BURDEN OF TOBACCO-RELATED CANCERS IN CALIFORNIA 1988-2017

CALIFORNIA CANCER REGISTRY

UC DAVIS HEALTH | COMPREHENSIVE CANCER CENTER

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THIS PUBLICATION
WAS PREPARED BY CALIFORNIA
CANCER REPORTING AND EPIDEMIOLOGIC
SURVEILLANCE (CALCARES) PROGRAM,
INSTITUTE FOR POPULATION HEALTH IMPROVEMENT,
UNIVERSITY OF CALIFORNIA DAVIS HEALTH

SUGGESTED CITATION:

MAGUIRE FB, MOVSISYAN AS, VUONG TD, MORRIS CR, PARIKH-PATEL A, TONG EK, WILLIAMS R, KEEGAN THM, WUN T. BURDEN OF TOBACCO-RELATED CANCERS IN CALIFORNIA, 1988-2017. SACRAMENTO, CA: CALIFORNIA CANCER REPORTING AND EPIDEMIOLOGIC SURVEILLANCE (CALCARES) PROGRAM, UNIVERSITY OF CALIFORNIA DAVIS HEALTH, JUNE 2020.

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ACKNOWLEDGEMENTS AND DISCLAIMER

The collection of cancer incidence data used in this study was supported by the California Department of Public Health pursuant to California Health and Safety Code Section 103885; Centers for Disease Control and Prevention's (CDC) National Program of Cancer Registries, under cooperative agreement 5NU58DP006344; the National Cancer Institute's Surveillance, Epidemiology and End Results Program under contract HHSN261201800032I awarded to the University of California, San Francisco, contract HHSN261201800015I awarded to the University of Southern California, and contract HHSN261201800009I awarded to the Public Health Institute. The ideas and opinions expressed herein are those of the author(s) and do not necessarily reflect the opinions of the State of California, Department of Public Health, the National Cancer Institute, and the Centers for Disease Control and Prevention or their Contractors and Subcontractors.

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Important: An accessible excel file with data for all tables and figures can be downloaded from the Cancer Statistics and Reports (https://www.ccrcal.org/retrieve-data/data-for-the-public/cancer-statistics-and-reports/) webpage.

SUMMARY

- The Surgeon General concludes that tobacco causes 12 different cancers. These tobacco-related cancer sites are oral cavity/pharynx, larynx, esophagus, lung/bronchus, liver/intrahepatic bile duct (IBD), stomach, pancreas, kidney/renal pelvis, urinary bladder, colon/rectum, uterine cervix, and acute myeloid leukemia.

- This report describes tobacco use patterns and the burden of tobacco-related cancers in California from 1988 to 2017. This is the first report to describe California's incidence and mortality trends over time for the twelve tobacco-related cancers, including regional variations and variations by sex, race/ethnicity, and age group. Local data for California's 58 counties is included in the appendix.

Tobacco Use and Exposure in California

- Over the past two decades, cigarette smoking has declined in California from 22.6% in 1988 to 11.2% in 2018 and the percentage of never smokers has risen. However, new tobacco products are emerging. In 2018, approximately 3.3 million Californians were current cigarette smokers, 1.8 million used other smoked tobacco, 1.8 million were vapers, and 359,000 used smokeless tobacco. The largest population totals of tobacco product users are represented by low-income populations, non-Hispanic/Latino whites, Hispanic/Latinos, and individuals that did not complete high school. Notably, young adults are among the largest population totals, not for cigarettes, but with other smoked tobacco, vape products, and smokeless tobacco.

- Differences in the current use of tobacco products exist by race/ethnicity, sex, and age group. Among adults, cigarette smoking was highest among American Indians, other smoked tobacco use was highest among African Americans/blacks, vaping was highest among Asian/Pacific Islanders, and smokeless tobacco use was highest among non-Hispanic/Latino whites. Tobacco use was greater among males and vaping was more common in younger age groups.

- The Surgeon General concludes that secondhand smoke causes cancer in nonsmokers, and there is no risk-free level of exposure. Nearly 53% of adults

reported second-hand smoke exposure. Second-hand smoke exposure was highest among multi-racial groups and American Indians.

Tobacco Use among the Tobacco-Related Cancers in California

- Among all Californians diagnosed with a tobacco-related cancer from 2012 to 2017, 10.6% (n=41,202) were current tobacco users (cigarettes, chewing tobacco, snuff, cigars, cigarillos, pipes), 22.8% (n=86,266) were former tobacco users, and 22.2% were never users (n=86,171). These are likely significant underestimates as the percentage with unknown tobacco status in the CCR remains high across all cancers (44%). Improving the documentation of tobacco status is needed, along with including vaping and assessing secondhand smoke exposure.

- The percentage of current tobacco users among patients with lung/bronchus (17.3%) and larynx cancer (19.5%) is higher than the overall state percentage of current tobacco users (15.7%). Patients with AML had the lowest percentage (5.5%) of current tobacco users. Patients with lung/bronchus cancer (31.7%) and esophagus cancer (29.3%) had the highest percentage of former tobacco users while patients with cervical cancer had the highest percentage of never use (38.0%).

Incidence and Mortality Rates of Tobacco-Related Cancers in California

- Between 2012-2017, 387,948 people in California were diagnosed with a tobacco-related cancer. The top five tobacco-related cancer sites are lung/bronchus, colon/rectum, urinary bladder, kidney/renal pelvis, and pancreas.

- From 1988 to 2017, age-adjusted incidence rates decreased for the following tobacco-related cancers: lung/bronchus, colon/rectum, urinary bladder, oral cavity/pharynx, stomach, uterine cervix, larynx, and esophagus. Age-adjusted mortality rates for these cancers either decreased or remained relatively constant. Age-adjusted incidence and mortality rates increased for liver/IBD cancer and acute myeloid leukemia.

- From 2007 to 2016, incidence and mortality rates for males increased significantly for cancers of the pancreas and liver/IBD. For females, incidence and mortality rates increased significantly only for liver/IBD cancer.

- Northern and eastern California counties had the highest percentage of current smokers among the general population, but this cannot yet be determined for tobacco-related cancers given the available data. The highest incidence rates for cancers of the lung/bronchus, oral cavity/pharynx, and larynx were in northern California counties. The highest incidence rates for gastrointestinal cancers were in central and southern areas of the state.

- Males had higher incidence and mortality rates than females for all smoking related cancers. Hispanics/Latinos were the only racial/ethnic group where colon/rectum cancer was more common than lung/bronchus cancer. African Americans/blacks had the highest incidence and mortality rates for cancers of the lung/bronchus, colon/rectum, and pancreas. American Indians had the highest incidence and mortality rates for cancers of the kidney/renal pelvis, liver/IBD, and esophagus. Hispanics/Latinos had the highest incidence and mortality rates for stomach cancer while non-Hispanic/Latino whites had the highest incidence and mortality rates for urinary bladder cancer. Among younger age groups (<65 years), colon/rectum cancer was more common than lung/bronchus cancer.

Between 2012 - 2017, 387,948 people in California were diagnosed with a tobacco-related cancer

African Americans/blacks had the highest incidence and mortality rates for cancers of the lung/bronchus, colon/rectum, and pancreas

Males had higher incidence and mortality rates than females for all tobacco-related cancers

INTRODUCTION

Over 60 years ago in 1964, the United States (U.S.) Surgeon General first determined that smoking causes lung cancer.[1] In 2014, the U.S Surgeon General concluded that smoking is causally associated with twelve different cancers, and cancer patients and survivors who continue to smoke have a higher risk of mortality.[1] These twelve tobacco-related cancers include oral cavity/pharynx, larynx, esophagus, lung/bronchus, liver/intrahepatic bile duct (IBD), stomach, pancreas, kidney/renal pelvis, urinary bladder, colon/rectum, uterine cervix, and acute myeloid leukemia (Figure 1). Lung cancer is usually highlighted as a smoking-related cancer in studies, as more than 87% of lung cancer deaths are attributable to smoking and it is the leading cause of cancer death in the U.S. However, it is important to understand that smoking increases the risk of many cancers, and that secondhand smoke exposure in nonsmokers is also causally linked to cancer.[2] It has been estimated that 40% of all cancers diagnosed in the U.S. are linked to tobacco.[3]

Compared to other states, California has the second lowest smoking rate[4] and ranks 50th in the U.S. in the proportion of cancer deaths attributable to cigarette smoking.[5] The California Tobacco Control Program, established in 1989, has contributed to significant declines in cigarette consumption, lung cancer incidence, and heart disease mortality in California.[6,7] From 1986 to 2013, California's annual lung cancer mortality was 28% lower than in the rest of the U.S.[8]

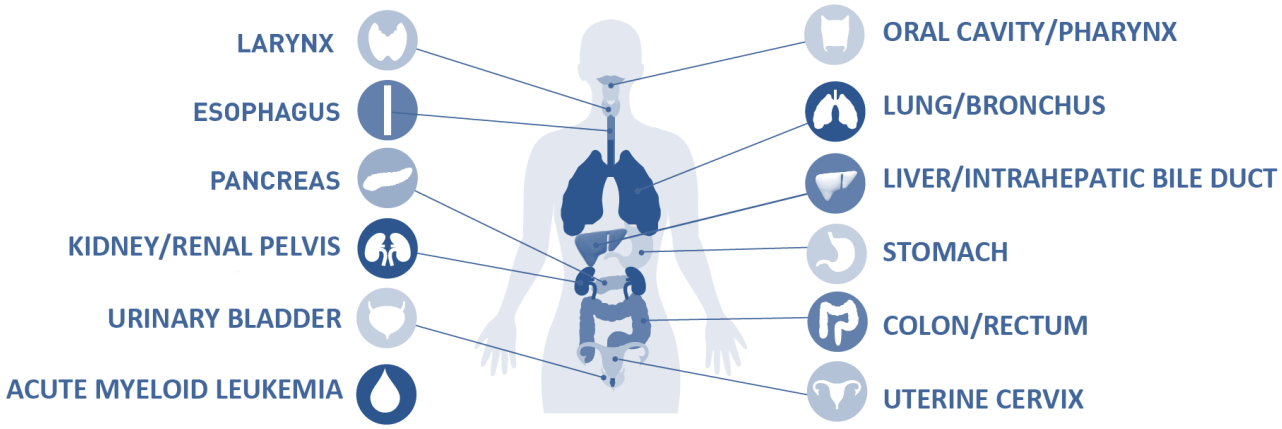
Despite these successes, California, the largest and most diverse state, still has almost 3 million smokers[9] and a high proportion of light and intermittent smokers.[10] Light and intermittent smokers report better health than daily smokers,[11] but have higher risks for cancer, heart disease, and respiratory disease mortalities than never smokers.[12,13]

Almost 40% of California's smokers have Medicaid insurance,[14] and cancer patients with Medicaid in California are less likely to get recommended treatment and have lower survival rates than patients with other types of insurance.[15] Smoking rates are higher among rural populations and specific racial/ethnic subgroups, such as American Indians, which have been demonstrated to have cancer disparities in California.[16,17] Newer tobacco products like vapes also are increasing in use, especially in young people.

This report describes tobacco use patterns and the burden of tobacco-related cancers in California from 1988 to 2017. This is the first report to describe California's incidence and mortality trends over time for the twelve tobacco-related cancers, including regional variations and variations by sex, race/ethnicity, and age group. To provide context about tobacco use, current and former tobacco use trends are included for the general population and among Californians with tobacco-related cancer. Data on cancer were obtained from the California Cancer Registry (CCR), which has collected information on all cancers diagnosed among California residents since 1988. The CCR is California's statewide, population-based cancer surveillance system and is responsible for monitoring the burden of cancer in California. Data on cancer incidence, mortality, diagnosis, treatment and follow-up are gathered through a system of regional registries and provide the foundation for research studies and cancer control initiatives throughout the state. 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 Health to manage day-to-day operations of the CCR.

We hope that cancer care providers, cancer registries, health plans, public health partners, and policy makers will utilize this information to continue improving tobacco-related cancer incidence and mortality. The California Tobacco Control Program has tobacco control coalitions and partners in every county. In 2015, California Dialogue on Cancer published its "Tobacco Cessation in Cancer Prevention and Treatment: A Call to Action for California Cancer Centers."[18] The National Cancer Institute has a Cancer Center Cessation Initiative that is building capacity for cancer centers to integrate tobacco treatment as an important part of cancer care.[19] As new tobacco products and behaviors emerge, the epidemiologic data and trends over time continue to be important for understanding and mitigating tobacco-related cancer incidence and mortality.

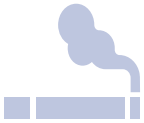
FIGURE 1. DIAGRAM OF TOBACCO-RELATED CANCER SITES



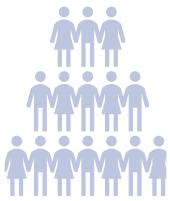
Source: The truth about tobacco and cancer. https://truthinitiative.org/research-resources/harmful-effects-tobacco/truth-about-tobacco-and-cancer. Accessed June 12, 2020.

