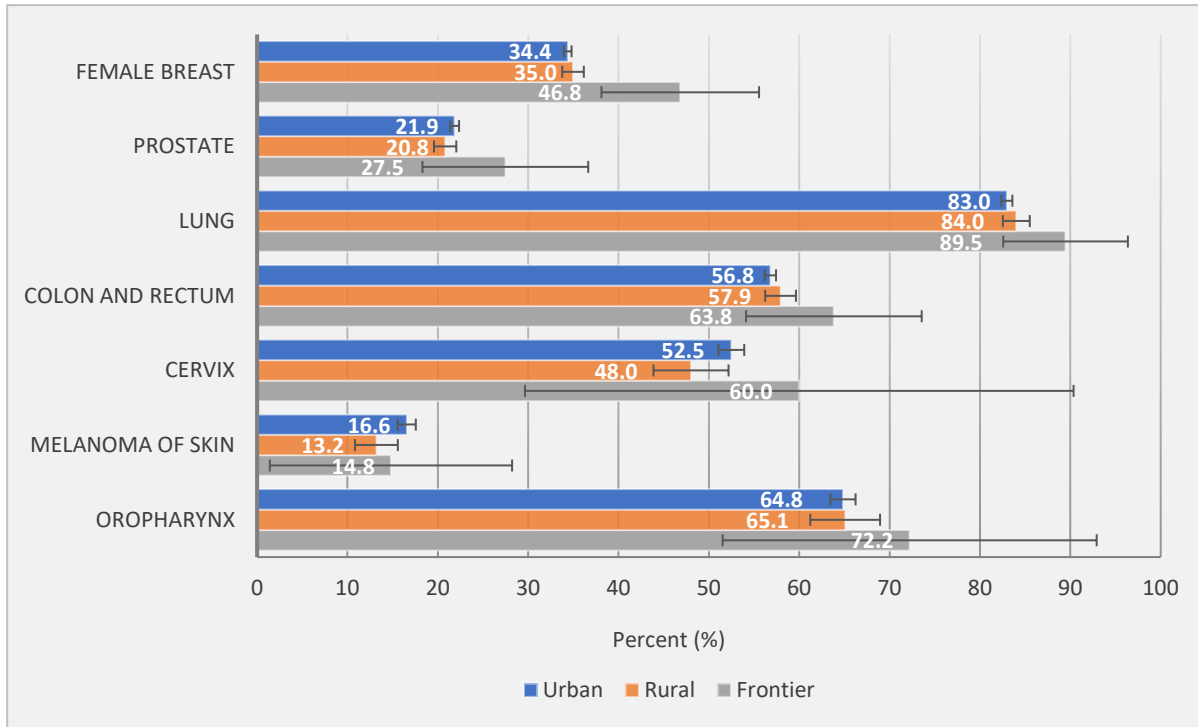
Figures 2.4 to 2.6 show the percent of patients diagnosed at late stage in urban, rural, and frontier areas by race/ethnicity. For non-Hispanic white persons, frontier populations had significantly higher percentages of late stage diagnoses for colon and rectum cancer, melanoma of the skin, and oropharyngeal cancer compared to rural and urban populations. Rural populations had significantly higher percentages of late stage diagnoses for lung and female breast cancer compared to urban populations. For Hispanic persons, frontier populations had higher percentages of late stage diagnoses compared to urban and rural populations for all sites except melanoma of the skin, but the difference was only significant for female breast cancer. In the other race group (African American, Asian/Pacific Islander, Native American, and other/unknown races), rural populations had significantly lower percentages of late stage diagnoses for prostate cancer and melanoma of the skin compared to urban populations. Although frontier populations had higher percentages of late stage diagnoses for lung cancer and colon and rectum cancer, these differences were not significant.

Figure 2.4. Percent of screen-detectable cancers diagnosed at late stage among non-Hispanic white persons residing in urban, rural, and frontier areas of California with 95% confidence intervals, 2006-2015



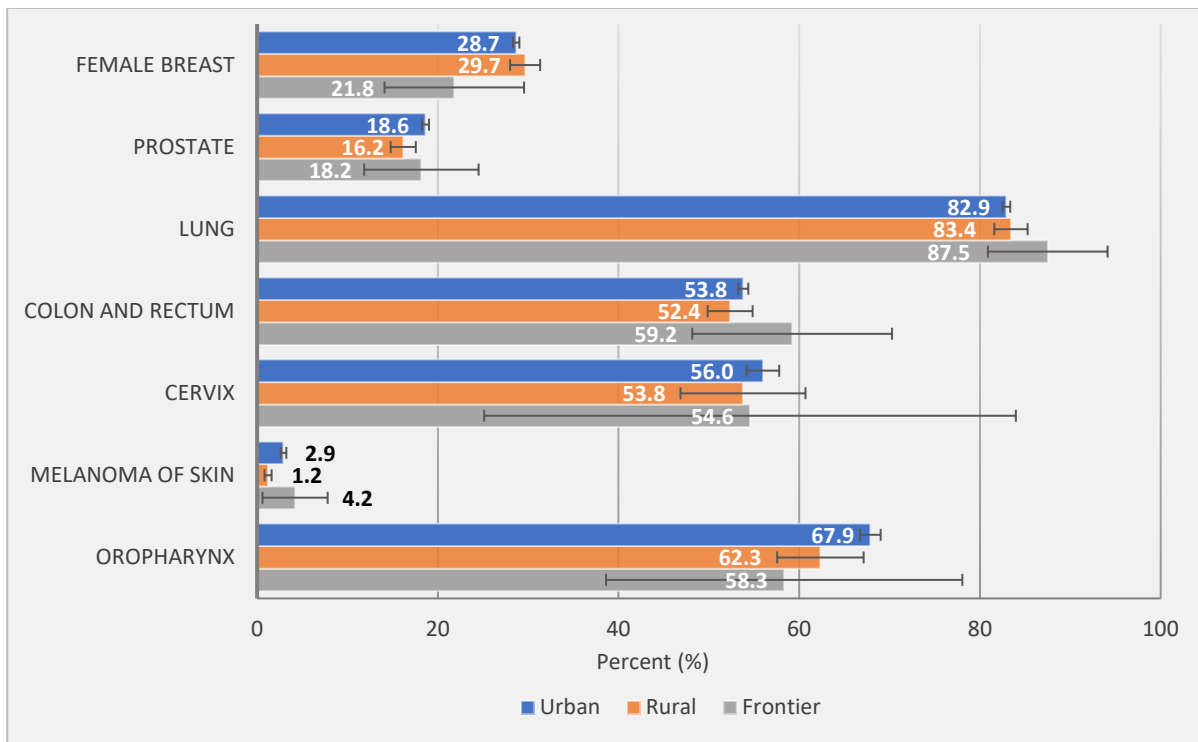
—: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 2.5. Percent of screen-detectable cancers diagnosed at late stage among Hispanics residing in urban, rural, and frontier areas of California with 95% confidence intervals, 2006-2015



—|—: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 2.6. Percent of screen-detectable cancers diagnosed at late stage among persons of other race groups* residing in urban, rural, and frontier areas of California with 95% confidence intervals, 2006-2015



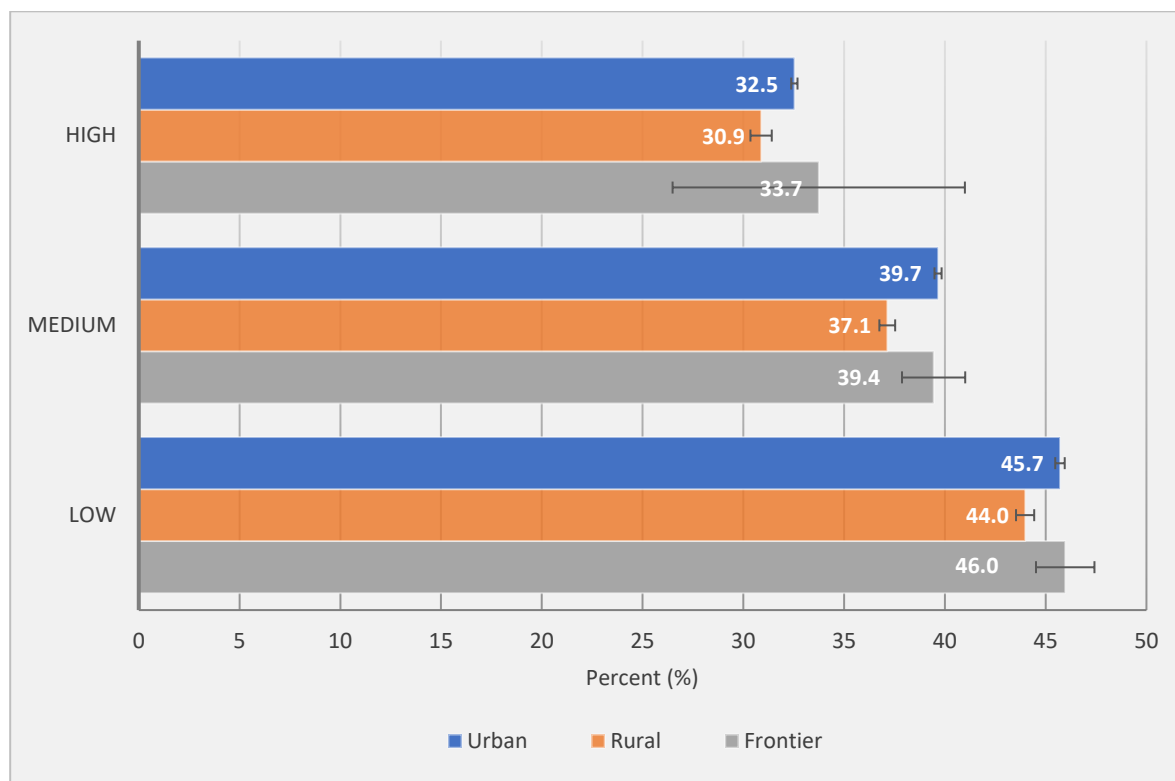
*Other races include African American, Asian/Pacific Islander, Native American, and other/unknown races.