TOBACCO USE IN CALIFORNIA

Over the past two decades, cigarette smoking has declined in California (22.6% in 1988 to 11.2% in 2018) and the percentage of never smokers has risen (51.6% in 1988 to 66.7% in 2018) (Figure 2). However, there is a wide variety of emerging tobacco products besides cigarettes, including smokeless tobacco (e.g., chewing tobacco, snuff, snus), vape products (e.g., e-cigarettes, vape pens, e-hookah), and other smoked tobacco (e.g., cigars, cigarillos, pipes, hookah). In California, cigarettes are the main tobacco product used (11.2% of adults), followed by other smoked tobacco (6.2% of adults), vaping products (5.9% of adults), and smokeless tobacco (1.2% of adults).[9]



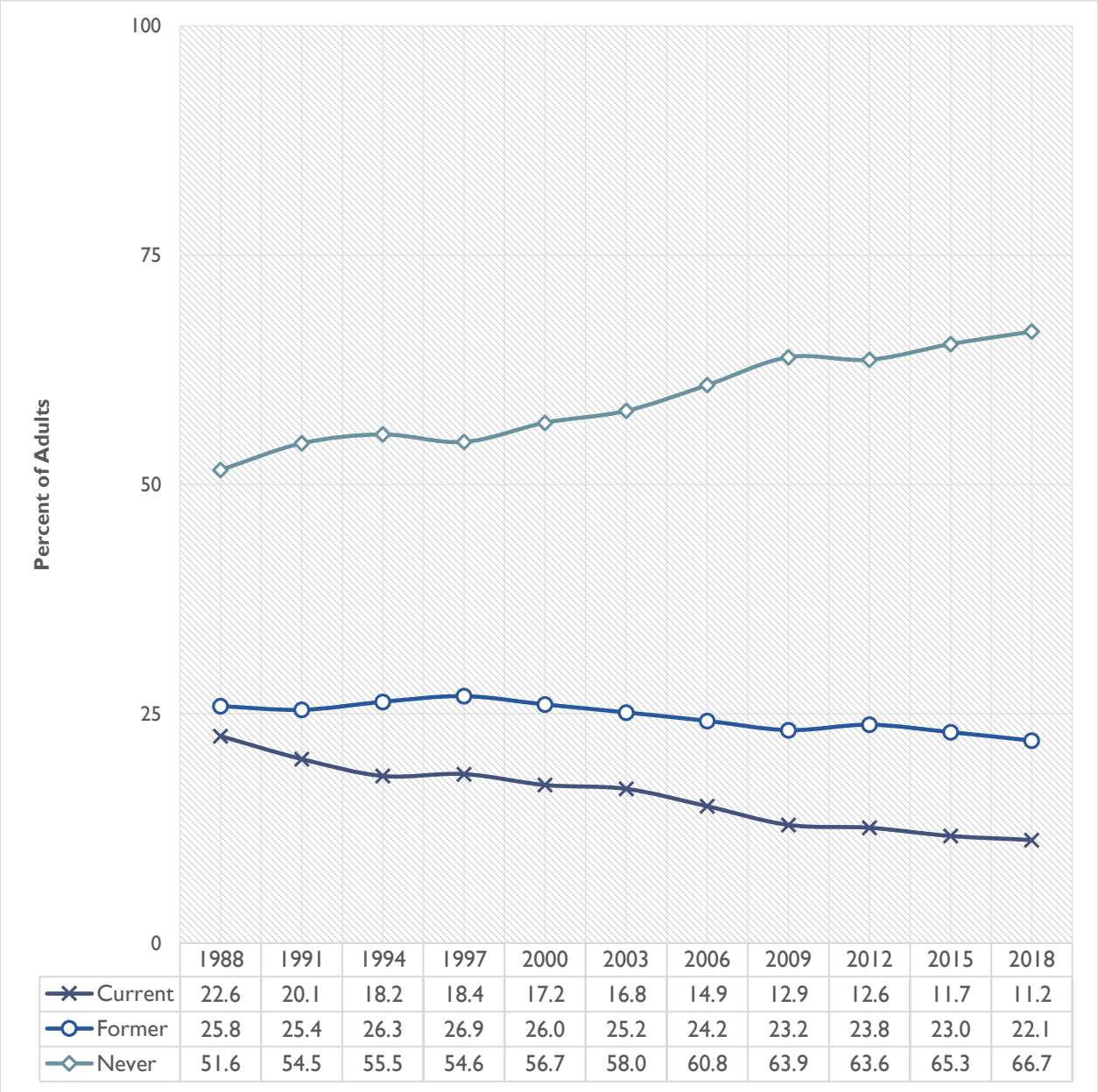
Cigarettes are the main tobacco product used among California adults



~3.3 million California adults were current smokers in 2018

Cigarette smoking has declined in California and the percentage of never-smokers has increased over the past two decades

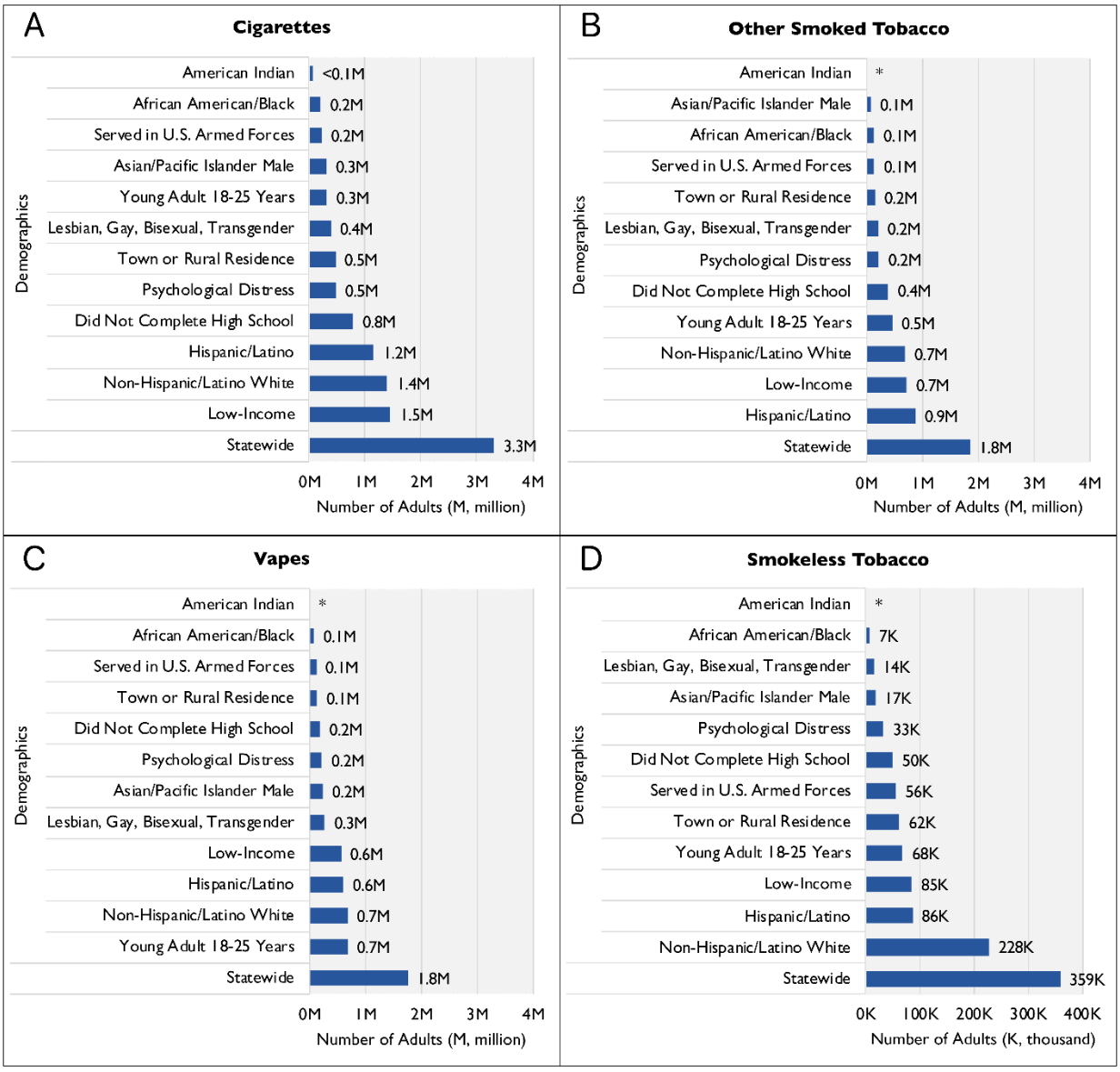
FIGURE 2. CIGARETTE SMOKING IN CALIFORNIA ADULTS ≥18 YEARS, 1988 TO 2018



	1988	1991	1994	1997	2000	2003	2006	2009	2012	2015	2018
Current	22.6	20.1	18.2	18.4	17.2	16.8	14.9	12.9	12.6	11.7	11.2
Former	25.8	25.4	26.3	26.9	26.0	25.2	24.2	23.2	23.8	23.0	22.1
Never	51.6	54.5	55.5	54.6	56.7	58.0	60.8	63.9	63.6	65.3	66.7

Source: Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System Survey 1988-2018. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

FIGURE 3. NUMBER OF ADULTS ≥18 YEARS WHO ARE CURRENT CIGARETTE SMOKERS (A), OTHER SMOKED TOBACCO USERS (B), VAPE USERS (C), SMOKELESS TOBACCO USERS (D) CALIFORNIA, 2018



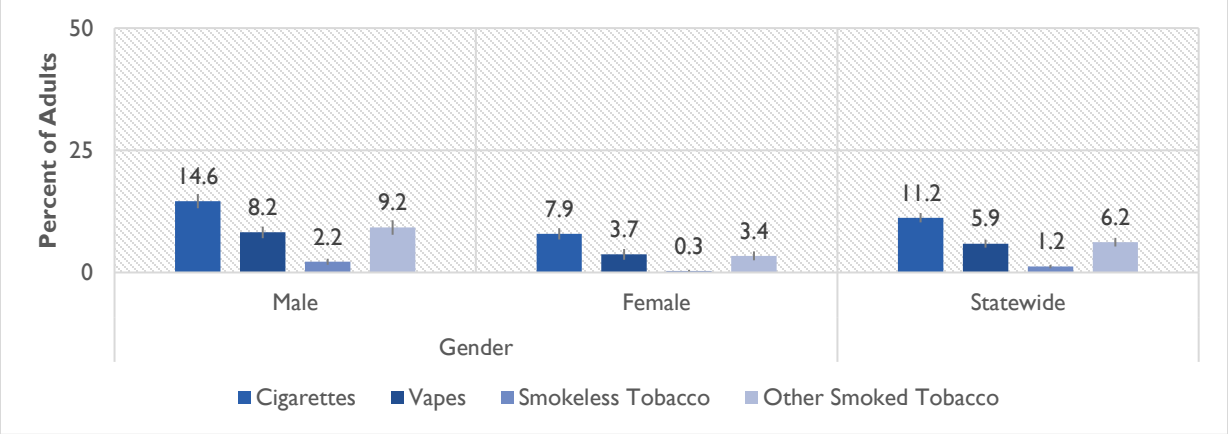
*Data not presented when unweighted sample size < 500 or coefficient of variation >= 30%.
Psychological Distress: Based on Kessler 6 score of ≥ 13; Low income: Federal poverty level of 184% or lower.
Source: California Health Interview Survey, CHIS 2018 Adult Files. Los Angeles, CA: UCLA Center for Health Policy Research; February 2020.

In 2018, approximately 3.3 million adult Californians were current cigarette smokers, 1.8 million used other smoked tobacco, 1.8 million were vapers, and 359,000 used smokeless tobacco (Figure 3). Excluding vape products, approximately 15.7% of Californians used cigarettes, other smoked tobacco, and/or smokeless tobacco in 2018.[9]

The largest population totals of tobacco product users are represented by low income populations, non-Hispanic/Latino whites, Hispanics/Latinos, and individuals that did not complete high school. Notably, young adults are among the largest population totals, not for cigarettes, but with other smoked tobacco, vape products, and smokeless tobacco. With this new generation of tobacco users at greatest risk for tobacco-related cancers, it is important to understand how changes in tobacco behavior will influence incidence and mortality of tobacco-related cancers and other disease.

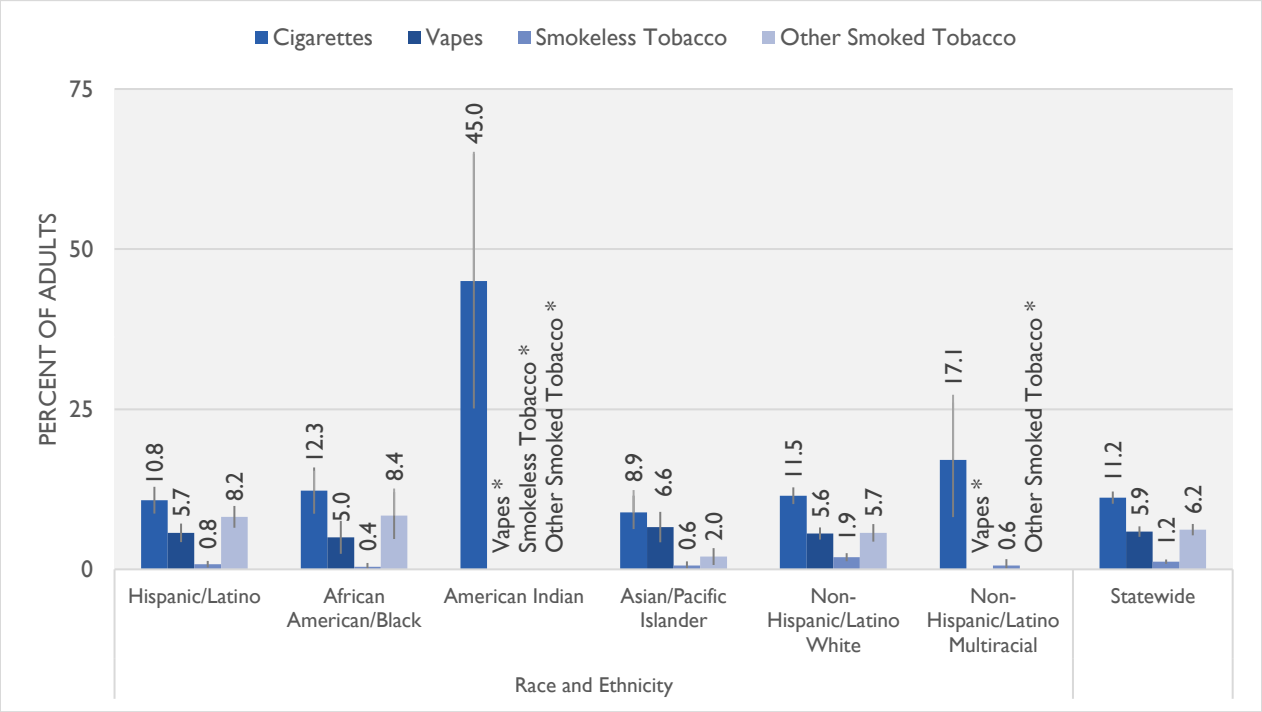
Differences in the use of tobacco products exist by sex, race/ethnicity, and age group. Use among males (vs. females) was higher for every tobacco product (Figure 4). Cigarette smoking was highest among American Indians, other smoked tobacco use was highest among African Americans/blacks, vaping was highest among Asian/Pacific Islanders, and smokeless tobacco use was highest among non-Hispanic/Latino whites (Figure 5). Vaping and use of other smoked tobacco were highest among young adults (18 to 25 years) and decreased with increasing age (Figure 6). Those aged 26 to 49 years had the greatest use of cigarettes. Use of smokeless tobacco was highest in those aged 26 to 49 and 18 to 25 years.

FIGURE 4. USE OF TOBACCO PRODUCTS IN ADULTS ≥18 YEARS BY SEX, CALIFORNIA, 2018



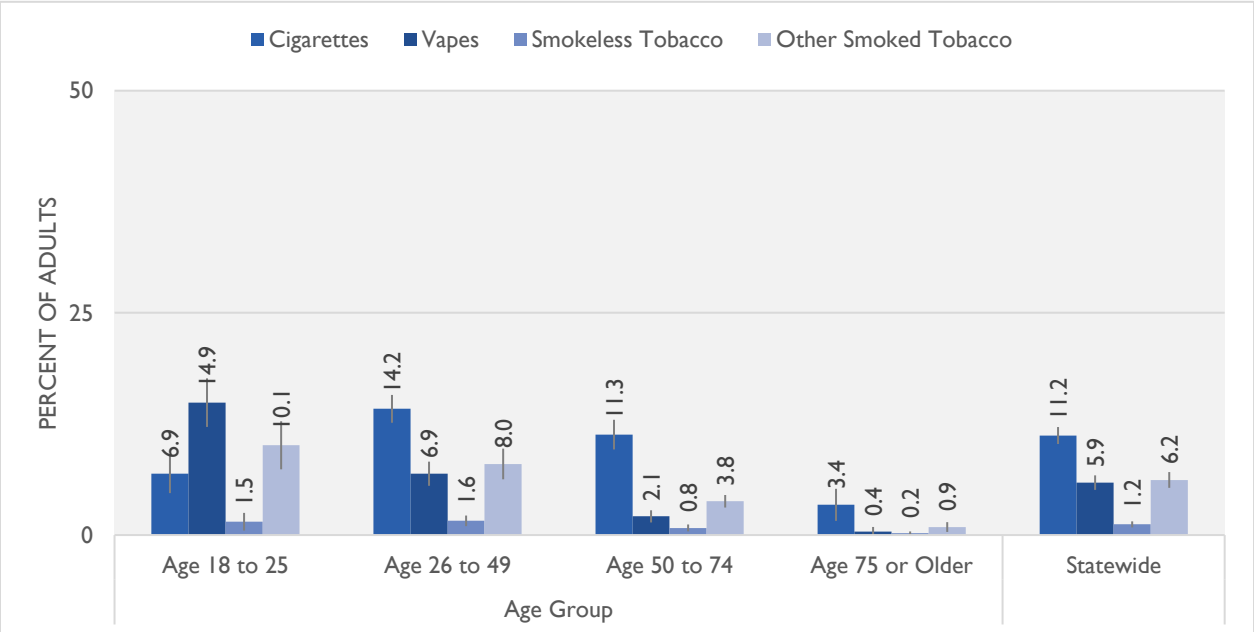
Source: California Health Interview Survey. CHIS 2018 Adult Files. Los Angeles, CA: UCLA Center for Health Policy Research; February 2020.

FIGURE 5. USE OF TOBACCO PRODUCTS BY RACE/ETHNICITY IN ADULTS ≥18 YEARS, CALIFORNIA, 2018



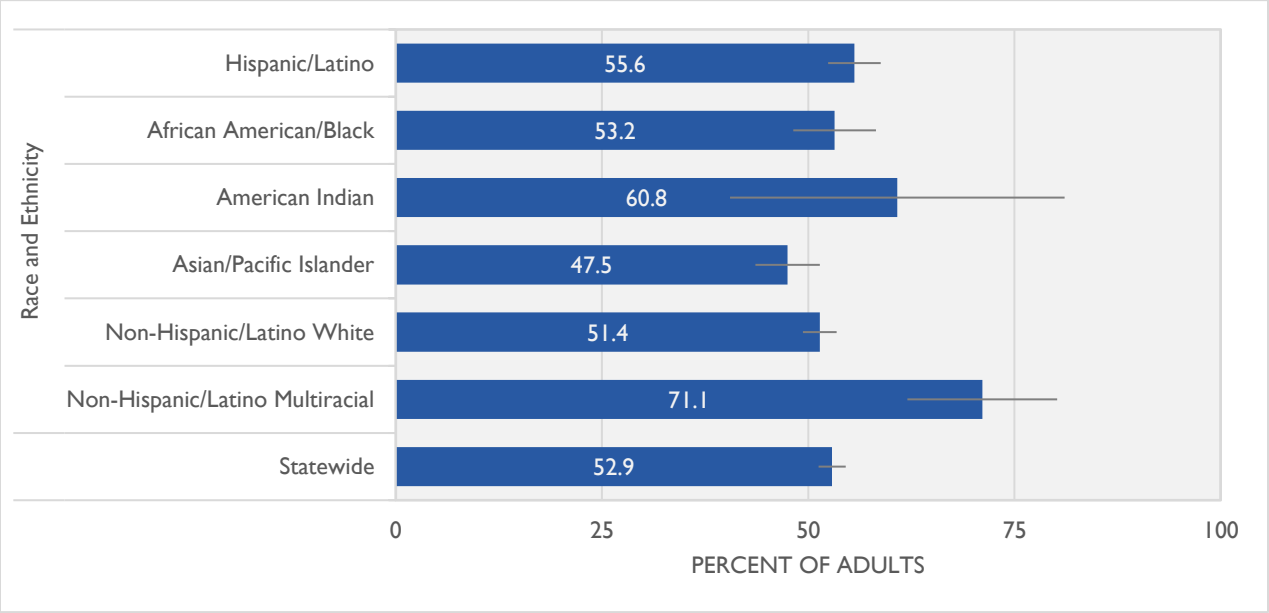
*Data not presented when unweighted sample size < 500 or coefficient of variation >= 30%.
Source: California Health Interview Survey, CHIS 2018 Adult Files. Los Angeles, CA: UCLA Center for Health Policy Research; February 2020. DSU, data suppressed; H/L, Hispanic/Latino.

FIGURE 6. USE OF TOBACCO PRODUCTS BY AGE GROUP (YEARS), CALIFORNIA, 2018



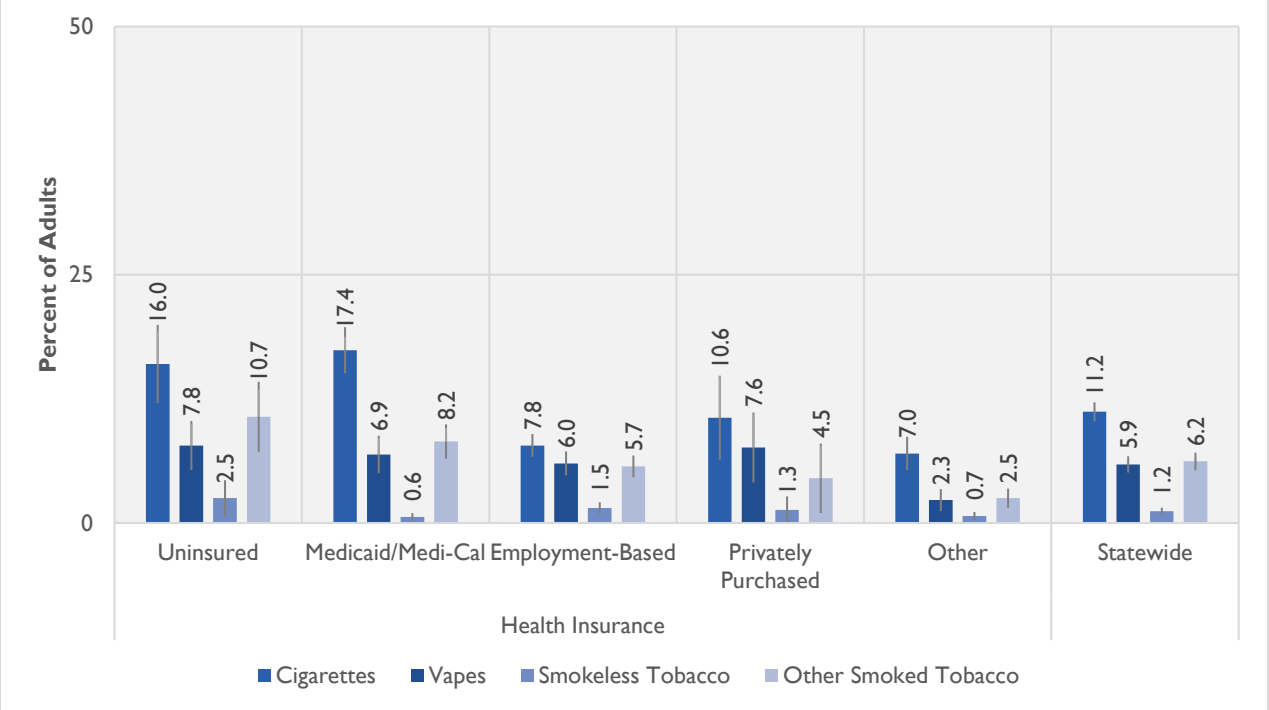
Source: California Health Interview Survey. CHIS 2018 Adult Files. Los Angeles, CA: UCLA Center for Health Policy Research; February 2020.

FIGURE 7. ADULTS ≥18 YEARS EXPOSED TO SECONDHAND TOBACOO SMOKE OR E-CIGARETTE VAPOR BY RACE/ETHNICITY, CALIFORNIA, 2018



Source: California Health Interview Survey, CHIS 2018 Adult Files. Los Angeles, CA: UCLA Center for Health Policy Research; February 2020. H/L, Hispanic/Latino

FIGURE 8. ADULT TOBACCO USE BY HEALTH INSURANCE STATUS, CALIFORNIA, 2018



Source: California Health Interview Survey, CHIS 2018 Adult Files. Los Angeles, CA: UCLA Center for Health Policy Research; February 2020

Figure 7 shows secondhand smoke exposure by race/ethnicity. Second-hand smoke is an important source of exposure among children and adults. It has been classified as a known human carcinogen by the U.S. Environmental Protection Agency, the U.S. National Toxicology Program, the U.S. Surgeon General, and the International Agency for Research and Cancer.[2,20-22] The U.S. Surgeon General report states that “there is no risk-free level of exposure to nonsmokers”.[2] In California, nearly 53% of adults reported secondhand tobacco smoke or e-cigarette aerosol exposure. Secondhand smoke or vapor exposure was highest among multi-racial groups and American Indians.

Figure 8 shows tobacco use by health insurance type. In a previous report of the CCR, cancer patients insured by California Medicaid or who were uninsured were less likely to get recommended treatment and also had lower survival rates than patients with other types of insurance.[15] Cigarette and other smoked tobacco use were highest among those with Medicaid insurance and the uninsured. While this report focuses on the 12 tobacco-related cancers, future studies should consider how the higher tobacco use rates in these populations affect all cancers.

CALIFORNIA CANCER REGISTRY: TOBACCO-RELATED CANCERS AND AVAILABLE DATA ON TOBACCO USE STATUS

In 2012, the Centers for Disease Control and Prevention began requiring registries to collect data on tobacco use, including cigarettes, smokeless tobacco (chewing tobacco, snuff), and other smoked tobacco products (e.g., cigars, pipes). Current use is defined as use as of the date of the cancer diagnosis. Former use is defined as quitting any time before the date of diagnosis. Although vape products are considered tobacco products, they are not included in the CDC definition at this time. Also, secondhand smoke exposure among nonsmokers, or “passive smoking”, is not collected. As with any new variable introduced into cancer registries, collection of tobacco use and exposure may improve over time.

From 2012-2017 (Table 1), among all Californians diagnosed with a tobacco-related cancer, at least 10.6% were current tobacco users (n=41,202) and 22.8% were former tobacco users (n=88,266). The percentage of current tobacco users among patients with lung/bronchus cancer (17.3%) and larynx cancer (19.5%) is higher than the overall state percentage of current tobacco users (15.7%).[9] Patients with AML had the lowest percentage (5.5%) of current tobacco users. Patients with lung/bronchus cancer (31.7%) and esophagus cancer (29.3%) had the highest percentage of former tobacco users while patients with cervical cancer had the highest percentage of never use (38.0%). The estimates of tobacco use among patients with a tobacco-related cancer are likely significant underestimates as the percentage of unknown tobacco status in the CCR remains high across all cancers (44%). Improving the documentation of tobacco status is needed, along with including vaping and assessing secondhand smoke exposure. For county specific information, see Appendix 1.

TABLE 1. HISTORY OF TOBACCO USE INCLUDING CIGARETTES, SMOKELESS TOBACCO (CHEWING TOBACCO, SNUFF), AND OTHER SMOKED TOBACCO PRODUCTS (E.G., CIGARS, PIPES), AMONG PATIENTS (20 YEARS AND OLDER) DIAGNOSED WITH TOBACCO-RELATED CANCERS, CALIFORNIA, 2012-2017

Tobacco Use					
	Current	Former	Never	Unknown	Total
Cancer Site	**n** *(row %)*	**n** *(row %)*	**n** *(row %)*	**n** *(row %)*	**n**
Acute Myeloid Leukemia	**490** *(5.5)*	**1,590** *(17.9)*	**2,848** *(32.1)*	**3,951** *(44.5)*	**8,879**
Urinary Bladder	**3,577** *(8.9)*	**9,624** *(23.9)*	**7,251** *(18.1)*	**19,696** *(49.1)*	**40,148**
Uterine cervix	**824** *(9.5)*	**988** *(11.3)*	**3,311** *(38.0)*	**3,591** *(41.2)*	**8,714**
Colon/ rectum	**5,754** *(6.7)*	**14,529** *(16.8)*	**26,489** *(30.6)*	**39,810** *(45.9)*	**86,582**
Esophagus	**1,067** *(12.2)*	**2,559** *(29.3)*	**1,479** *(16.9)*	**3,639** *(41.6)*	**8,744**
Kidney/Renal Pelvis	**2,700** *(7.6)*	**6,417** *(18.1)*	**9,601** *(27.1)*	**16,760** *(47.2)*	**35,478**
Larynx	**1,031** *(19.5)*	**1,488** *(28.1)*	**477** *(9.0)*	**2,297** *(43.4)*	**5,293**
Liver and Intrahepatic Bile Duct	**2,685** *(11.1)*	**5,462** *(22.6)*	**5,166** *(21.4)*	**10,848** *(44.9)*	**24,161**
Lung/ bronchus	**16,851** *(17.3)*	**30,920** *(31.7)*	**10,427** *(10.7)*	**39,505** *(40.4)*	**97,703**
Oral Cavity/ Pharynx	**2,983** *(11.6)*	**5,775** *(22.4)*	**5,273** *(20.4)*	**11,801** *(45.7)*	**25,832**
Pancreas	**2,026** *(7.2)*	**5,510** *(19.5)*	**8,630** *(30.5)*	**12,158** *(42.9)*	**28,324**
Stomach	**1,214** *(6.7)*	**3,404** *(18.8)*	**5,219** *(28.9)*	**8,253** *(45.6)*	**18,090**
Total	**41,202** *(10.6)*	**88,266** *(22.8)*	**86,171** *(22.2)*	**172,309** *(44.4)*	**387,948**