—|—: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Socioeconomic Status (SES)

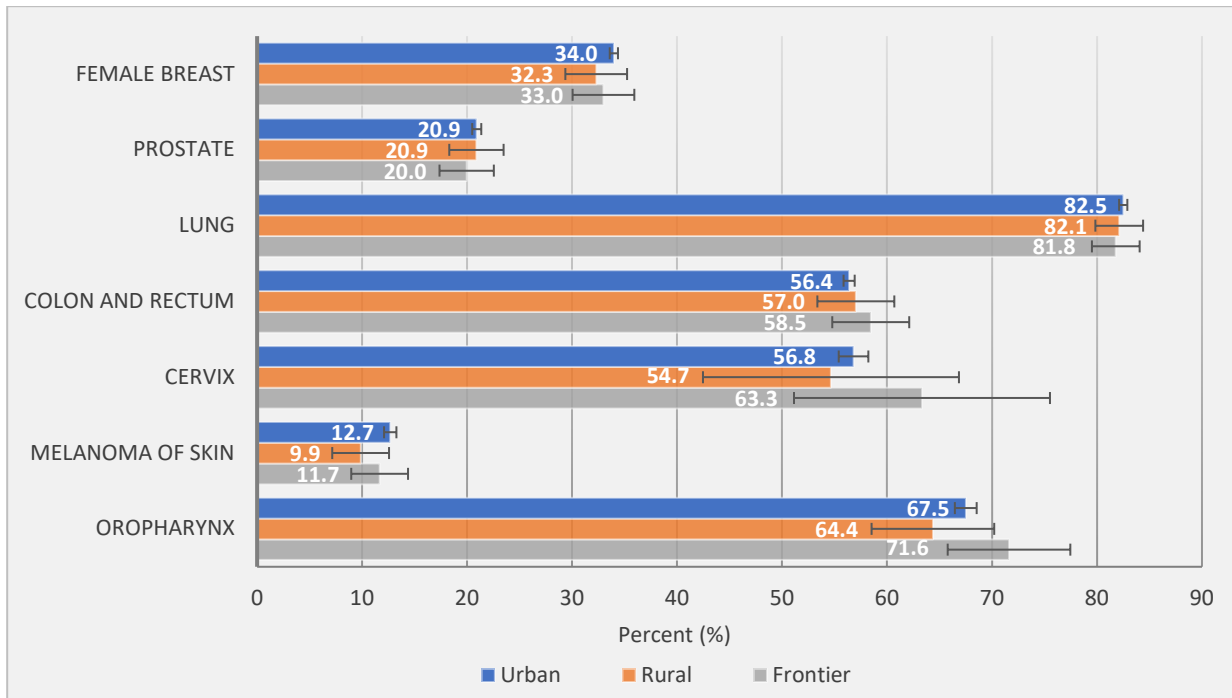
Figures 2.7 to 2.10 show the percent of patients diagnosed at late stage in urban, rural, and frontier areas by SES. Overall, for each SES tertile, there was a lower percentage of rural patients diagnosed late stage (Figure 2.7). Within each SES tertile (Figures 2.8-2.10), there were few significant site-specific differences between urban, rural, and frontier patients. Among patients in the middle SES tertile, a higher percentage of patients in frontier areas were diagnosed at late stage for colon and rectum cancer. Other differences within SES tertiles were not significant.

Figure 2.7. Percent of screen-detectable cancers diagnosed at late stage among persons residing in urban, rural, and frontier areas of California by socioeconomic status with 95% confidence intervals, 2006-2015



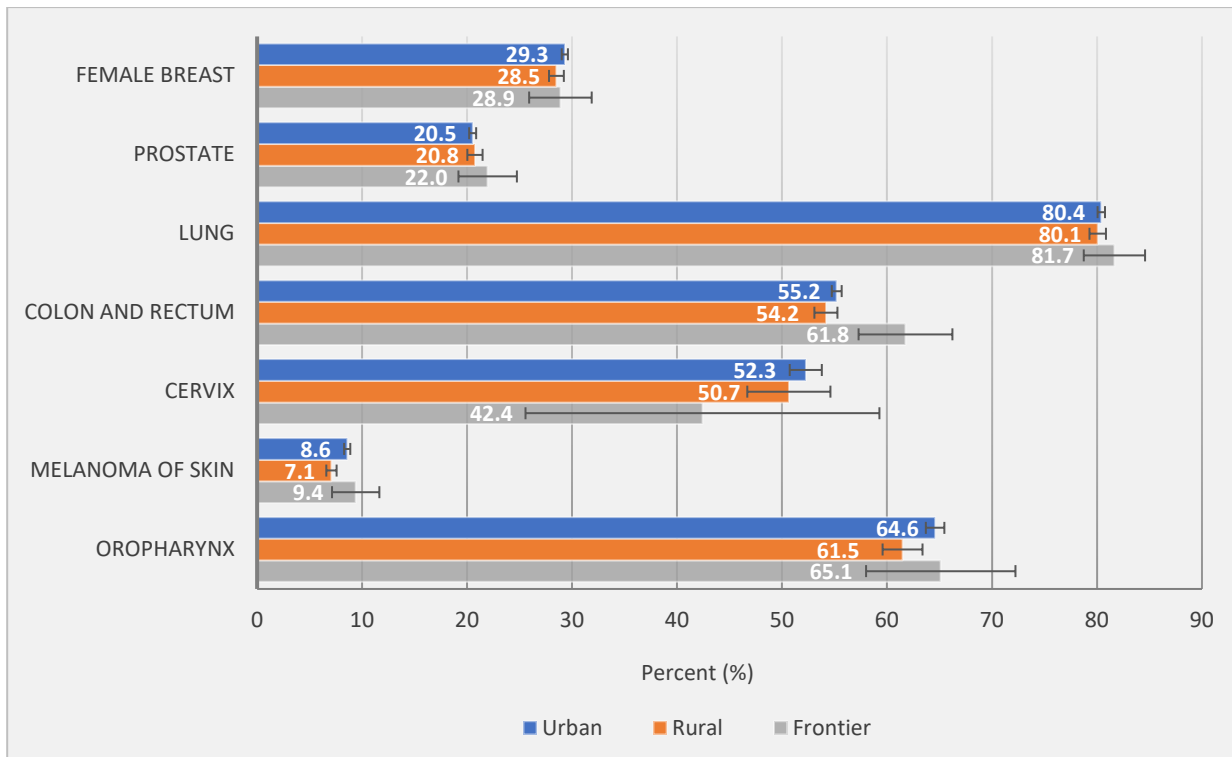
—|—: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 2.8. Percent of screen-detectable cancers diagnosed at late stage among low socioeconomic status patients residing in urban, rural, and frontier areas of California with 95% confidence intervals, 2006-2015



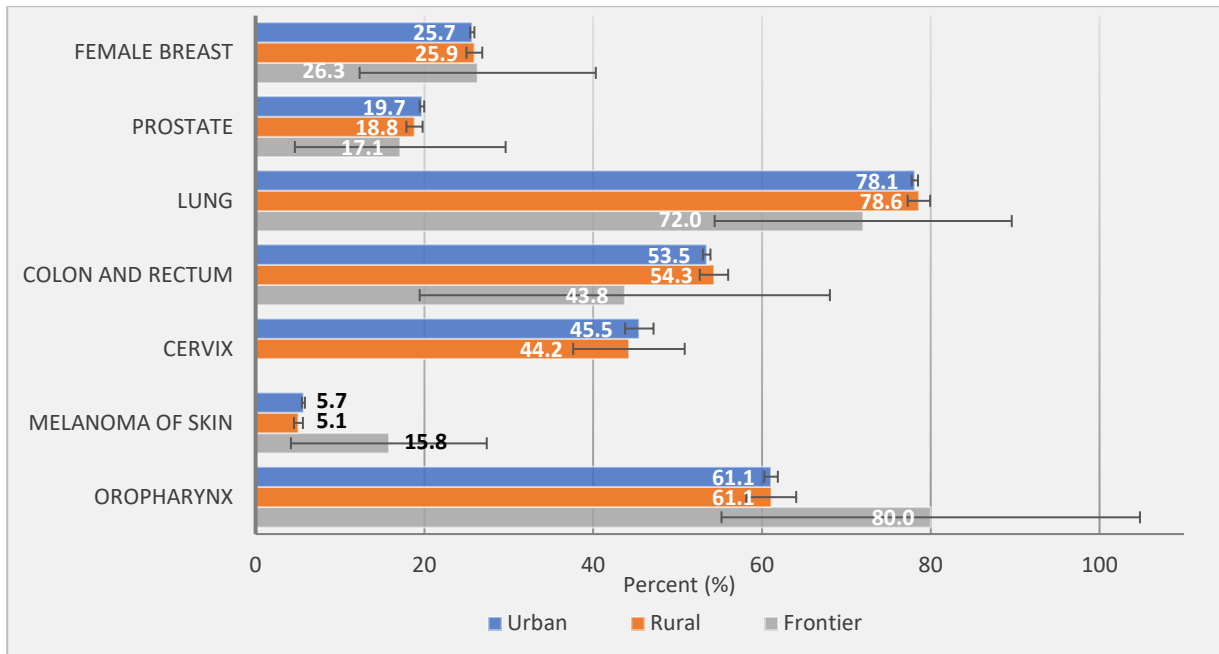
—|: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 2.9. Percent of screen-detectable cancers diagnosed at late stage among middle socioeconomic status patients residing in urban, rural, and frontier areas of California with 95% confidence intervals, 2006-2015



—|: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 2.10. Percent of screen-detectable cancers diagnosed at late stage among high socioeconomic status patients residing in urban, rural, and frontier areas of California with 95% confidence intervals, 2006-2015

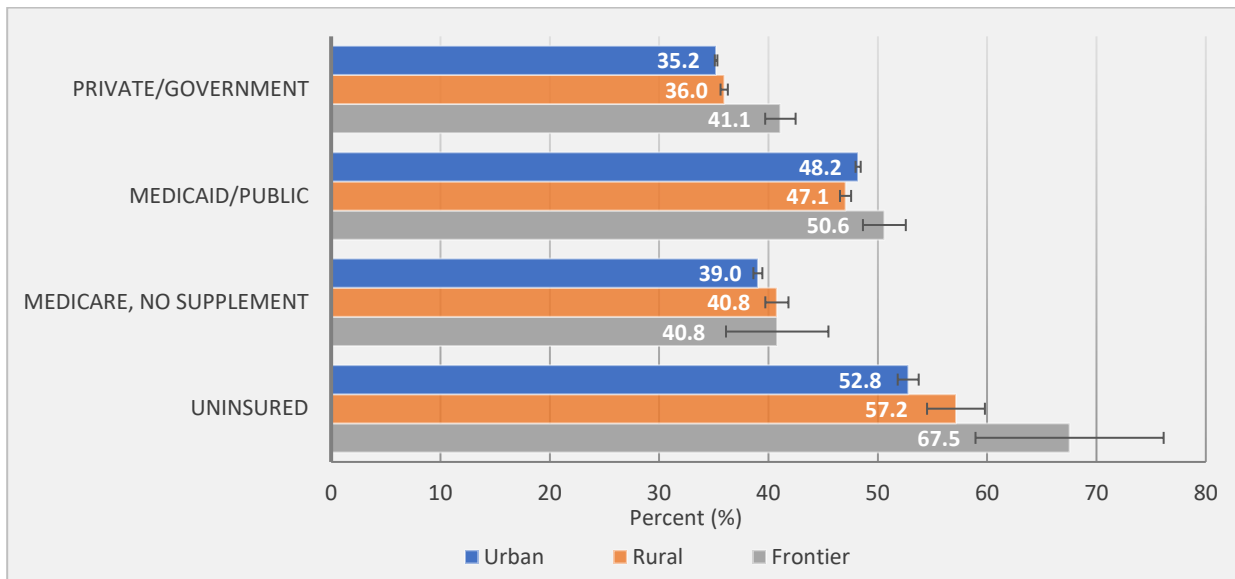


—|: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Source of Health Insurance

Figure 2.11 shows the percent of patients diagnosed late stage in urban, rural, and frontier areas by source of health insurance. Frontier and rural patients with private/government insurance had significantly higher percentages of late stage diagnoses compared to urban patients with private/government insurance. Frontier patients with Medicaid/public insurance and rural patients with no health insurance also had significantly higher percentages of late stage diagnoses compared to urban patients with the same type of insurance.