Source: California Cancer Registry

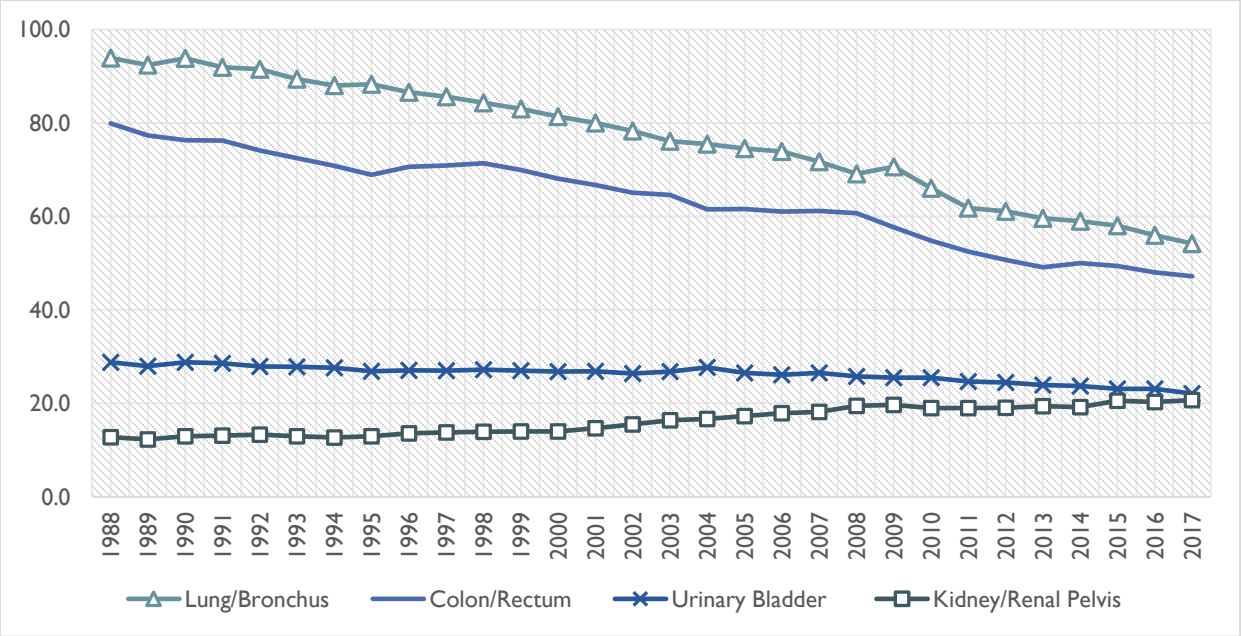
SUMMARY OF ANNUAL TOBACCO-RELATED CANCERS

Between 2012-2017, Table 1 shows that 387,948 people in California have been diagnosed with a tobacco-related cancer. The top five tobacco-related cancers are lung/bronchus, colon/rectum, urinary bladder, kidney/renal pelvis, and pancreas. In 2017, 67,086 people in California were diagnosed with one of the twelve tobacco-related cancers as follows: lung/bronchus (n=16,611), colon/rectum (14,992), urinary bladder (6,884), kidney/renal pelvis (6,610), pancreas (5,012), oral cavity/pharynx (n=4,432), liver/IBD (n=4,095), stomach (n=3,129), acute myeloid leukemia (n=1,503), uterine cervix (1,494), esophagus (n=1,479), and larynx (n=845).

INCIDENCE AND MORTALITY RATE TRENDS FOR TOBACCO-RELATED CANCERS

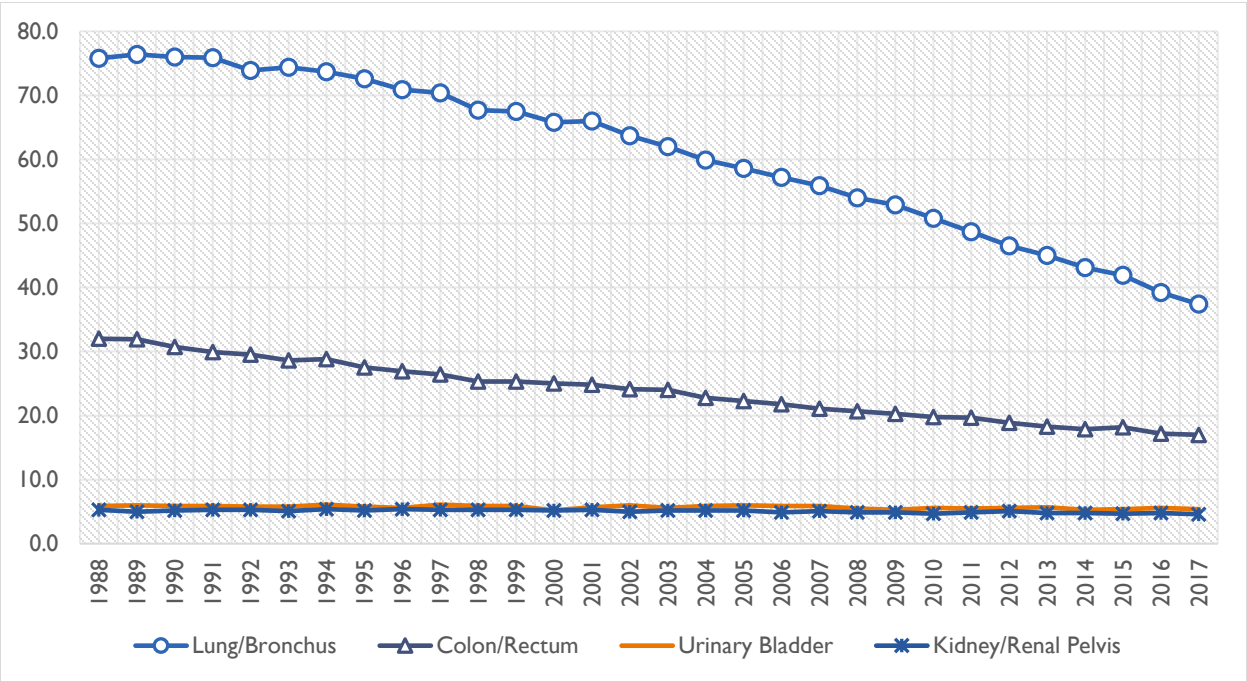
Figures 9 through 14 show the incidence and mortality trends over time (1988-2017) for the twelve tobacco-related cancers. Age-adjusted incidence rates for the following cancers decreased from 1988 to 2017: lung/bronchus, colon/rectum, urinary bladder, oral cavity/pharynx, stomach, uterine cervix, larynx, and esophagus (Figures 9,11,13). Age-adjusted mortality rates for these cancers either decreased or remained relatively constant over the same time period (Figures 10,12,14). However, for cancers of the kidney/renal pelvis, liver/IBD, pancreas, and acute myeloid leukemia, age-adjusted incidence rates increased over this period. For liver/IBD cancer and acute myeloid leukemia, the mortality rates also increased, while mortality rates remained relatively constant over the years for kidney/renal pelvis cancer and pancreatic cancer.

FIGURE 9. AGE-ADJUSTED INCIDENCE RATES FOR CANCER OF THE LUNG/BRONCHUS, COLON/RECTUM, URINARY BLADDER, AND KIDNEY/RENAL PELVIS, 1988-2017, CALIFORNIA



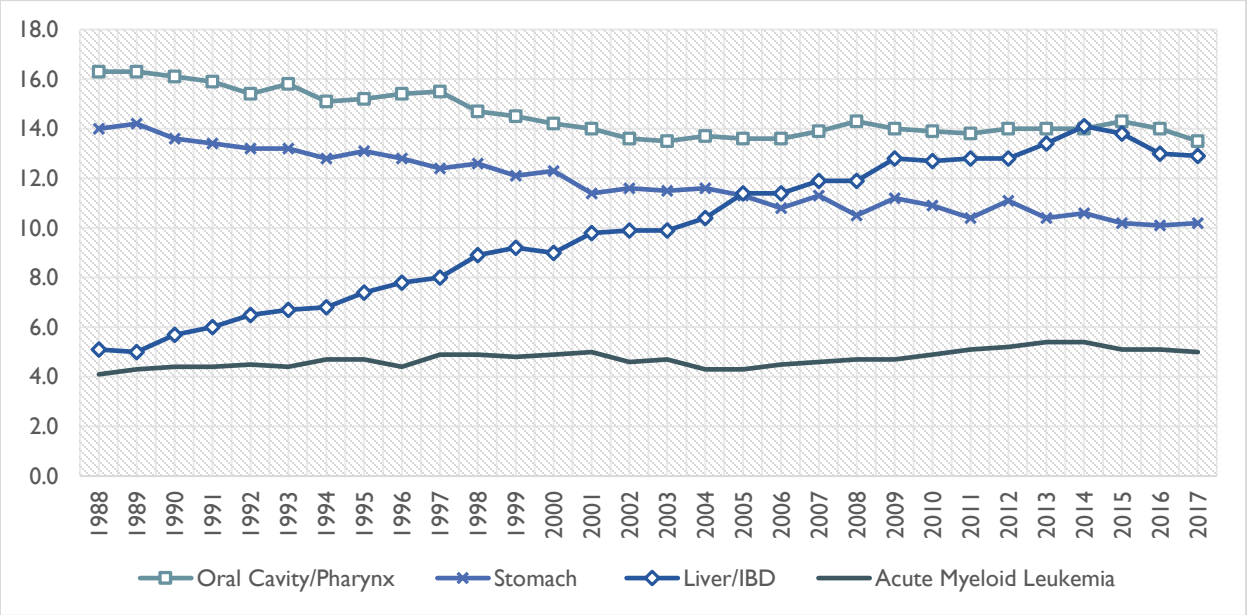
Source: California Cancer Registry, California Department of Public Health, SEER*Stat Database: Incidence – California, December 2019.

FIGURE 10. AGE-ADJUSTED MORTALITY RATES FOR CANCER OF THE LUNG/BRONCHUS, COLON/RECTUM, URINARY BLADDER, AND KIDNEY/RENAL PELVIS, 1988-2017, CALIFORNIA



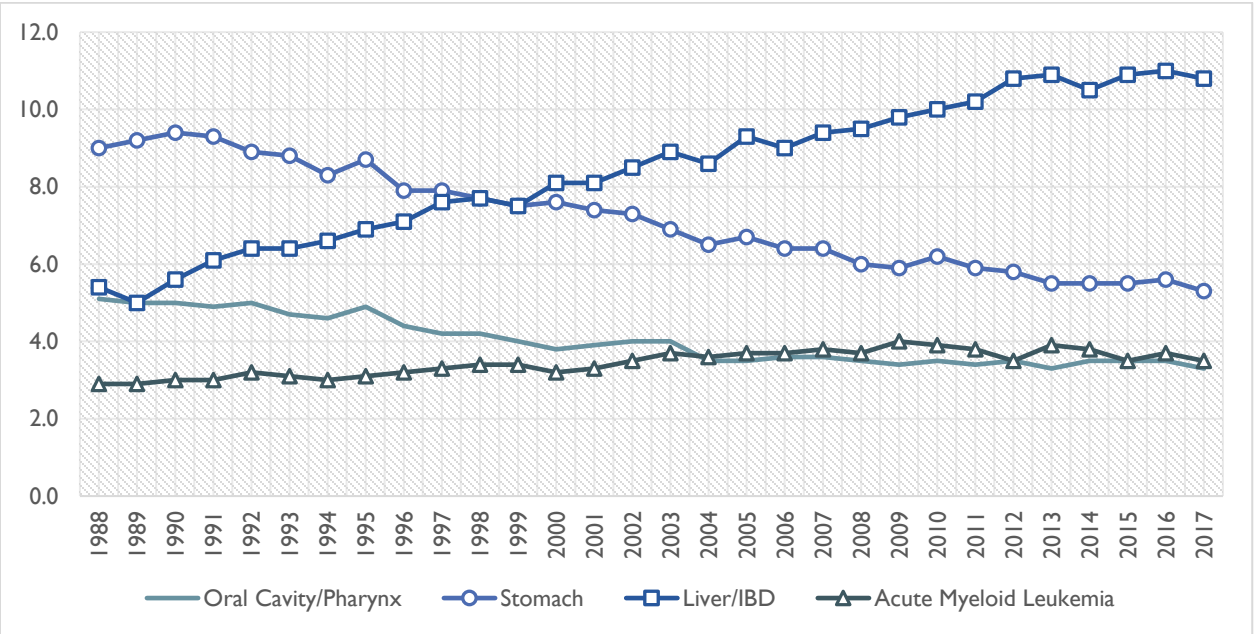
Source: California all-cause mortality 1970-2017, 01/21/2019, California Department of Public Health, Center for Health Statistics Death Master Files 1970-2017.

FIGURE 11. AGE-ADJUSTED INCIDENCE RATES FOR CANCER OF THE ORAL CAVITY/PHARYNX, STOMACH, LIVER/IBD, AND ACUTE MYELOID LEUKEMIA, 1988-2017, CALIFORNIA



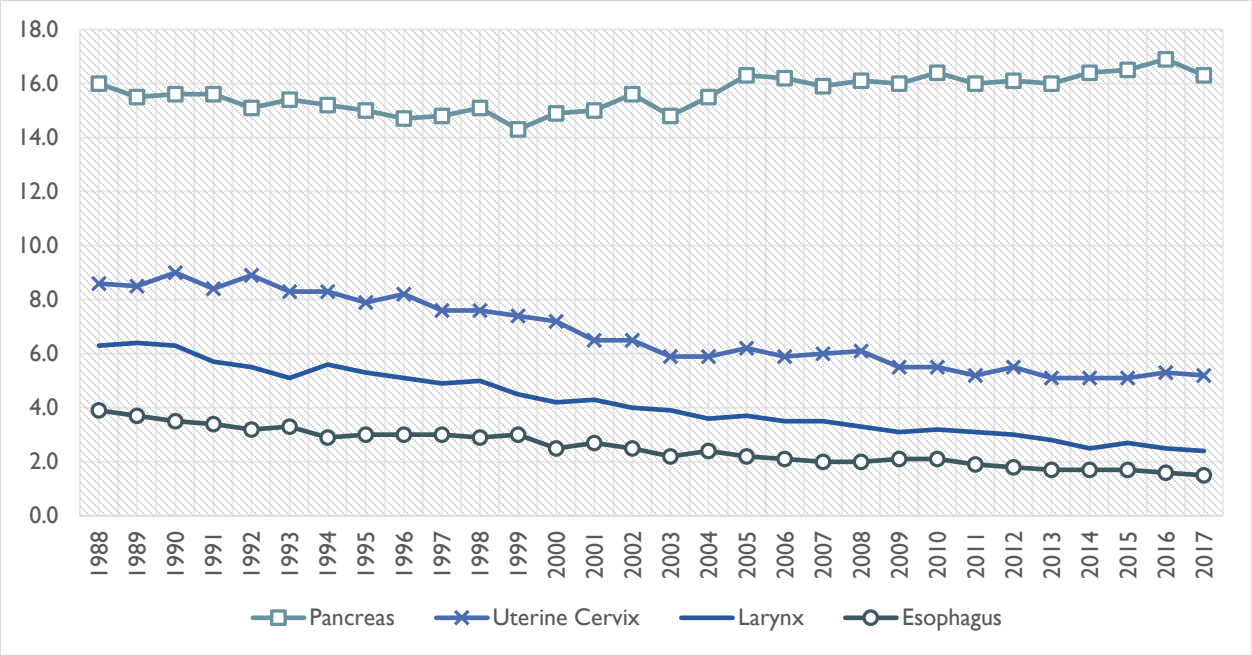
IBD=intrahepatic bile duct
Source: California Cancer Registry, California Department of Public Health, SEER*Stat Database: Incidence – California, December 2019.

FIGURE 12. AGE-ADJUSTED MORTALITY RATES FOR CANCER OF THE ORAL CAVITY/PHARYNX, STOMACH, LIVER/IBD, AND ACUTE MYELOID LEUKEMIA, 1988-2017, CALIFORNIA



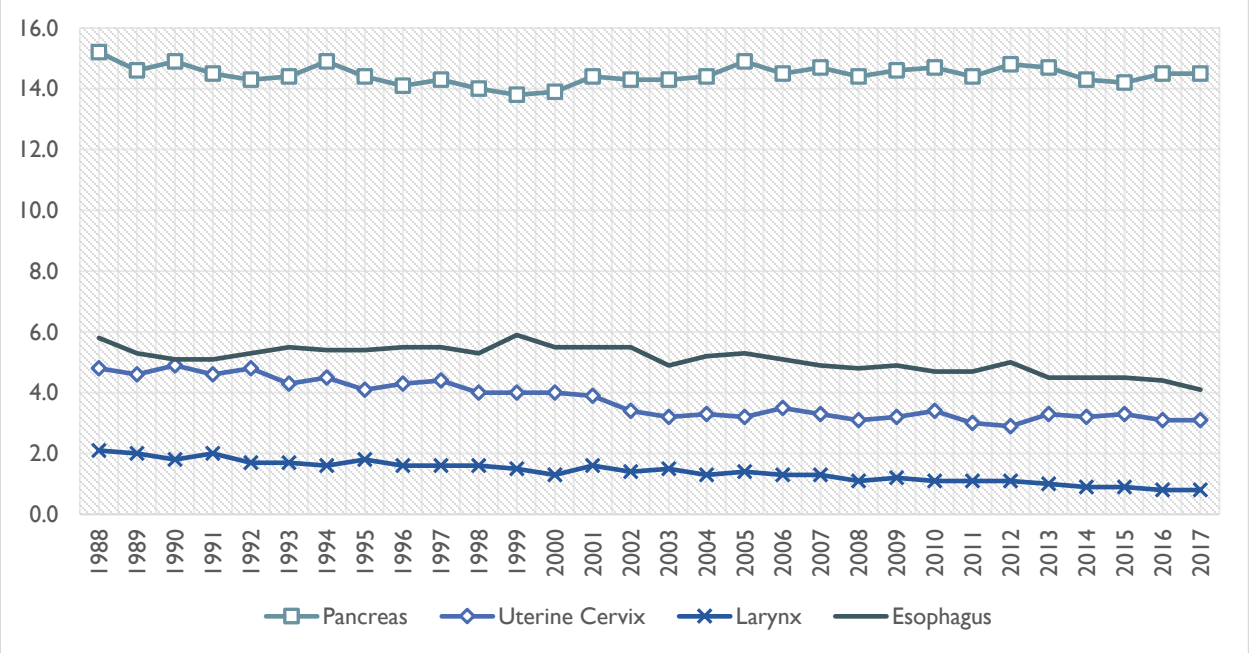
IBD=intrahepatic bile duct
Source: California all-cause mortality 1970-2017, 01/21/2019, California Department of Public Health, Center for Health Statistics Death Master Files 1970-2017.

FIGURE 13. AGE-ADJUSTED INCIDENCE RATES FOR CANCER OF THE PANCREAS, UTERINE CERVIX, LARYNX, AND ESOPHAGUS, 1988-2017, CALIFORNIA



Cancer of the esophagus restricted to squamous cell carcinoma
Source: California Cancer Registry, California Department of Public Health, SEER*Stat Database: Incidence – California, December 2019.

FIGURE 14. AGE-ADJUSTED MORTALITY RATES FOR CANCER OF THE PANCREAS, UTERINE CERVIX, LARYNX, AND ESOPHAGUS, 1988-2017, CALIFORNIA



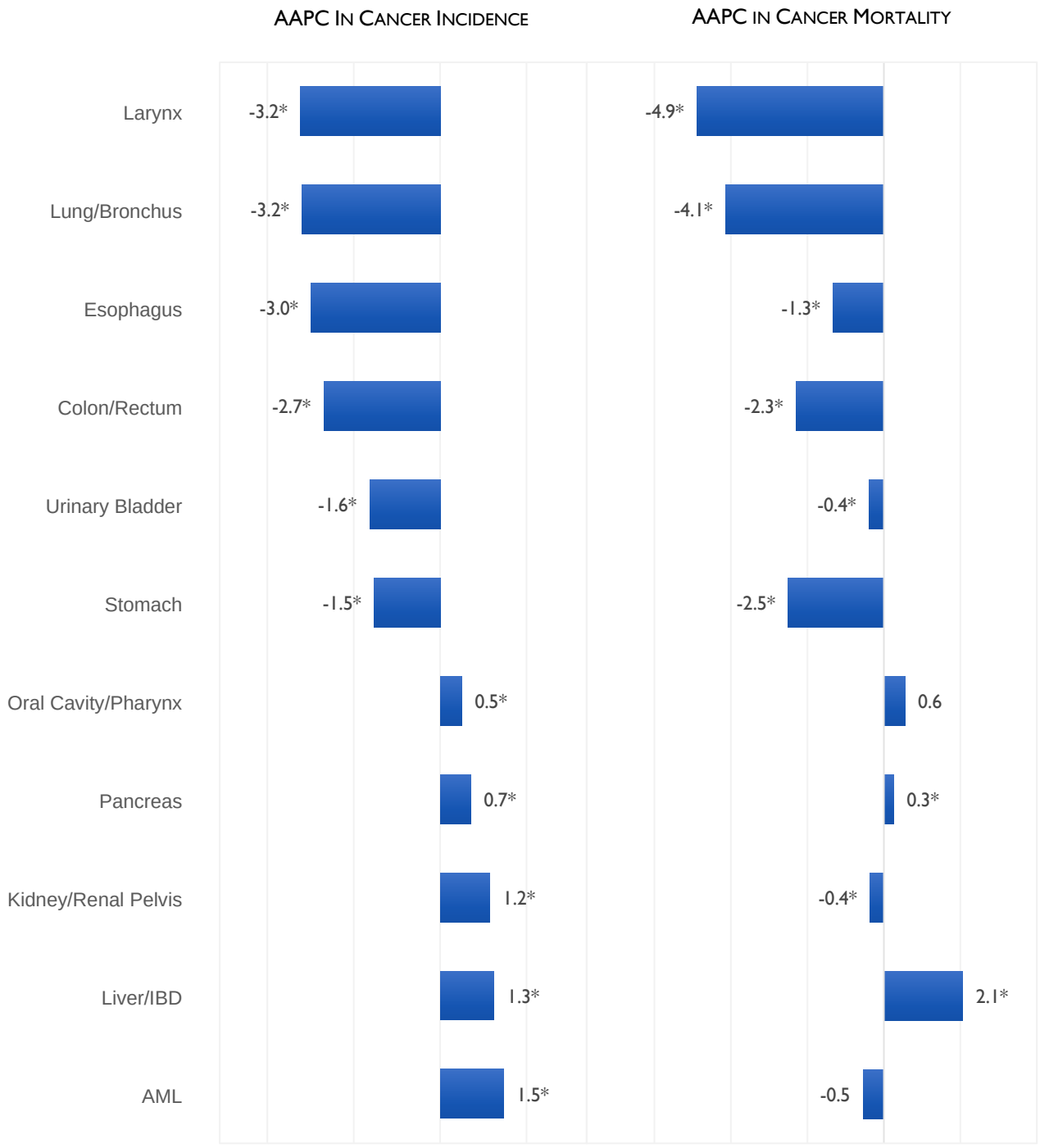
Source: California all-cause mortality 1970-2017, 01/21/2019, California Department of Public Health, Center for Health Statistics Death Master Files 1970-2017.

Figures 15 and 16 show the average annual percent change (AAPC) in incidence and mortality for the twelve tobacco-related cancers among males and females over a ten-year period. AAPC is a summary measure of the trend over a specified time interval. Looking at trends over a recent time interval can reveal new or emerging trends. A bar to the right of zero (i.e., a positive percentage) means that, on average, the rate increased and a bar to the left of zero (i.e., a negative percentage) means that the rate decreased. An asterisk indicates that the change was statistically significant.

For males, incidence and mortality rates both increased significantly for cancers of the pancreas and liver/IBD (Figure 15). Although incidence rates increased significantly for cancers of the oral cavity/pharynx, kidney/renal pelvis, and acute myeloid leukemia, mortality rates either decreased or were stable. Increases in incidence, but not mortality, can result from more detection of earlier stage disease through screening or incidental findings on imaging. For the remaining cancer sites, incidence and mortality rates decreased significantly.

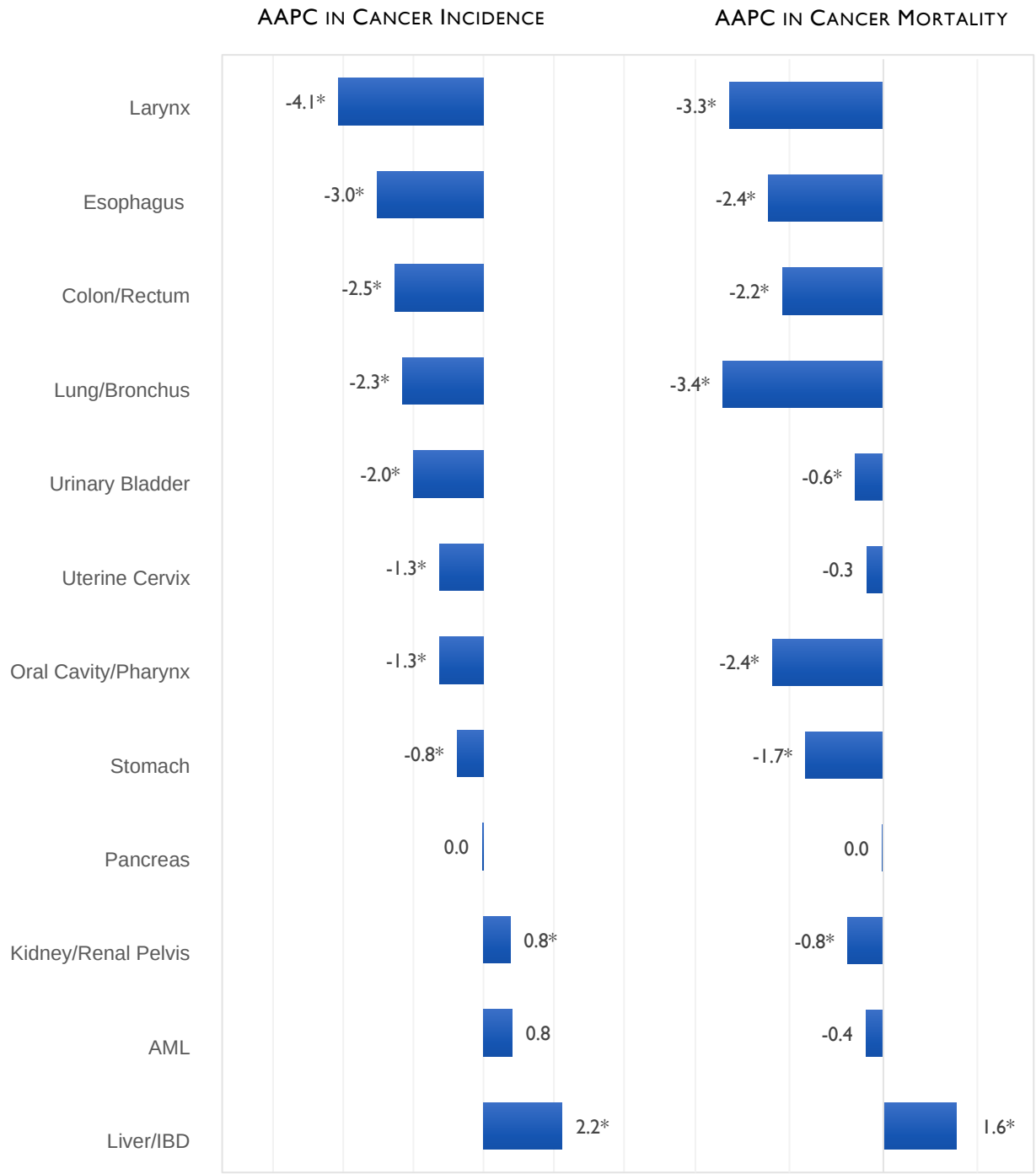
For females, incidence and mortality rates increased significantly only for liver/IBD cancer (Figure 16). Although the incidence of kidney/renal pelvis cancer increased significantly, the mortality rate decreased significantly, consistent with incidental findings of small tumors on imaging.[23] Significantly decreasing incidence and mortality rates were seen for cancers of the larynx, esophagus, colon/rectum, lung/bronchus, urinary bladder, oral cavity/pharynx, and stomach. Of note, incidence significantly decreased for uterine cervix cancer, but mortality was stable. This suggests that although fewer women were diagnosed with cancer of the uterine cervix, those who were diagnosed did not experience better survival.

FIGURE 15. AVERAGE ANNUAL PERCENT CHANGE (AAPC) IN TOBACCO RELATED CANCERS INCIDENCE AND MORTALITY AMONG CALIFORNIA MALES, 2007-2016



IBD=Intrahepatic Bile Duct
AML=Acute Myeloid Leukemia
*AAPC is significantly different from zero at $p < 0.05$. Rates are per 100,000 and age-adjusted to the 2000 U.S standard population.

FIGURE 16. AVERAGE ANNUAL PERCENT CHANGE (AAPC) IN TOBACCO RELATED CANCERS INCIDENCE AND MORTALITY AMONG CALIFORNIA FEMALES, 2007-2016



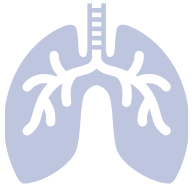
IBD=Intrahepatic Bile Duct
AML=Acute Myeloid Leukemia
*AAPC is significantly different from zero at $p < 0.05$. Rates are per 100,000 and age-adjusted to the 2000 U.S standard population.

INCIDENCE RATES BY COUNTY FOR TOBACCO-RELATED CANCERS

Smoking prevalence and incidence rates vary by county. As shown in Figure 17, the northern and eastern counties have the highest percentage of current cigarette smokers in the general population, although many of these counties were pooled together due to small sample size. In the Appendix, the county-specific rates of current tobacco users with a tobacco-related cancer vary compared to the general population rates. However, each county still has significant amounts of missing tobacco status data, so these county rates are not reflected in a figure.