Figure 2.11. Percent of screen-detectable cancers diagnosed at late stage among persons residing in urban, rural, and frontier areas of California by source of health insurance with 95% confidence intervals, 2006-2015



—|: 95% confidence interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Survival

Overall

Survival of cancer patients residing in urban, rural, and frontier areas varied by sex, race/ethnicity, age at diagnosis, stage at diagnosis, and type of health insurance (Table 3.1). Overall, cancer patients residing in rural and frontier areas of California had significantly lower five-year relative survival (64.4% and 60.4%, respectively) compared to cancer patients residing in urban areas (66.6%). Rural and frontier non-Hispanic white persons had significantly lower survival (64.7% and 60.4%, respectively) than their urban counterparts (68.0%) and rural Hispanic persons had significantly lower survival (63.9%) than their urban counterparts (65.9%). Rural and frontier cancer patients diagnosed between the ages of 40 and 69 years also had significantly lower survival than their urban counterparts.

Stage at diagnosis is one of the strongest predictors of survival.⁸ Cancers detected at an early stage are more likely to respond to treatment and have the potential to be cured. Yet, rural and frontier cancer patients diagnosed at an early stage (i.e. *in situ* and localized) had significantly lower survival (89.2% and 87.6%, respectively) compared to cancer patients residing in urban areas diagnosed at an early stage (90.7%).

Survival disparities were also observed by area of residence and type of health insurance. Cancer patients residing in rural and frontier areas with private/government health insurance had significantly lower survival (71.3% and 67.4%, respectively) than cancer patients with private/government health insurance residing in urban areas (73.0%). Uninsured rural and frontier cancer patients also had significantly lower survival (49.4% and 45.3%, respectively) compared to urban uninsured cancer patients (56.2%) and frontier cancer patients with Medicaid/public health insurance had significantly lower survival (49.6%) than urban cancer patients (53.5%) with the same type of health insurance.

Table 3.1. Five-year relative survival for all cancers diagnosed among persons residing in urban, rural, and frontier areas of California, 2006-2011

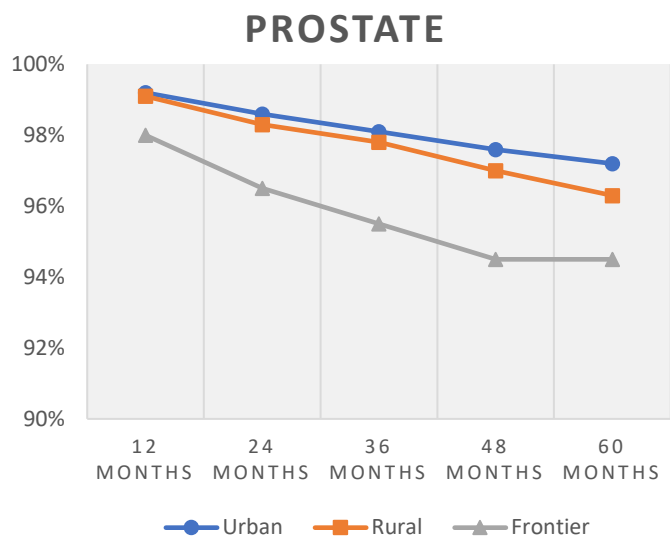
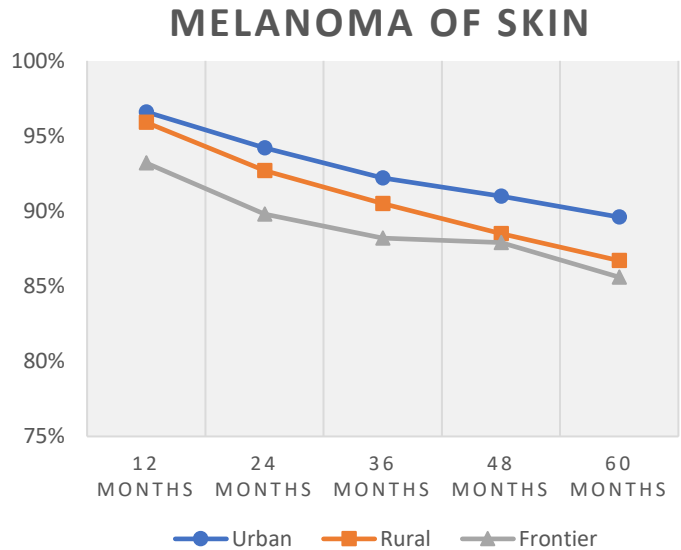
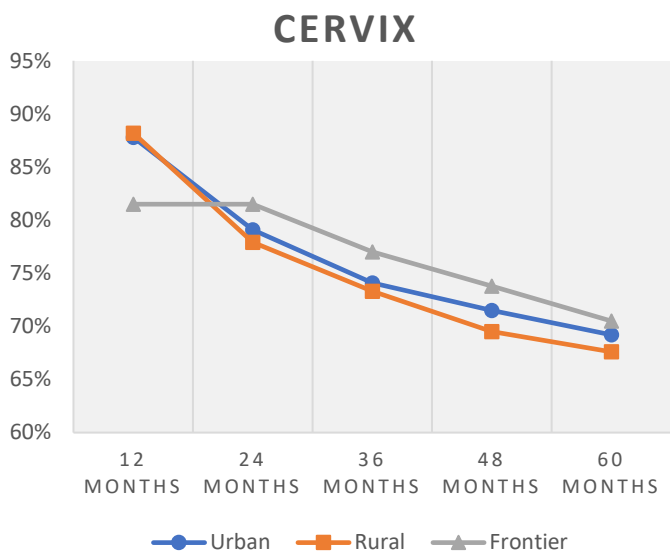
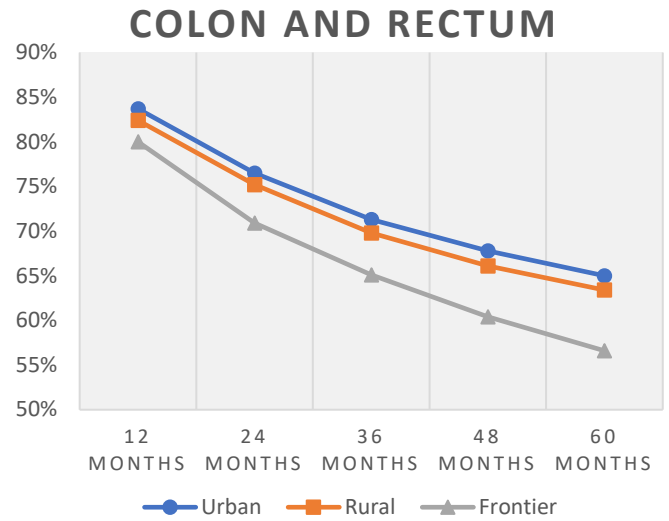
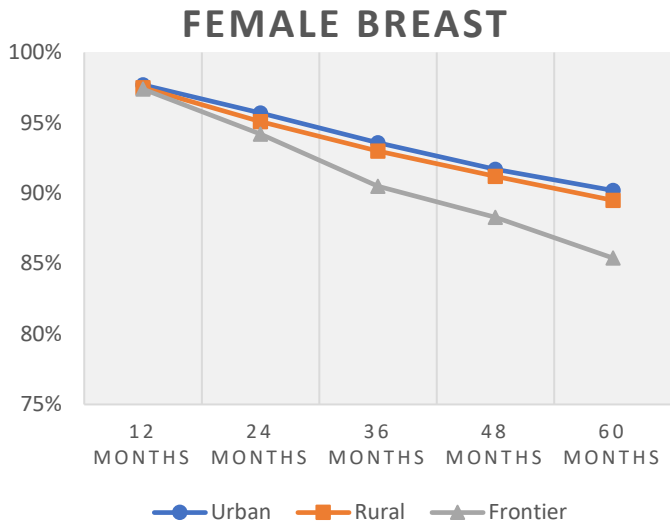
Characteristic	Urban			Rural			Frontier		
	N	Survival (%)	95% Confidence Interval	N	Survival (%)	95% Confidence Interval	N	Survival (%)	95% Confidence Interval
All Cases	640,925	66.6%	66.5%, 66.8%	96,889	64.4%	64.1%, 64.8%	6,104	60.4%	59.0%, 61.8%
Sex									
Male	325,920	66.2%	66.0%, 66.4%	52,086	63.9%	63.4%, 64.4%	3,574	59.8%	57.9%, 61.6%
Female	315,005	67.1%	66.9%, 67.3%	44,803	65.0%	64.5%, 65.5%	2,530	61.3%	59.1%, 63.4%
Race/ethnicity									
Non-Hispanic White	390,984	68.0%	67.9%, 68.2%	74,857	64.7%	64.3%, 65.1%	5,522	60.4%	58.9%, 61.9%
Hispanic	122,318	65.9%	65.6%, 66.2%	16,649	63.9%	63.0%, 64.7%	428	60.6%	55.2%, 65.6%
Asian/ Pacific Islander	78,798	64.0%	63.6%, 64.3%	2,848	62.6%	60.6%, 64.5%	49	64.7%	48.0%, 77.2%
African American	48,825	61.4%	60.9%, 61.9%	2,535	60.5%	58.3%, 62.7%	105	54.7%	43.0%, 64.9%
Age (years)									
0-39	46,298	82.5%	82.2%, 82.9%	5,507	81.7%	80.6%, 82.7%	202	79.1%	72.7%, 84.2%
40-54	124,121	75.7%	75.5%, 76.0%	17,101	73.3%	72.6%, 74.0%	937	67.5%	64.3%, 70.6%
55-69	239,650	70.7%	70.5%, 70.9%	38,510	67.9%	67.4%, 68.4%	2,656	62.5%	60.4%, 64.4%
70+	230,856	53.9%	53.6%, 54.1%	35,771	53.4%	52.7%, 54.0%	2,309	53.4%	50.8%, 55.9%
Stage at Diagnosis									
<i>In situ</i> / Localized	308,448	90.7%	90.5%, 90.8%	46,352	89.2%	88.8%, 89.6%	2,749	87.6%	85.7%, 89.2%
Regional/ Distant	291,168	46.2%	46.0%, 46.3%	43,704	43.4%	42.8%, 43.9%	2,816	40.0%	38.0%, 41.9%
Socioeconomic Status									
Low	162,196	57.9%	57.6%, 58.1%	36,408	58.4%	57.8%, 59.0%	3,427	56.1%	54.1%, 57.9%
Medium	216,615	64.7%	64.5%, 65.0%	41,555	65.7%	65.2%, 66.2%	2,536	65.9%	63.8%, 68.0%
High	262,114	73.6%	73.4%, 73.8%	18,926	73.0%	72.2%, 73.7%	114	65.1%	54.1%, 74.1%
Health Insurance									
Private/ Government	411,291	73.0%	72.9%, 73.2%	57,308	71.3%	70.9%, 71.8%	3,483	67.4%	65.5%, 69.2%
Medicare, No Supplement	32,787	62.3%	61.7%, 63.0%	5,246	62.6%	61.0%, 64.2%	278	65.0%	57.6%, 71.3%
Medicaid/ Public	153,924	53.5%	53.2%, 53.8%	27,998	53.0%	52.3%, 53.6%	1,856	49.6%	47.0%, 52.1%
Uninsured	13,342	56.2%	55.2%, 57.1%	1,507	49.4%	46.7%, 52.1%	107	45.3%	35.3%, 54.7%
Unknown	29,581	53.2%	52.5%, 53.8%	4,830	53.6%	52.0%, 55.2%	380	49.3%	43.5%, 54.8%