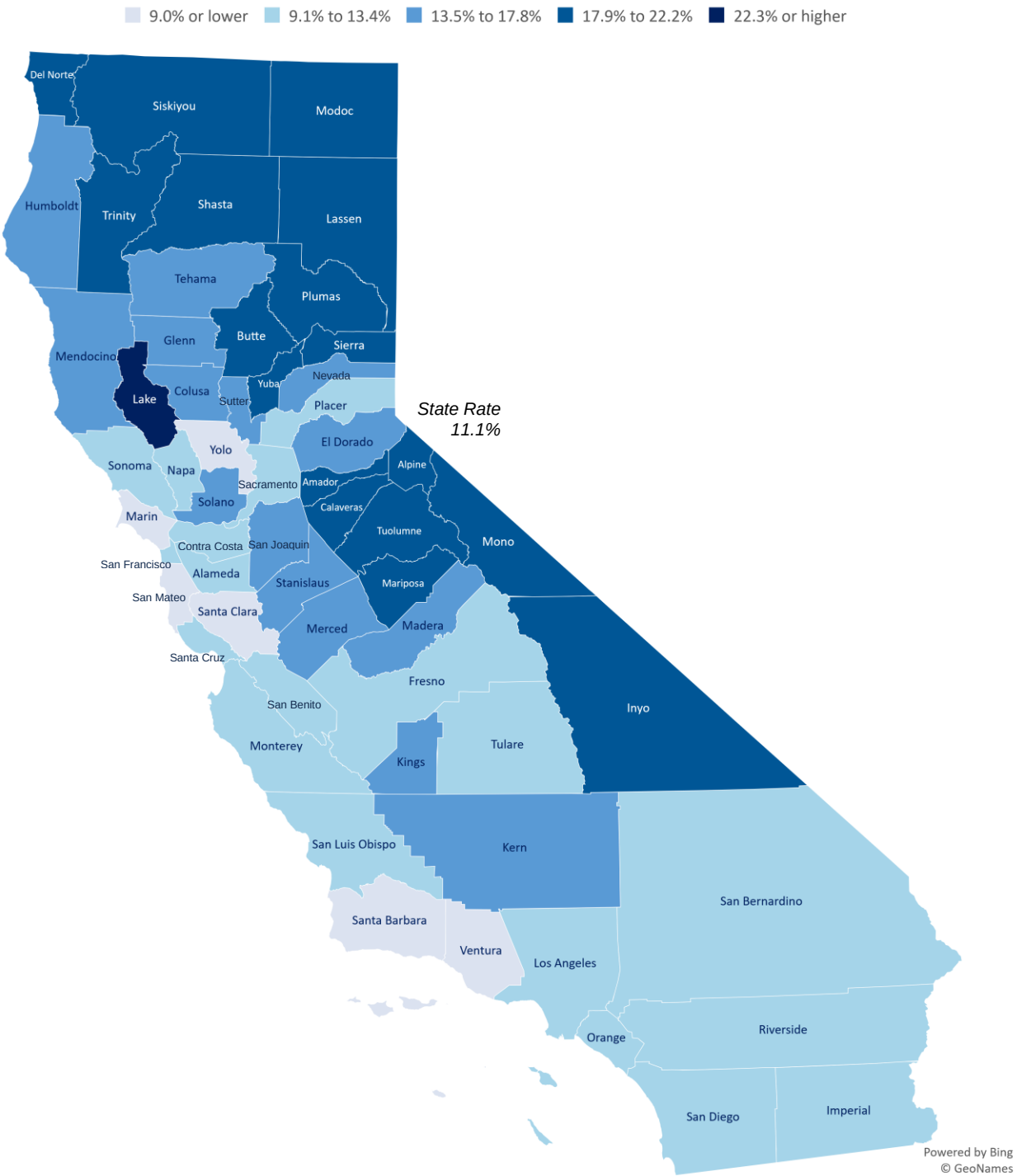
For county-specific incidence rates, some of the cancer sites are grouped together based on the organ system and treating provider specialty. Cancers of the lung/bronchus (Figure 18), oral cavity/pharynx, and larynx (Figure 20) had higher rates in northern California counties, aligning somewhat with the map of current cigarette smokers. Cancers of the genitourinary system (uterine cervix, urinary bladder, kidney/renal pelvis) had the highest rates in the central and northern areas (Figure 19). For acute myeloid leukemia, the highest rate counties were scattered across the state (Figure 21). Gastrointestinal cancers (colon/rectum, liver/IBD, stomach, pancreas, esophagus) had the highest rates in central and southern areas of the state, while far northern counties had the lowest rates (Figure 22).

Northern and eastern counties in California have the highest percentage of current cigarette smokers



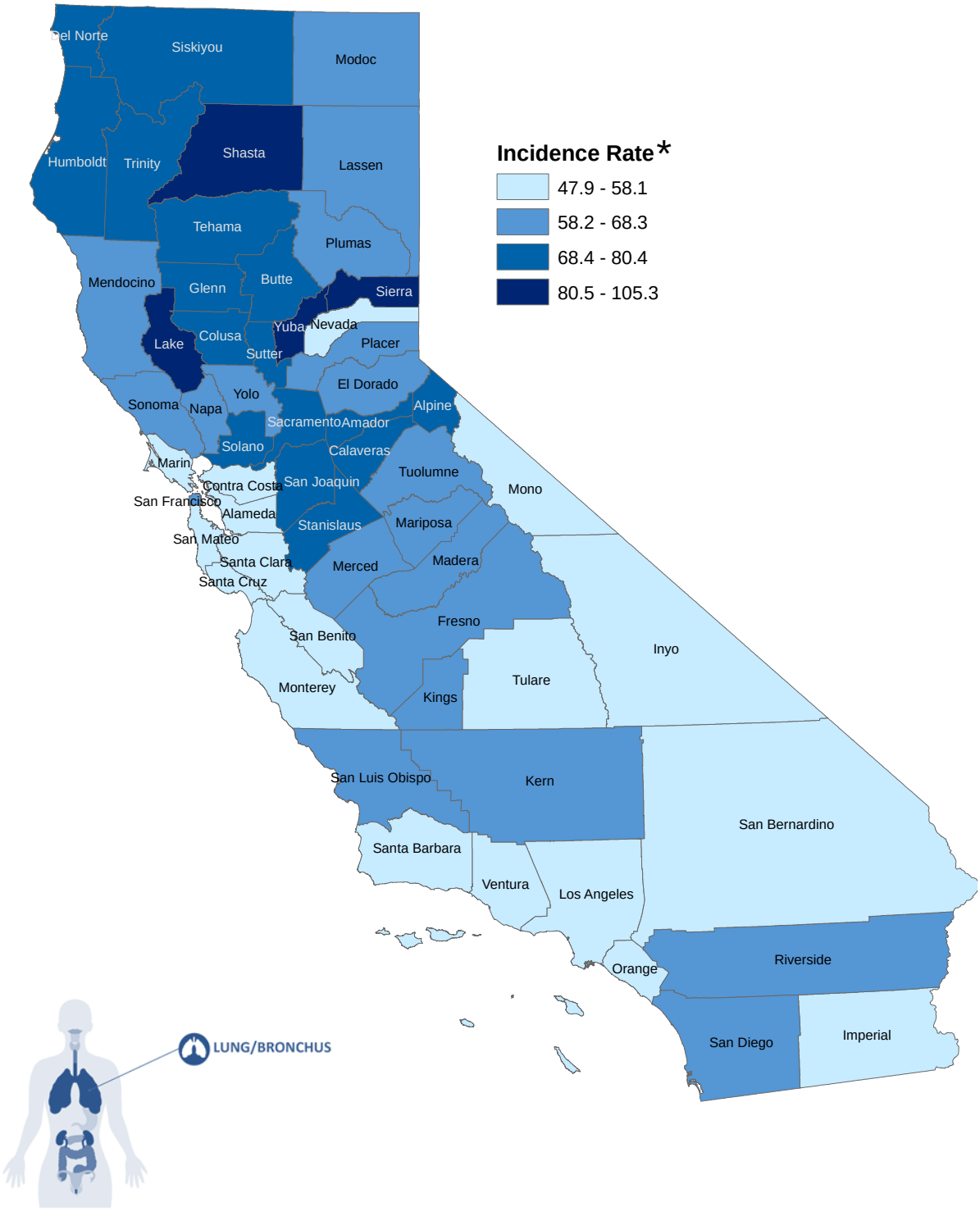
Lung, oral cavity, pharynx, and larynx cancers are seen at higher rates in northern California

FIGURE 17. PERCENTAGE OF CALIFORNIA ADULTS ≥18 YEARS IN THE GENERAL POPULATION WHO ARE CURRENT CIGARETTE SMOKERS, 2016-2018



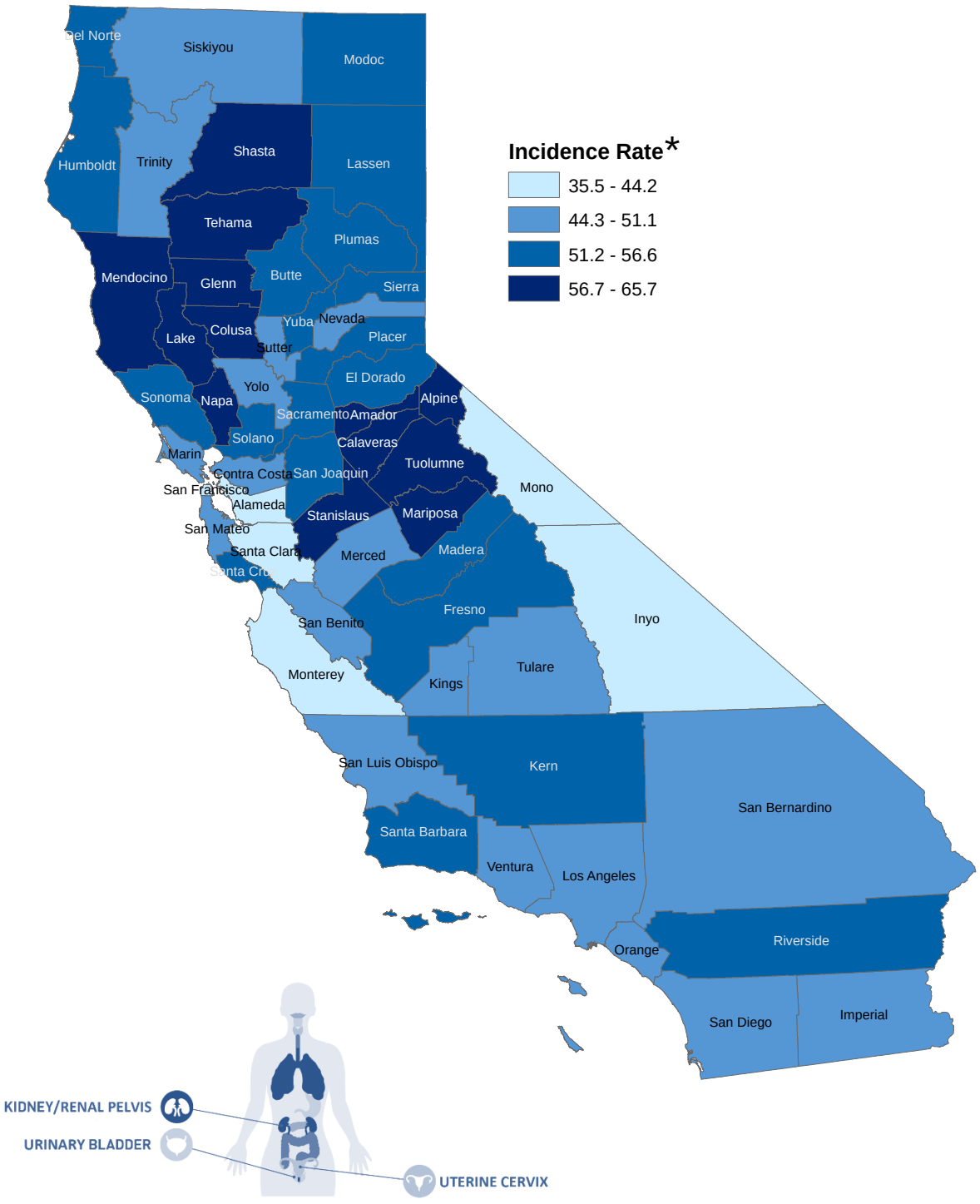
Notes: Current cigarette smoking was assessed by asking: (1) “Altogether, have you smoked at least 100 or more cigarettes in your Entire lifetime?” and (2) “Do you now smoke cigarettes every day, some days, or not at all?” Current cigarette smokers are Respondents who smoke cigarettes every day or some days. County of residence was assessed by asking: “To be sure we are Covering the entire state, what county do you live in?” The following counties were collapsed together: (1) Alpine, Amador, Calaveras, Inyo, Mariposa, Mono, Tuolumne; (2) Colusa, Glenn, Tehama; (3) Del Norte, Lassen, Modoc, Plumas, Sierra, Siskiyou, Trinity; (4) Napa, Sonoma; (5) San Benito, Santa Cruz; and (6) Santa Barbara, Ventura.
Source: California Health Interview Survey. CHIS 2016 (release Jul.2019), CHIS 2017 (release Feb. 2020), and CHIS 2018 (release Feb. 2020) Adult Files. Los Angeles, CA: Center for Health Policy Research, Los Angeles, CA.

FIGURE 18. LUNG AND BRONCHUS CANCER INCIDENCE RATES BY COUNTY, 2013-2017



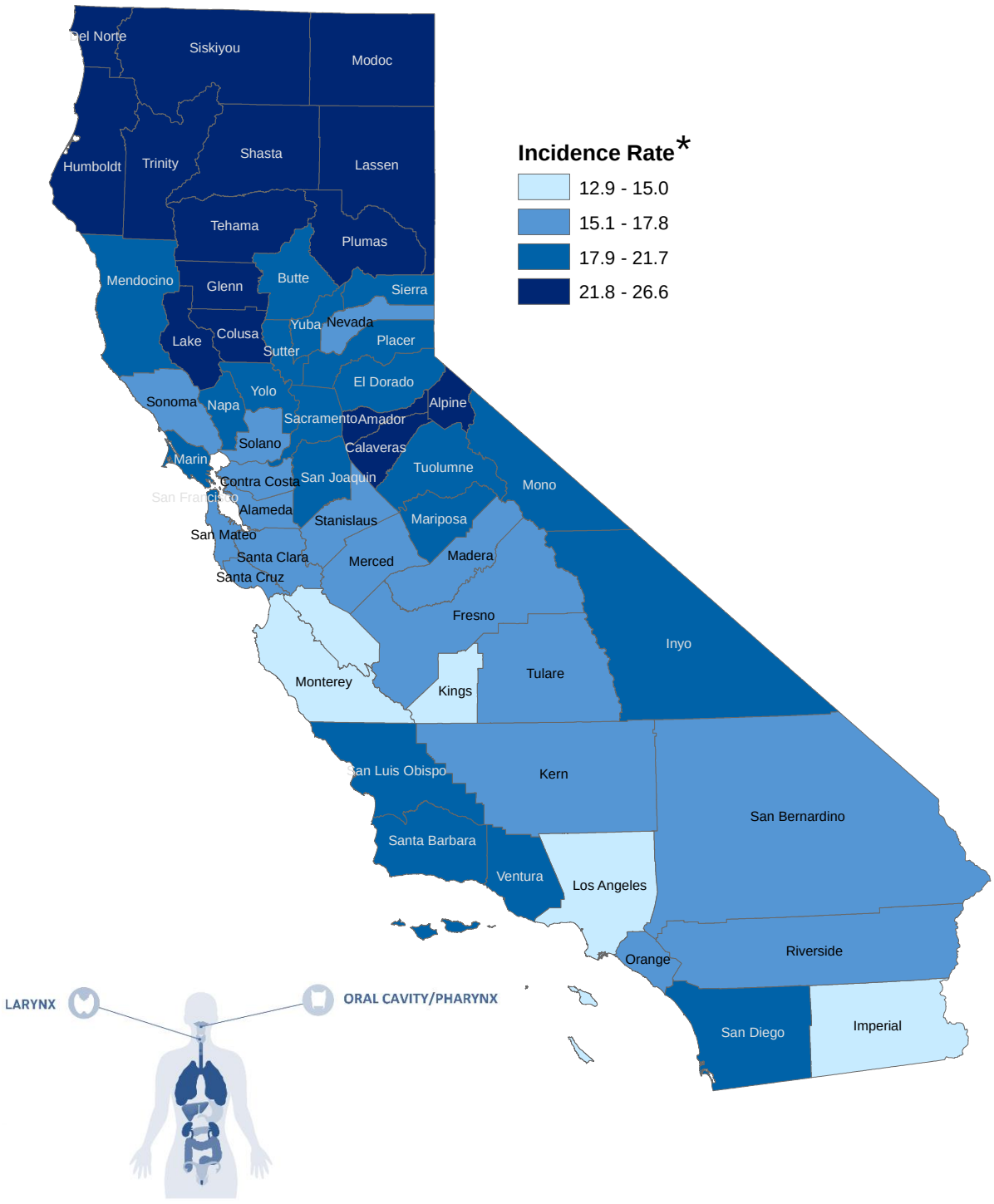
*Rates are per 100,000 and age-adjusted to the 2000 U.S standard population.

FIGURE 19. UTERINE CERVIX, URINARY BLADDER, KIDNEY/RENAL PELVIS CANCER INCIDENCE RATES BY COUNTY, 2013-2017



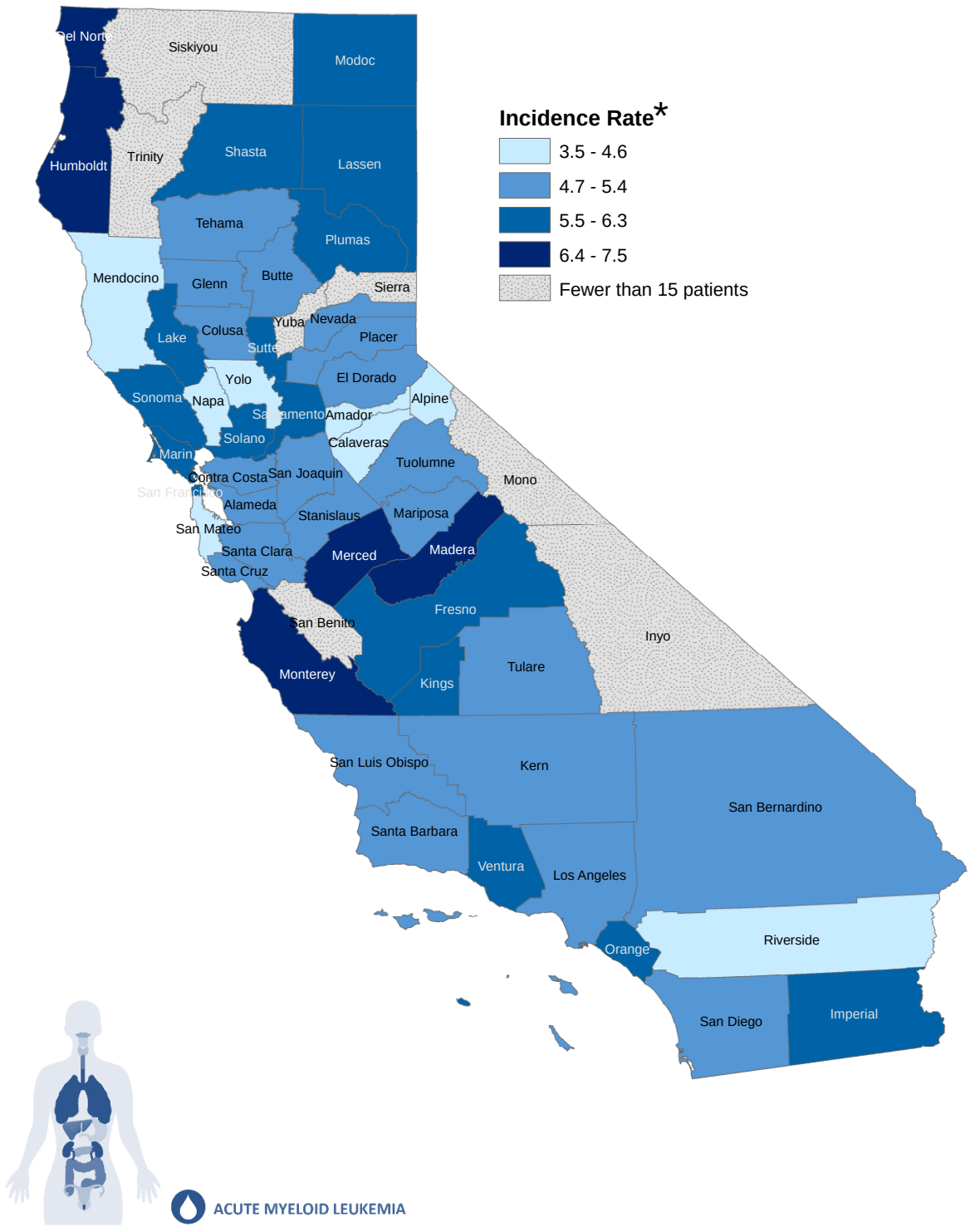
*Rates are per 100,000 and age-adjusted to the 2000 U.S standard population.

FIGURE 20. ORAL CAVITY/PHARYNX, LARYNX CANCER INCIDENCE RATES BY COUNTY, 2013-2017



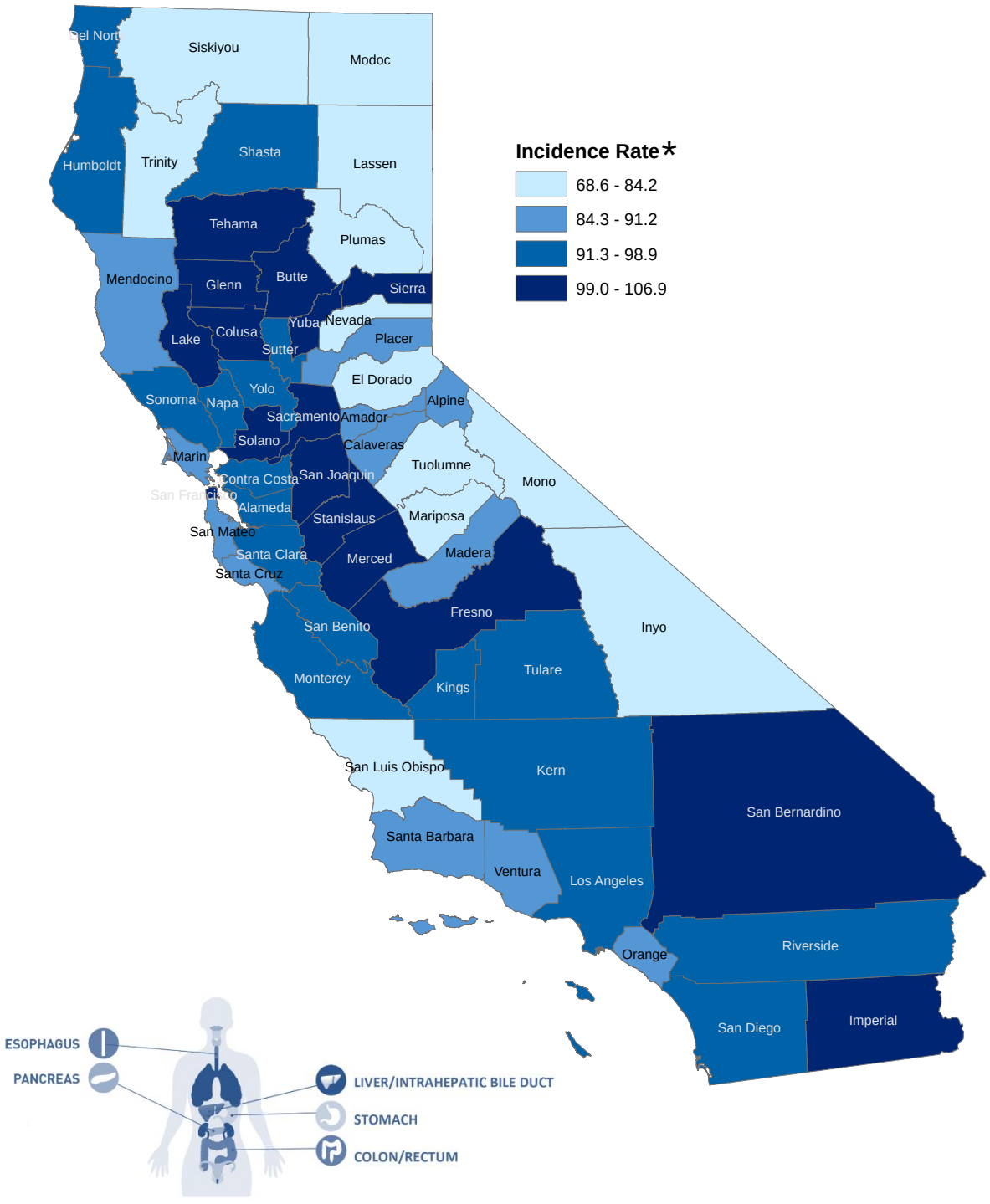
*Rates are per 100,000 and age-adjusted to the 2000 U.S standard population.

FIGURE 21. ACUTE MYELOID LEUKEMIA CANCER INCIDENCE RATES BY COUNTY, 2013-2017



*Rates are per 100,000 and age-adjusted to the 2000 U.S standard population.

FIGURE 22. COLON/RECTUM, LIVER, STOMACH, PANCREAS, ESOPHAGUS CANCER INCIDENCE RATES BY COUNTY, 2013-2017



*Rates are per 100,000 and age-adjusted to the 2000 U.S standard population.

INCIDENCE AND MORTALITY RATES BY DEMOGRAPHIC CHARACTERISTICS

The incidence and mortality rates vary by sex, race/ethnicity, and age group. Males have higher incidence and mortality rates than females for all smoking related cancers. However, there are differences between the sexes in the order of the incidence rates; pancreatic cancer is the third most common cancer among females, while urinary bladder cancer is the third most common among males (Figure 23). Cancers of the oral cavity/pharynx are the fifth most common cancer among males but are not among the top five most common cancers in females.

Among the racial/ethnic groups, African Americans/blacks had the highest incidence of lung/bronchus cancer, colon/rectum cancer, and pancreatic cancer (Figure 24). American Indians had the highest incidence of cancers of the kidney/renal pelvis, liver/IBD, uterine cervix, esophagus, and larynx. Hispanics/Latinos were the only racial/ethnic group where colon/rectum cancer was more common than lung/bronchus cancer. Hispanics/Latinos had the highest incidence and mortality rates for stomach cancer. African Americans/blacks had the highest mortality rates for cancers of the lung/bronchus, colon/rectum, pancreas, and uterine cervix. American Indians had the highest mortality rates for cancers of the liver/IBD, kidney/renal pelvis, and esophagus. Non-Hispanic/Latino whites had the highest incidence and mortality rate for urinary bladder cancer.

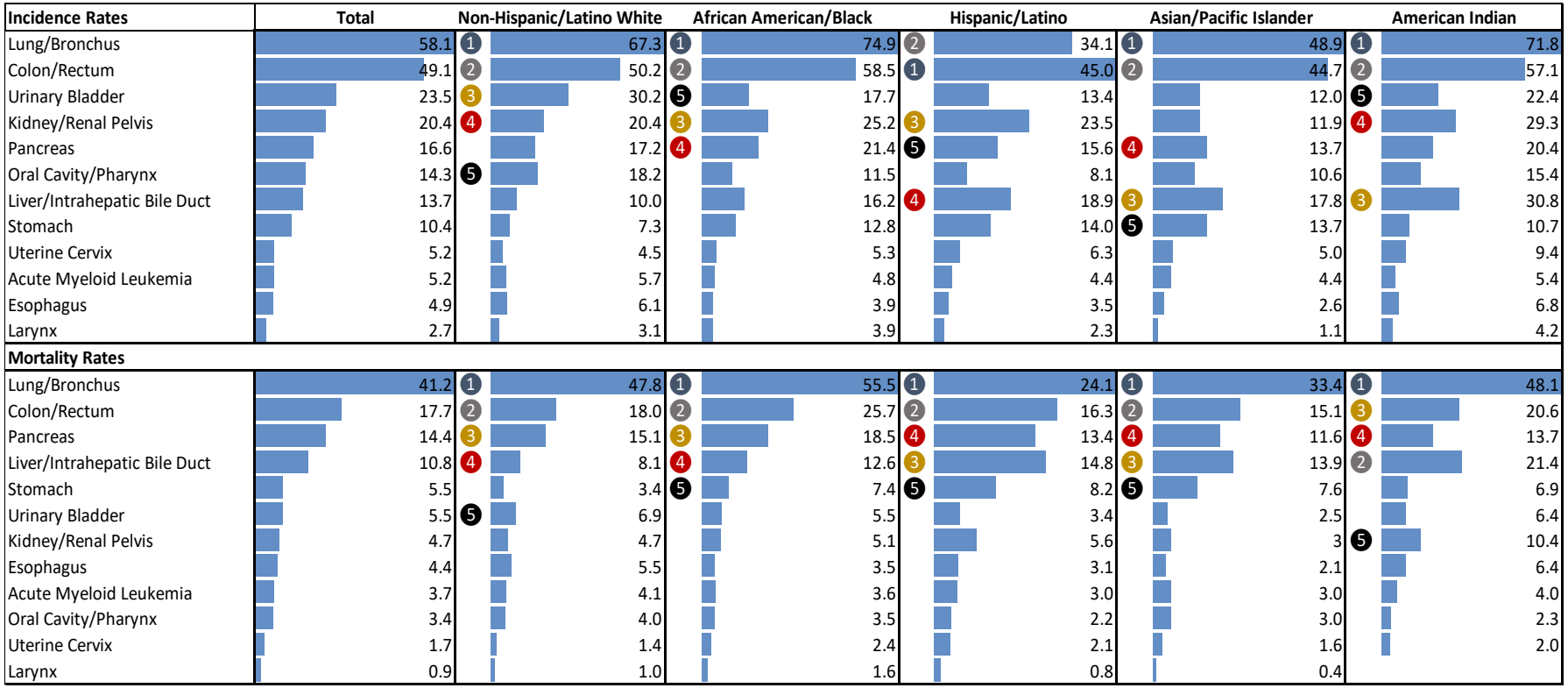
Both incidence and mortality increased with increasing age (Figure 25). Among the younger age groups, colon/rectum cancer was more common than lung/bronchus cancer, and urinary bladder and pancreatic cancers were not among the five most common cancers. However, among the older age groups, urinary bladder and pancreatic cancer were third to fifth most common cancers. Cervical cancer had the fourth highest mortality rate among the youngest age group (20-49 years) but was not among the top five cancer mortalities in the other age groups.