Bold text indicates that individuals residing in rural and/or frontier areas had significantly lower survival compared to those residing in urban areas. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Screen-detectable Cancers

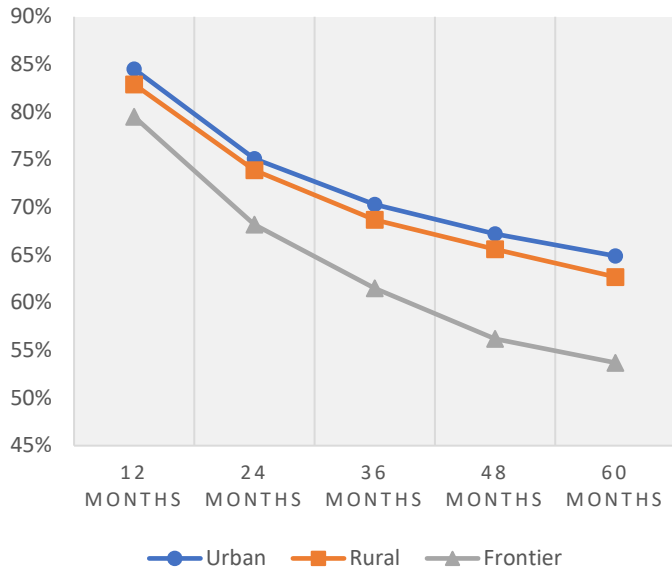
Several cancers including female breast, prostate, lung, colon and rectum, cervical, melanoma of the skin, and oropharyngeal have the potential for early diagnosis through screening. Detecting these cancers early, when they are more likely to respond to treatment, has the potential to increase survival. Despite the availability of screening for these cancers, patients residing in frontier areas had lower one-, two-, three-, four-, and five-year relative survival for five of the seven cancers – prostate, colon and rectum, melanoma of the skin, lung, and oropharyngeal – compared to those residing in urban areas (Figure 3.1). Women residing in frontier areas diagnosed with breast cancer also had lower two-, three-, four-, and five-year relative survival than women residing in urban areas. Five-year relative survival among rural cancer patients was lower than that of urban cancer patients by more than two percent for melanoma of the skin and oropharyngeal cancer.

Figure 3.1. Relative survival of cancer patients diagnosed with screen-detectable cancers residing in urban, rural, and frontier areas of California, 2006-2011

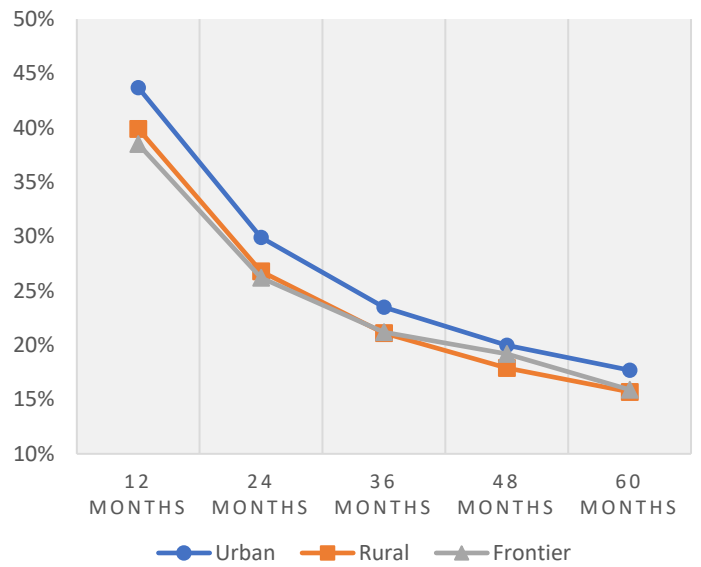


Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

OROPHARYNX



LUNG



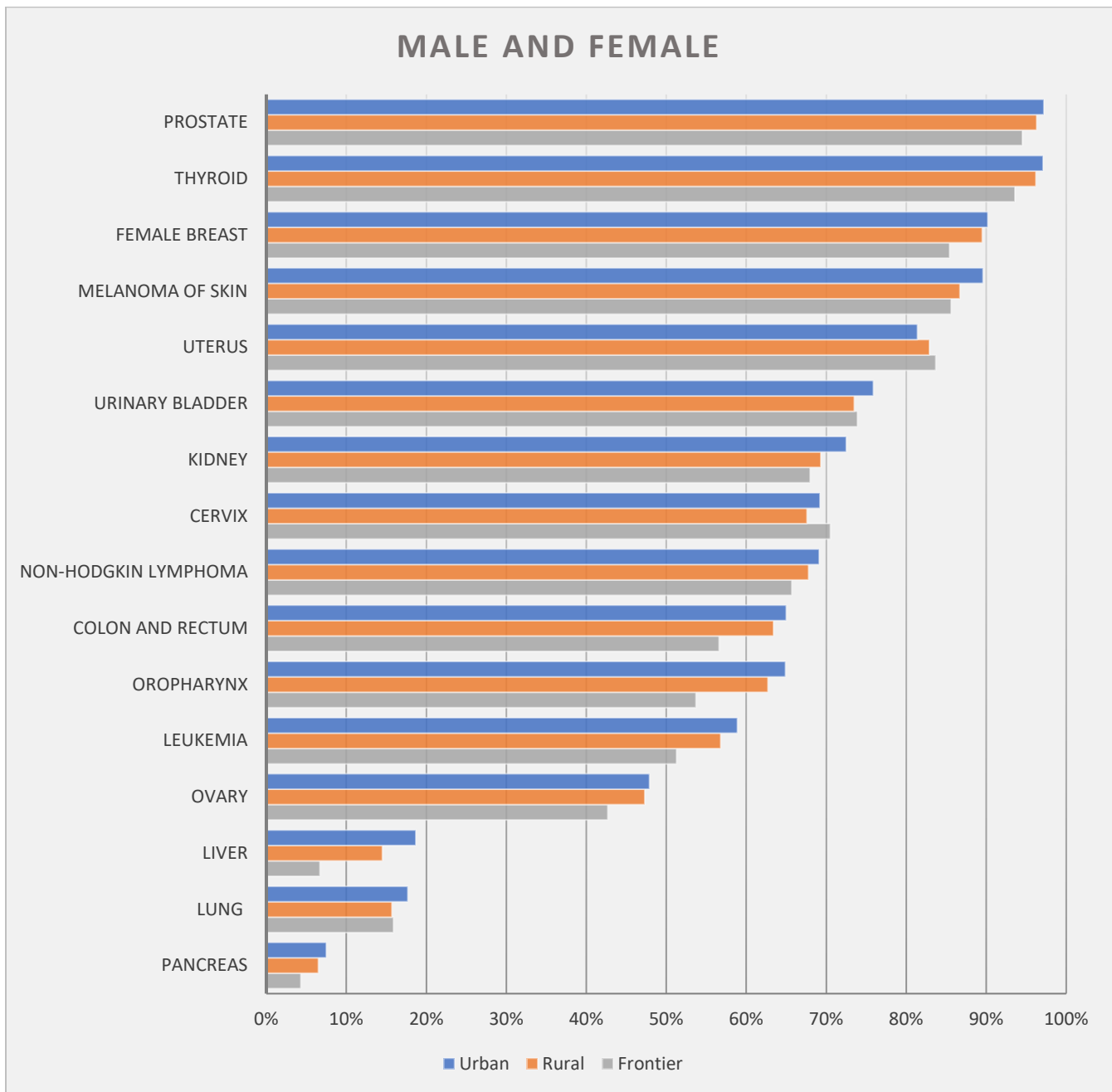
Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Sex

Compared to those residing in urban areas, five-year relative survival among persons residing in rural and frontier areas was significantly lower for cancers of the liver (14.5% and 6.7%, respectively, versus 18.7%) and prostate (96.3% and 94.5%, respectively, versus 97.2%). Most striking was the difference in survival for liver cancer whereby patients residing in urban areas were 2.5 times more likely to survive liver cancer in the five-year period following diagnosis than those residing in frontier areas. Additionally, frontier populations had significantly lower survival of female breast cancer (85.4% versus 90.2%), colon and rectum cancer (56.6% versus 65.0%), and oropharyngeal cancer (53.7% versus 64.9%) compared to urban populations. Rural populations also had significantly lower survival of lung cancer (15.7% versus 17.7%), melanoma (86.7% versus 89.6%), and kidney cancer (69.3% versus 72.5%) compared to urban populations (Figure 3.2).

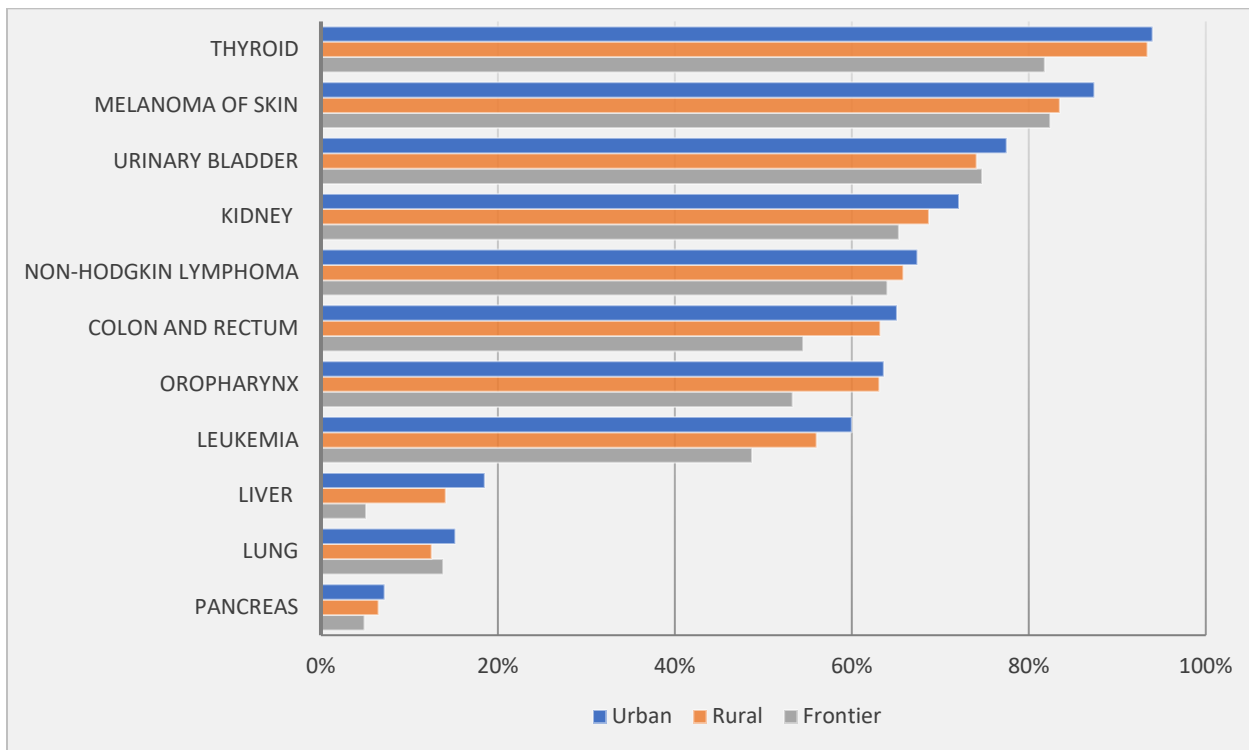
When survival was evaluated by sex, males residing in frontier areas had significantly lower survival than males residing in urban areas for cancers of the colon and rectum (54.5% versus 65.1%), oropharynx (53.3% versus 63.6%), and liver (5.1% versus 18.5%) (Figure 3.3). Compared to urban males, rural males had significantly lower survival of cancer of the liver (14.1% versus 18.5%), lung (13.8% versus 15.2%), urinary bladder (74.1% versus 77.5%), kidney (68.7% versus 72.1%), as well as melanoma (83.5% versus 87.4%) and leukemia (56.0% versus 60.0%) (Figure 3.3). Females residing in frontier areas had significantly lower survival of oropharyngeal cancers compared to those residing in urban areas (54.3% versus 67.8%) (Figure 3.4).

Figure 3.2. Five-year relative survival of cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



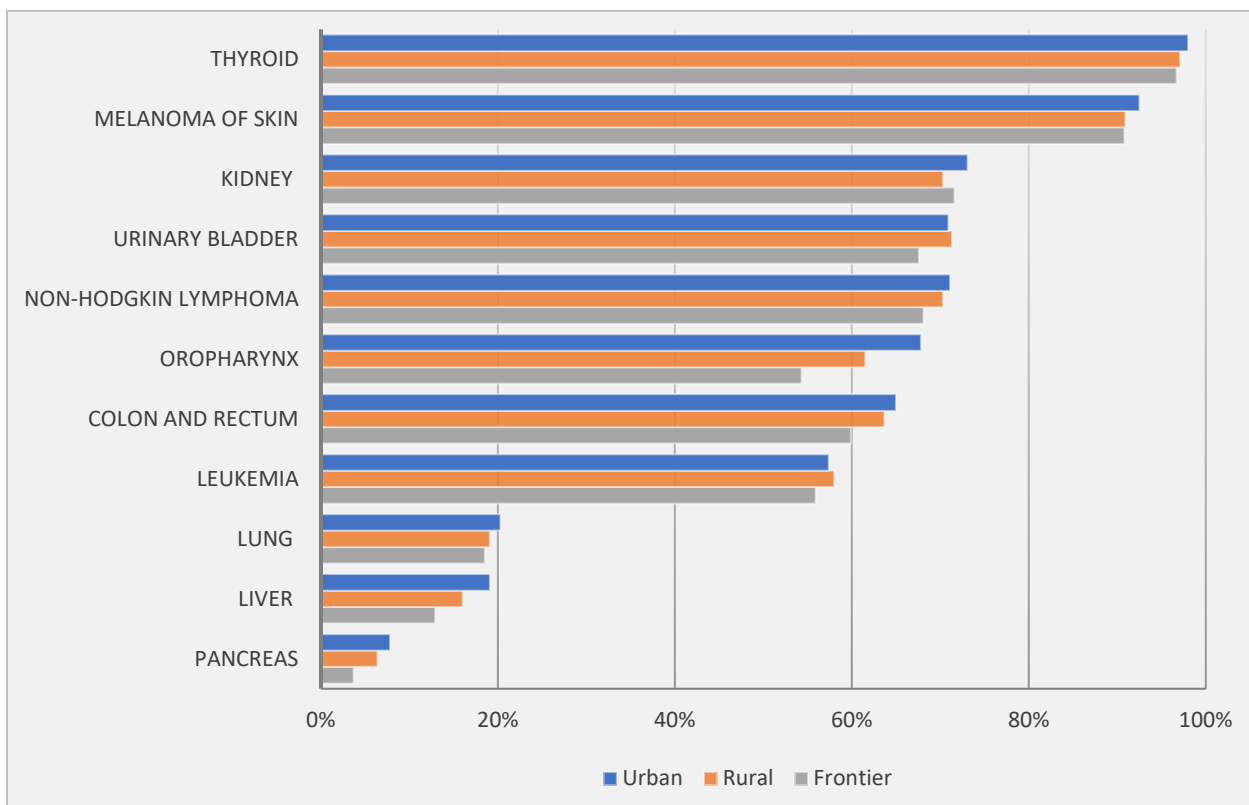
Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 3.3. Five-year relative survival of male cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 3.4. Five-year relative survival of female cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Race/Ethnicity

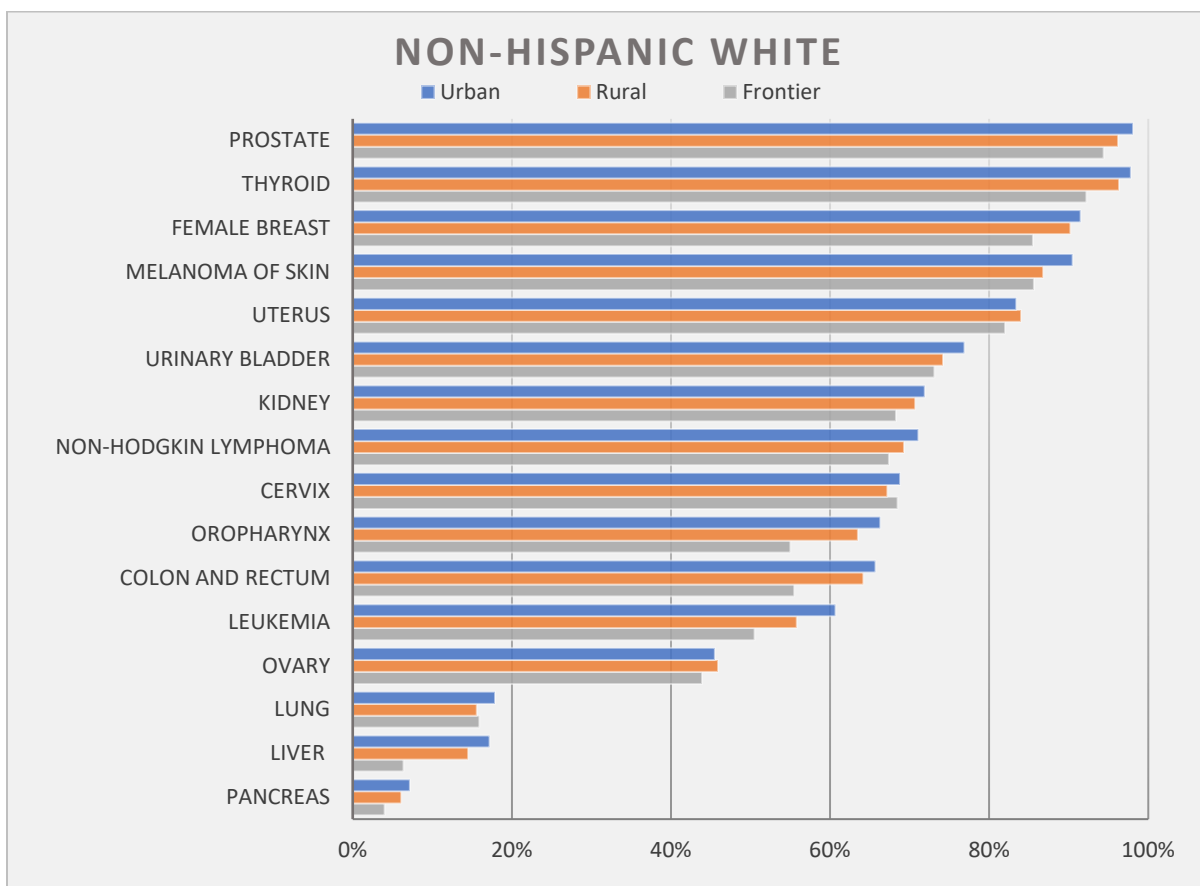
When survival was evaluated by race/ethnicity, non-Hispanic white persons residing in rural and frontier areas had significantly lower survival compared to those residing in urban areas for female breast cancer (90.2% and 85.5%, respectively, versus 91.5%), prostate cancer (96.2% and 94.4%, respectively, versus 98.1%), and leukemia (55.8% and 50.5%, respectively, versus 60.7%). Additionally, frontier non-Hispanic white persons had significantly lower survival compared to urban non-Hispanic white persons for cancers of the oropharynx (55.0% versus 66.3%), colon and rectum (55.5% versus 65.7%), liver (6.4% versus 17.2%), and thyroid (92.2% versus 97.8%). Rural non-Hispanic white persons also had significantly lower survival than urban non-Hispanic white persons for lung cancer (15.6% versus 17.9%) and melanoma of the skin (86.8% versus 90.5%) (Figure 3.5).

Rural African American persons had significantly lower survival for urinary bladder (47.3% versus 65.6%) and kidney (58.6% versus 73.5%) cancers compared to urban African American persons but had significantly higher survival for prostate cancer (98.7% versus 95.8%) (Figure 3.6).

Among Hispanic persons, those residing in rural areas had significantly lower survival for colon and rectum cancer (60.5% versus 65.4%) and kidney cancer (68% versus 73.8%) compared to Hispanics residing in urban areas (Figure 3.7).

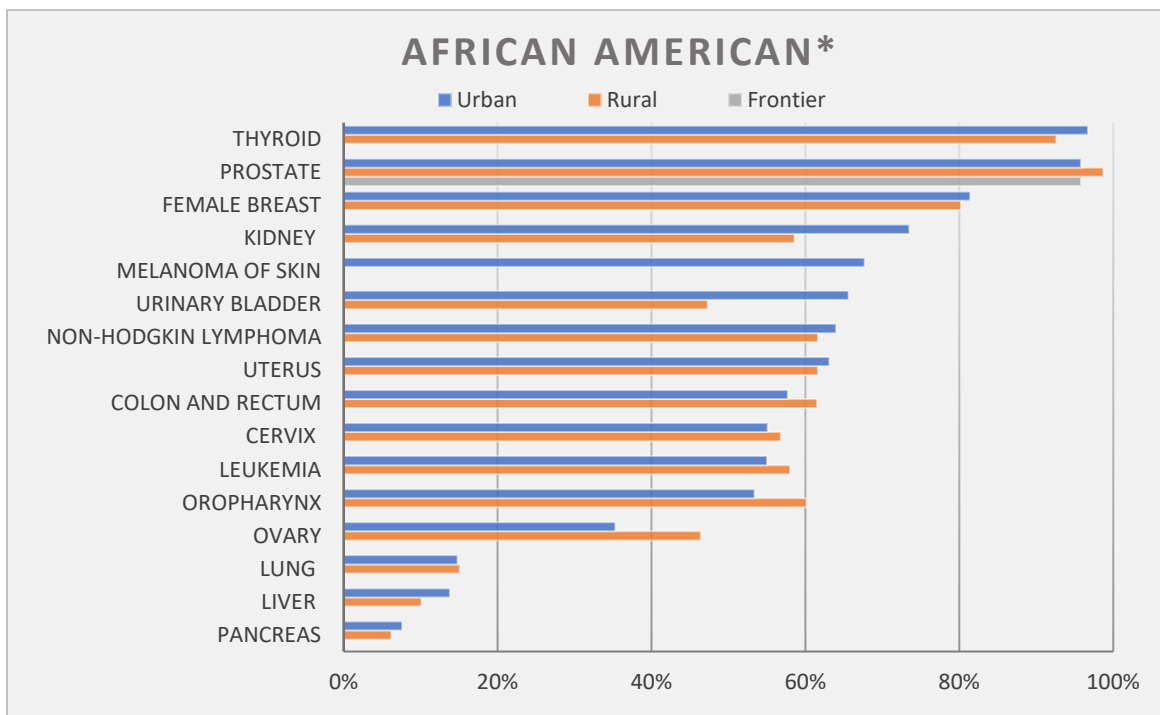
Of note, Asian/Pacific Islander persons residing in rural areas had significantly lower survival for kidney cancer (48.2%) compared to Asian/Pacific Islanders residing in urban areas (71.2%). Rural Asian/Pacific Islander persons also had significantly lower survival for oropharyngeal cancer (52.5%) compared to their urban counterparts (67.2%) (Figure 3.8).

Figure 3.5. Five-year relative survival of non-Hispanic white cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



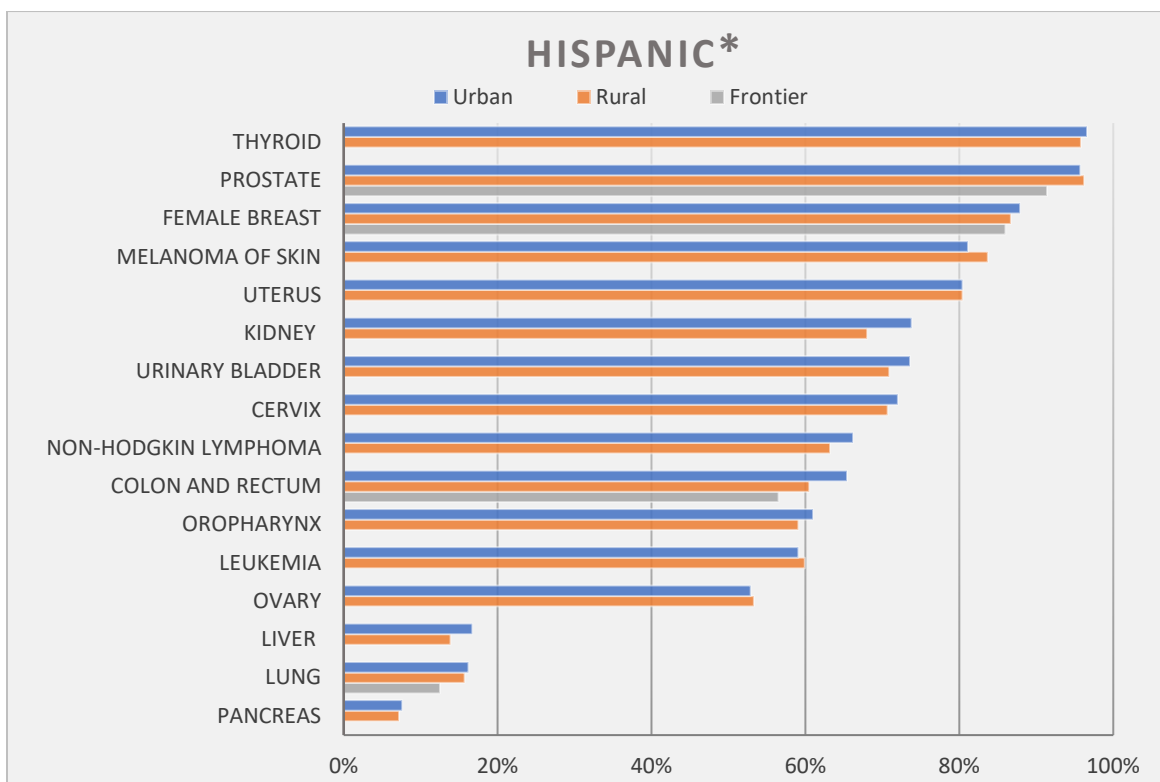
Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 3.6. Five-year relative survival of African American cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



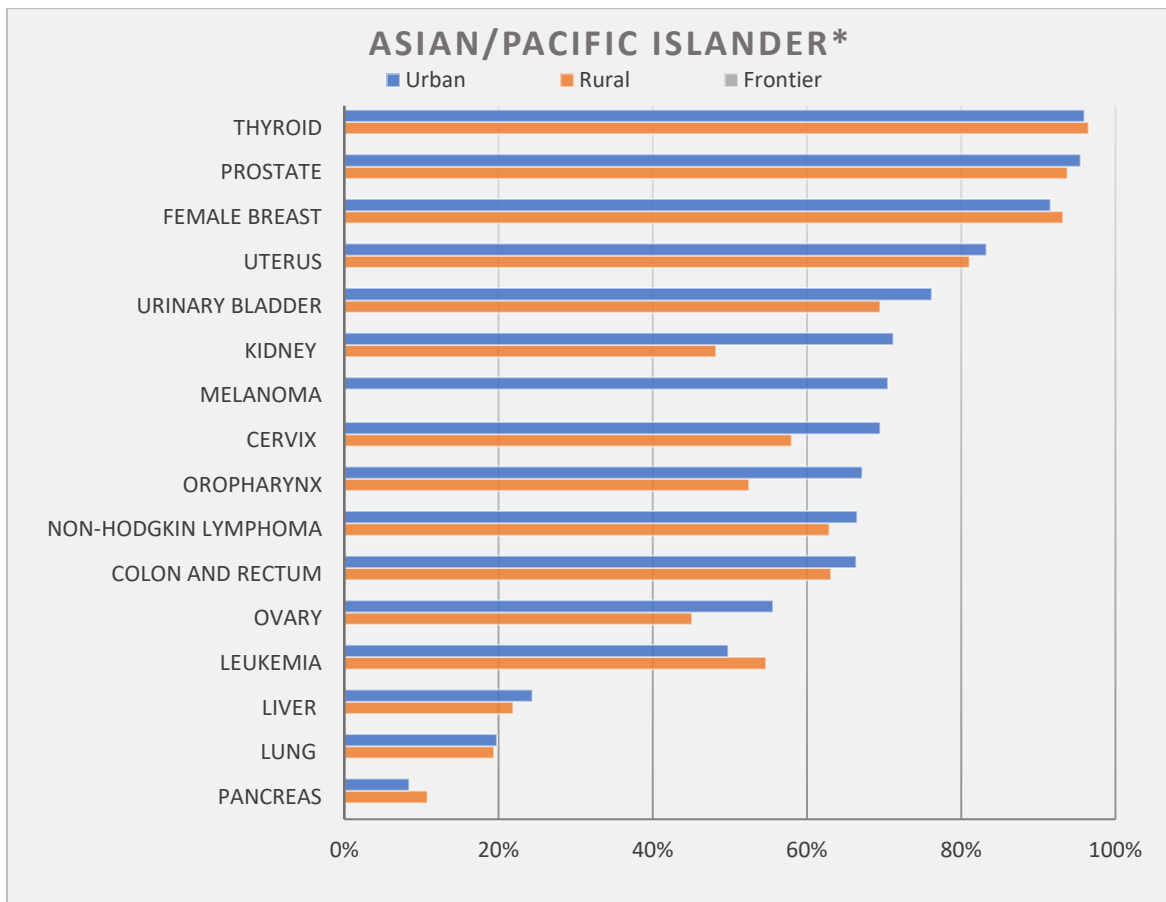
*Survival was not calculated when fewer than 25 patients were alive at the beginning of the time interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 3.7. Five-year relative survival of Hispanic cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



*Survival was not calculated when fewer than 25 patients were alive at the beginning of the time interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 3.8. Five-year relative survival of Asian/Pacific Islander cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



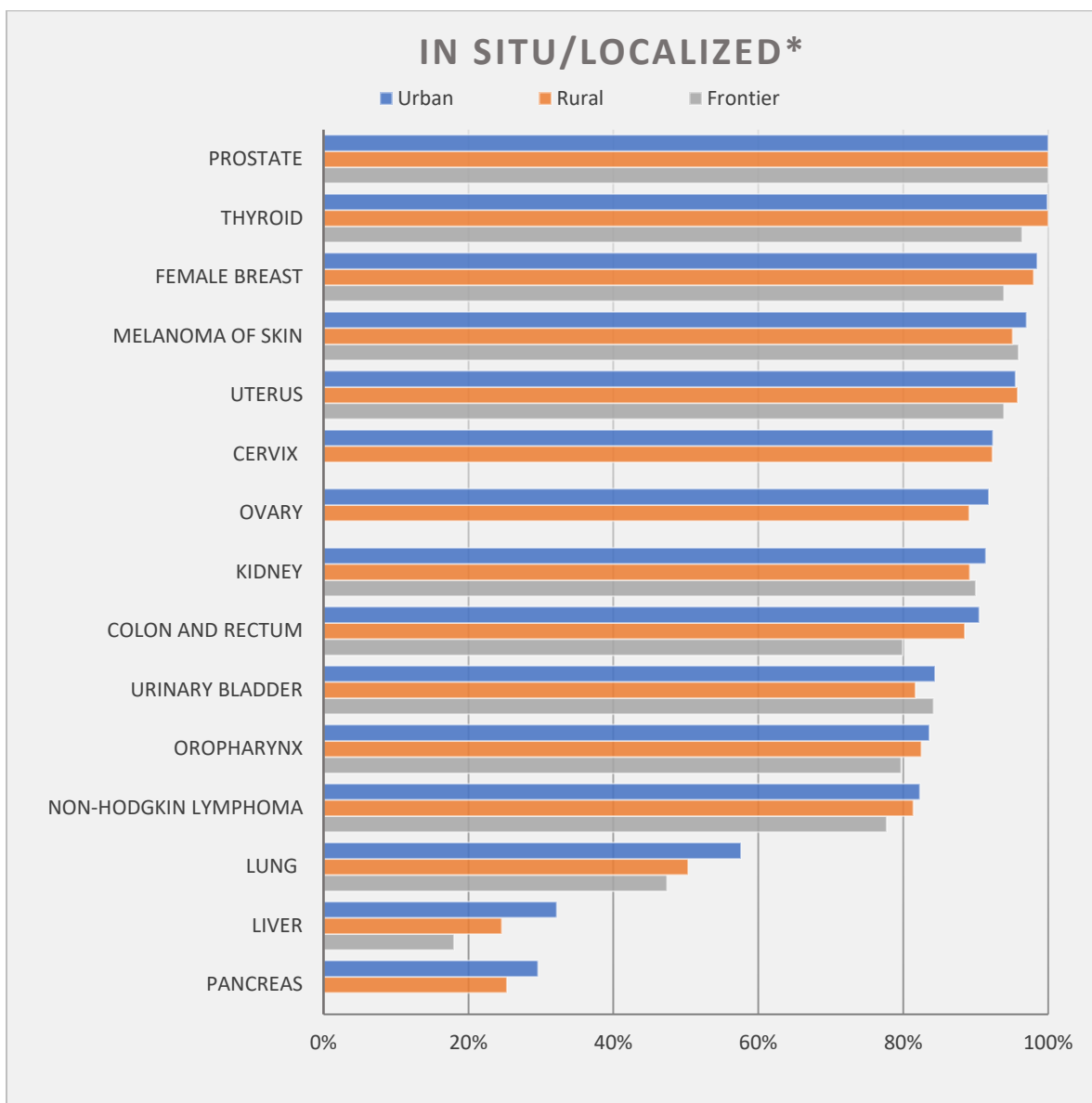
*Survival was not calculated when fewer than 25 patients were alive at the beginning of the time interval.

Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Stage at Diagnosis

Overall, cancer patients had better survival when cancers were diagnosed at an early stage (i.e. *in situ* or localized) versus a late stage (i.e. regional or distant) regardless of urban, rural, or frontier residence. However, differences in survival were observed among persons residing in urban, rural, and frontier areas for cancers diagnosed at an early stage. Frontier populations had significantly lower survival for early stage colon and rectum cancer (79.9%) and early stage female breast cancer (93.9%) compared to urban populations (90.5% and 98.5%, respectively). Rural populations had significantly lower survival for early stage liver cancer (24.6%), lung cancer (50.3%), melanoma of the skin (95.1%), and urinary bladder cancer (81.7%) compared to urban populations (32.2%, 57.6%, 97.0%, and 84.4%, respectively) (Figure 3.9). Survival also differed among urban, rural, and frontier populations for cancers diagnosed at a late stage. Frontier populations had significantly lower survival for late stage oropharyngeal cancer (47.5%) and liver cancer (1.6%) compared to urban populations (58.1% and 5.4%, respectively). Rural populations had significantly lower survival for late stage lung cancer (9.9%) compared to urban populations (11.0%) (Figure 3.10).

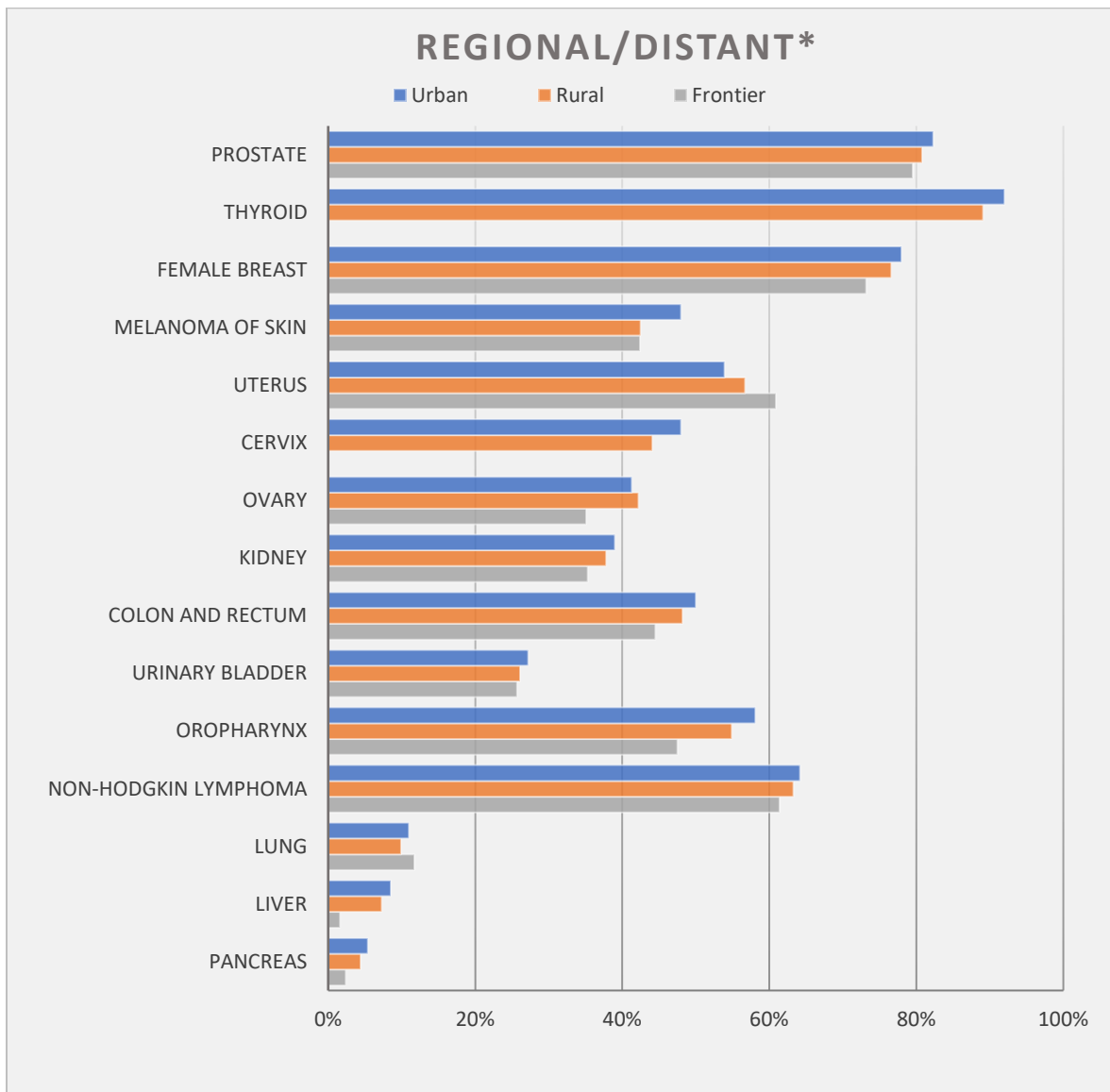
Figure 3.9. Five-year relative survival of cancer patients diagnosed at early stage residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



*Survival was not calculated when fewer than 25 patients were alive at the beginning of the time interval.

Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting And Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 3.10. Five-year relative survival of cancer patients diagnosed at late stage residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



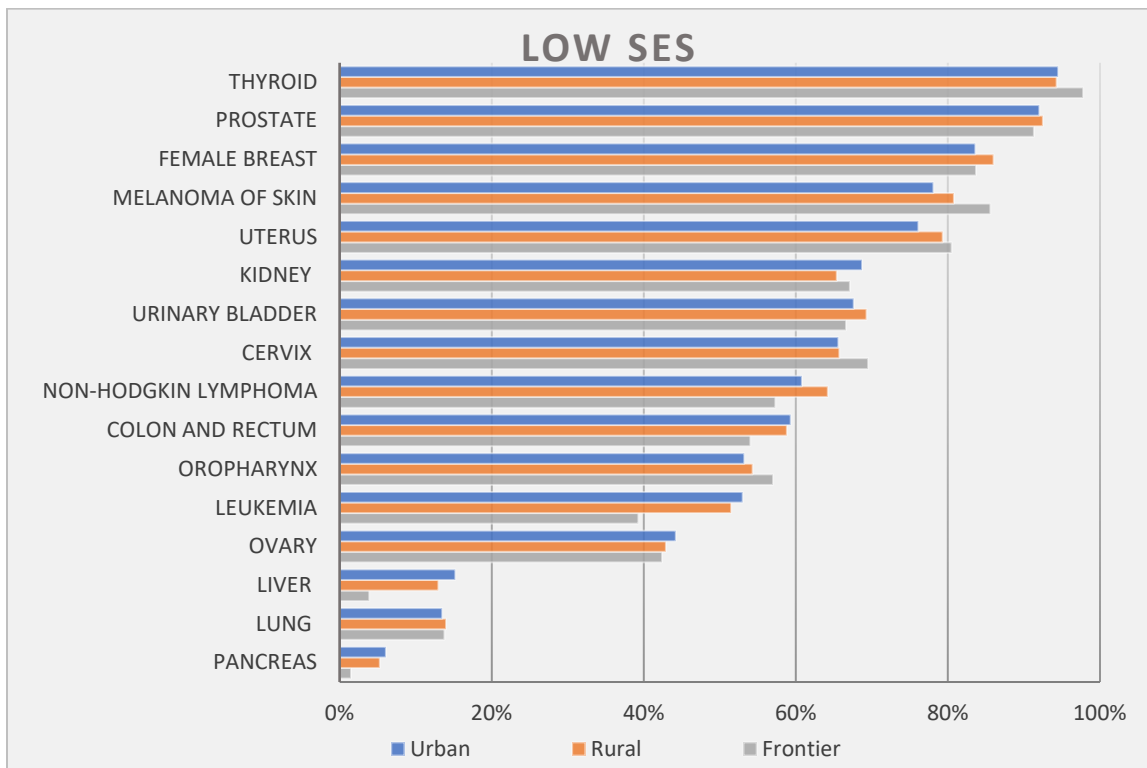
*Survival was not calculated when fewer than 25 patients were alive at the beginning of the time interval.

Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting And Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Socioeconomic Status (SES)

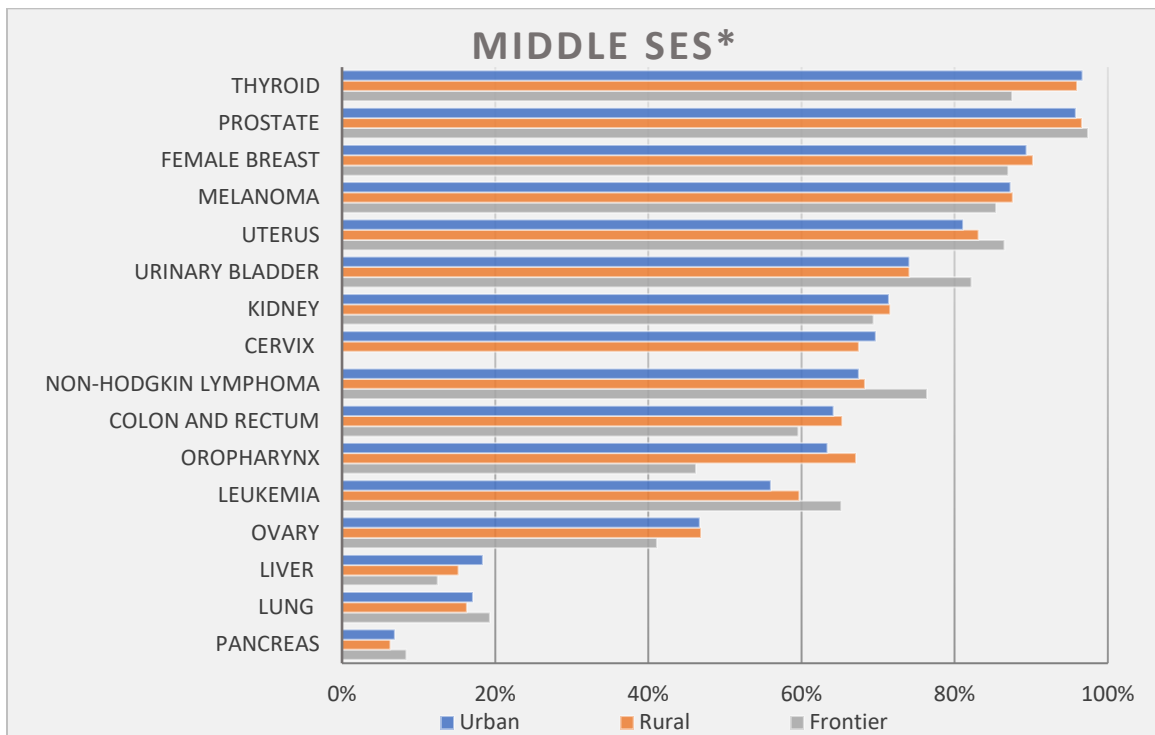
Differences in cancer survival among urban, rural, and frontier populations by socioeconomic status (SES) were observed. Among cancer patients in the lowest SES tertile, those residing in frontier areas had significantly lower survival for liver cancer (3.9%) and leukemia (39.3%) compared to those residing in urban areas (15.2% and 53.0%, respectively). However, urban women in the lowest SES tertile had significantly lower survival of breast cancer (83.6%) compared to rural women in the lowest SES tertile (86.0%) (Figure 3.11). Among cancer patients in the middle SES tertile, those residing in frontier areas had significantly lower survival for oropharyngeal (46.2%) and thyroid (87.5%) cancers compared to those in the middle SES tertile residing in urban areas (63.4% and 96.7%, respectively) (Figure 3.12). Cancer patients in the highest SES tertile residing in rural areas had significantly lower survival for lung cancer (18.7%) compared to those in the highest SES tertile residing in urban areas (21.7%) (Figure 3.13).

Figure 3.11. Five-year relative survival of low socioeconomic status (SES) cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



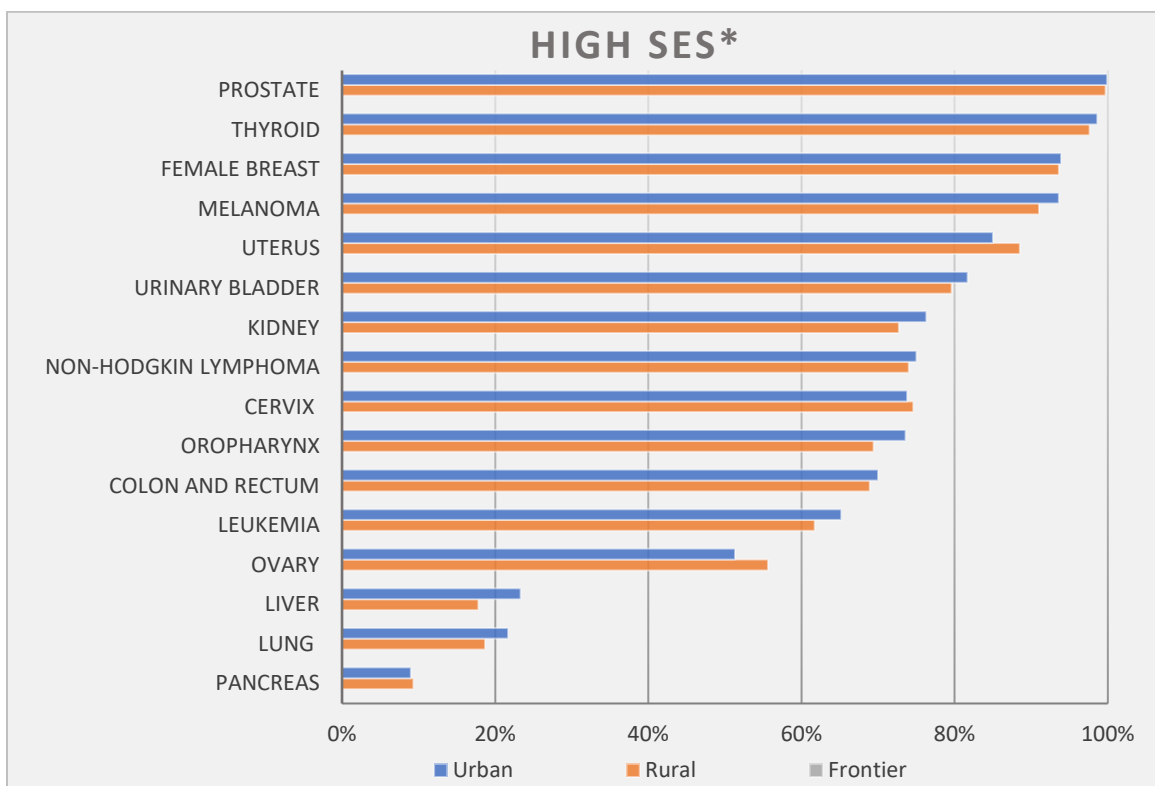
Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 3.12. Five-year relative survival of middle socioeconomic status (SES) cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



*Survival was not calculated when fewer than 25 patients were alive at the beginning of the time interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 3.13. Five-year relative survival of high socioeconomic status (SES) cancer patients residing in urban, rural, and frontier areas of California by cancer type, 2006-2011



*Survival was not calculated when fewer than 25 patients were alive at the beginning of the time interval. Source: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

CONCLUSIONS

Notable disparities were identified in cancer incidence, detection, and survival among rural and frontier populations compared to urban populations in California. These disparities include: significant increased risk of smoking-related cancers including lung cancer among those residing in rural and frontier areas, as well as urinary bladder and kidney cancer among those residing in rural areas; significant increased risk among those residing in rural areas of screen-detectable cancers including melanoma of the skin and cervical cancer (only among African American women); significantly higher percentages of late-stage diagnoses for three screen-detectable cancers including colon and rectum, melanoma of the skin, and oropharyngeal cancer among those residing in frontier areas; significantly lower overall survival among cancer patients residing in rural and frontier areas; and lower two-, three-, four-, and five-year survival among those residing in frontier areas for six screen-detectable cancers including prostate, female breast, colon and rectum, melanoma of the skin, lung, and oropharyngeal cancer.

The increased risk of smoking-related cancers observed in rural and frontier populations of California is concerning. According to the Centers for Disease Control and Prevention, tobacco use is highest in rural counties across the United States.⁹ Residents of rural areas are more likely to use tobacco products, to start using at a younger age, use more heavily, and are more likely to be exposed to secondhand smoke at work and home than residents of urban areas.¹⁰ More efforts need to be made to reduce the use of tobacco in rural and frontier areas of California. The American Lung Association calls on federal, state, and local governments to fund tobacco control programs and implement public health programs aimed at reducing the impact of tobacco use on rural communities. Such efforts may help reduce the disparity in smoking-related cancer incidence observed among rural and frontier populations in this study.

The observed differences in cancer detection and survival among those residing in rural and frontier areas compared to those residing in urban areas suggest that barriers to access to care exist for these populations. Such barriers may include, but are not limited to: an inadequate healthcare workforce in these remote areas, long travel times to providers and/or diagnostic and treating facilities, financial barriers, lack of knowledge and/or adherence to screening guidelines, and lack of access to clinical trials.^{4,5} Further research is needed to identify the barriers to healthcare access experienced by those residing in rural and frontier areas of California in order to develop and implement solutions to alleviate the identified disparities.

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