FIGURE 23. INCIDENCE AND MORTALITY RATES* OF SMOKING-RELATED CANCERS BY SEX, CALIFORNIA, 2013-2017

Incidence Rates	Total		Male		Female	
Lung/Bronchus	58.1	1	65.0	1	52.9	
Colon/Rectum	49.1	2	55.8	2	43.4	
Urinary Bladder	23.5	3	41.2	5	9.7	
Kidney/Renal Pelvis	20.4	4	28.1	4	13.7	
Pancreas	16.6		18.9	3	14.7	
Oral Cavity/Pharynx	14.3	5	21.6		7.8	
Liver/Intrahepatic Bile Duct	13.7		20.5		7.7	
Stomach	10.4		13.6		7.8	
Uterine Cervix	5.2				5.2	
Acute Myeloid Leukemia	5.2		6.4		4.3	
Esophagus	4.9		8.2		2.1	
Larynx	2.7		4.9		0.8	
Mortality Rates						
Lung/Bronchus	41.2	1	48.8	1	35.4	
Colon/Rectum	17.7	2	20.6	2	15.3	
Pancreas	14.4	3	16.5	3	12.7	
Liver/Intrahepatic Bile Duct	10.8	4	15.5	4	6.8	
Stomach	5.5		7.1	5	4.2	
Urinary Bladder	5.5	5	9.5		2.6	
Kidney/Renal Pelvis	4.7		7.0		2.8	
Esophagus	4.4		7.7		1.7	
Acute Myeloid Leukemia	3.7		4.7		2.9	
Oral Cavity/Pharynx	3.4		5.3		1.8	
Uterine Cervix	1.7				1.7	
Larynx	0.9		1.6		0.3	

*Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population.

FIGURE 24. INCIDENCE AND MORTALITY RATES* OF SMOKING-RELATED CANCERS BY RACIAL/ETHNIC GROUP, CALIFORNIA, 2013-2017



Incidence Rates	Total	Non-Hispanic/Latino White	African American/Black	Hispanic/Latino	Asian/Pacific Islander	American Indian
Lung/Bronchus	58.1	67.3	74.9	34.1	48.9	71.8
Colon/Rectum	49.1	50.2	58.5	45.0	44.7	57.1
Urinary Bladder	23.5	30.2	17.7	13.4	12.0	22.4
Kidney/Renal Pelvis	20.4	20.4	25.2	23.5	11.9	29.3
Pancreas	16.6	17.2	21.4	15.6	13.7	20.4
Oral Cavity/Pharynx	14.3	18.2	11.5	8.1	10.6	15.4
Liver/Intrahepatic Bile Duct	13.7	10.0	16.2	18.9	17.8	30.8
Stomach	10.4	7.3	12.8	14.0	13.7	10.7
Uterine Cervix	5.2	4.5	5.3	6.3	5.0	9.4
Acute Myeloid Leukemia	5.2	5.7	4.8	4.4	4.4	5.4
Esophagus	4.9	6.1	3.9	3.5	2.6	6.8
Larynx	2.7	3.1	3.9	2.3	1.1	4.2
Mortality Rates						
Lung/Bronchus	41.2	47.8	55.5	24.1	33.4	48.1
Colon/Rectum	17.7	18.0	25.7	16.3	15.1	20.6
Pancreas	14.4	15.1	18.5	13.4	11.6	13.7
Liver/Intrahepatic Bile Duct	10.8	8.1	12.6	14.8	13.9	21.4
Stomach	5.5	3.4	7.4	8.2	7.6	6.9
Urinary Bladder	5.5	6.9	5.5	3.4	2.5	6.4
Kidney/Renal Pelvis	4.7	4.7	5.1	5.6	3	10.4
Esophagus	4.4	5.5	3.5	3.1	2.1	6.4
Acute Myeloid Leukemia	3.7	4.1	3.6	3.0	3.0	4.0
Oral Cavity/Pharynx	3.4	4.0	3.5	2.2	3.0	2.3
Uterine Cervix	1.7	1.4	2.4	2.1	1.6	2.0
Larynx	0.9	1.0	1.6	0.8	0.4	

*Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population.

FIGURE 25. INCIDENCE AND MORTALITY RATES* OF SMOKING-RELATED CANCERS BY AGE GROUP, CALIFORNIA, 2013-2017

Incidence Rates	Total		20-49 years		50-64 years		65-74 years		75+ years
Lung/Bronchus	58.1		3.1	2	51.1	1	198.8	1	319.1
Colon/Rectum	49.1	1	11.4	1	65.5	2	121.1	2	202.4
Urinary Bladder	23.5		1.5		18.4	3	72.3	3	141.9
Kidney/Renal Pelvis	20.4	2	5.6	3	28.9	4	59.8	5	62.5
Pancreas	16.6		1.8		17.5	5	50.5	4	84.8
Oral Cavity/Pharynx	14.3	4	3.4	5	23.5		39.4		42.6
Liver/Intrahepatic Bile Duct	13.7		1.4	4	23.8		43.3		45.2
Stomach	10.4	5	2.4		11.7		27.3		46.8
Uterine Cervix	5.2	3	4.7		6.2		5.7		5.9
Acute Myeloid Leukemia	5.2		1.6		4.7		13.6		23.6
Esophagus	4.9		0.5		5.8		16.3		21.9
Larynx	2.7		0.3		3.7		9.0		10.5
Mortality Rates									
Lung/Bronchus	41.2	2	1.5	1	31.6	1	126.7	1	258.6
Colon/Rectum	17.7	1	2.5	2	17.4	3	40.0	2	103.9
Pancreas	14.4	5	0.9	4	13.1	2	42.1	3	85.6
Liver/Intrahepatic Bile Duct	10.8		0.9	3	15.0	4	32.4	4	49.0
Stomach	5.5	3	1.2	5	5.4		12.7		29.1
Urinary Bladder	5.5		0.1		2.5		11.5	5	44.9
Kidney/Renal Pelvis	4.7		0.5		4.8		13.5		25.3
Esophagus	4.4		0.4		4.7	5	13.8		22.3
Acute Myeloid Leukemia	3.7		0.6		2.6		10.2		21.4
Oral Cavity/Pharynx	3.4		0.5		4.2		9.7		16.1
Uterine Cervix	1.7	4	0.9		2.4		2.8		3.9
Larynx	0.9		0.0		0.9		2.9		4.6

*Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population.

CONCLUSION

Overall, cigarette smoking has declined in California, and the incidence and mortality rates of most tobacco-related cancers have decreased from 1988 to 2017. These positive changes show that California, with its comprehensive tobacco control program has had enormous success in curbing tobacco use, but there is still more work to be done. Over 3 million Californians still use tobacco products, and young adults are using other emerging tobacco products including vape products. Low income groups, including those with Medicaid insurance or the uninsured, have the highest tobacco use rates and have been previously demonstrated to have lower survival rates. Racial/ethnic disparities in tobacco use and cancer incidence and mortality exist; African Americans/blacks and American Indians had the highest incidence and mortality rates for certain cancers. Counties in the northern and rural areas with the highest percentage of smokers also had the highest incidence rates for some of the tobacco-related cancers.

Nearly 400,000 Californians were diagnosed with a tobacco-related cancer from 2012 to 2017, and the current tobacco use rate of 17.3% for lung/bronchus cancer and 19.5% for larynx cancer (reflecting almost 18,000 Californians) is higher than that of the general adult population (15.7%). The available tobacco use data in the CCR, with an unknown status of 44% for tobacco-related cancers, needs improvement. This data is paramount in understanding the true impact of tobacco on the health of Californians. Furthermore, use of vape products is currently not collected by the CCR and should be a required data collection item to help us understand the health consequences of its use. Since tobacco treatment is important in cancer treatment outcomes and mortality, the CCR data is important to help monitor quality of care across cancer types and population groups.[24]

This report highlights groups disproportionately affected by tobacco-related cancer and describes the various tobacco products in use. Future efforts should focus on addressing the disparities documented here by further study of these groups, the tobacco products they use, and measures that can be taken to further decrease all tobacco use in California. Continued success will require coordinated action across cancer care providers, health plans, public health partners, and policymakers as the CCR continues to improve data collection efforts for analyzing progress.

METHODS AND TECHNICAL NOTES

CLASSIFICATION OF ANATOMIC SITE

Cancers were grouped according to conventions of the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) program. Primary anatomic site and histologic type of cases were coded according to the International Classification of Diseases for Oncology. Cases diagnosed from 1988-1991 were coded using the Field Trial Edition, cases diagnosed from 1992-2000 were coded using the Second Edition (ICD-O-2), and those diagnosed from 2001- 2017 were coded using the Third Edition (ICD-O-3). Conversions from original coding schemes to the current ICD-O-3 edition were accomplished through computerized programs developed by SEER.

DEFINITION OF RACE/ETHNICITY

Race/ethnicity was grouped into the mutually exclusive categories non-Hispanic/Latino white, African American/black, Hispanic/Latino, Asian/Pacific Islander, and American Indian. Race and ethnicity were reported as separate data items during data collection for both cases and deaths. Persons with race reported as non-Hispanic/Latino white, African American/black, or unknown, but with a last name on the 1980 U.S. Census list of 12,497 Hispanic surnames, were categorized as Hispanic/Latino for analyses in this report. Maiden name, when present, was used in addition to last name to identify Latinas by surname. Similarly, persons with race coded as white, black, or unknown, but with a Vietnamese or Hmong surname were categorized as Asian/Pacific Islander.

INCIDENT CASES

This report includes invasive cancer cases diagnosed between January 1, 1988 and December 31, 2017 and reported to CCR as of December 2019. A "case" is defined as a primary cancer. If a cancer resulted from spread from a primary site to another organ it was not counted as a new case. Cases of *in situ* cancers, which are mostly detected through screening, were not included. Only cases diagnosed in California residents are included in this report. Persons who were treated for cancer in California, but were residents of another state or country, are not included.

CANCER MORTALITY

Data on cancer-related deaths were obtained from the California Department of Public Health, Center for Health Statistics. Beginning in 1999, cause of death was coded by the International Classification of Diseases, Tenth Edition (ICD-10). All mortality analyses presented in this report are the responsibility of the authors and were not reviewed or endorsed by the Center for Health Statistics prior to publication. Only deaths among California residents were included in these analyses.

CALCULATION OF AGE-ADJUSTED RATES

Rates were calculated as the number of new cases (incidence) or deaths (mortality) in specific age groups per 100,000 persons each year and were age-adjusted to the 2000 United States standard population. Age-adjusted rates are weighted averages of age-specific rates, where the weights represent the age distribution of a standard population. Such adjustment eliminates differences in rates due to changes in the age of a population over time, or due to differences in age distribution between population groups. Rates in this report were calculated using the Surveillance Research Program, National Cancer Institute SEER*Stat software version 8.3.6 (http//srab.cancer.gov/seerstat). Rates based on fewer than fifteen cases (or deaths) in any given year were not calculated.

AVERAGE ANNUAL PERCENT CHANGE (AAPC)

Average Annual Percent Change (AAPC) is a summary measure of a trend over a pre-specified fixed interval. It allows us to use a single number to describe the average increase or decrease in rates over a period of multiple years. The AAPC is a valid measure even if there were changes in trends during the period considered. It is computed as a weighted average of the annual percent changes from the joinpoint model, with the weights equal to the length of the time interval. The overall, or total percent change in rates during the period was calculated from the AAPC as $100*(1 + AAPC/100)^t - 100$, where t is the number of years in the period.

STATISTICAL ANALYSIS OF TRENDS

Joinpoint linear regression was used to determine trends in cancer incidence and mortality. In this analysis, a statistical algorithm detects joinpoints, or points in time where the slope of the regression line significantly changes. Thus, the model describes trends during different time segments, with the annual percent change (APC) estimated for each segment. The Joinpoint Regression Program, Version 4.7.0.0 - February 2019; Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute was used for all trend analyses in this report (http//srab.cancer.gov/joinpoint).

CAUTIONS ON INTERPRETATION

Statistical significance, set at alpha = 0.05, was determined by testing the hypothesis that the slope of the line in the joinpoint regression was equal to zero (null hypothesis). The trend in cancer rates was considered statistically significant if the probability of the result (p value) was less than five percent. However, statistical significance does not necessarily indicate the relevance of the results. Additional assessments are required to evaluate true public health concerns. On the other hand, non-significant results may have failed to reach statistical significance, even if a true difference exists, if the trends were based on a small number of cases or deaths per year.

The validity of rates depends on the completeness of cancer reporting and on the accuracy of population estimates. Cancer surveillance is a dynamic process and cases diagnosed in earlier years may be reported long after incidence data are considered “complete”. The delay in reporting of cancer cases may affect trends in cancer incidence, particularly for the most recent years of diagnosis.

APPENDIX TABLE 1. COUNTY SPECIFIC INCIDENCE AND MORTALITY RATES (2013-2017), CALIFORNIA

	Lung/Bronchus		Uterine Cervix		Urinary Bladder[a]		Kidney/Renal Pelvis		Colon/Rectum		Liver/IBD	
County	IR	MR	IR	MR	IR	MR	IR	MR	IR	MR	IR	MR
Alameda	39.8	28.4	5.5	1.7	15.6	3.3	12.6	2.8	33.9	11.8	10.0	7.5
Alpine	49.5	39.1	9.1	~	21.9	5.0	16.4	4.1	33.1	13.9	9.5	6.8
Amador	49.5	39.1	9.1	~	21.9	5.0	16.4	4.1	33.1	13.9	9.5	6.8
Butte	56.9	40.3	8.3	3.6	21.4	3.8	13.3	2.7	39.5	14.4	8.2	6.9
Calaveras	49.5	39.1	9.1	~	21.9	5.0	16.4	4.1	33.1	13.9	9.5	6.8
Colusa	57.5	43.4	10.2	~	21.1	5.8	19.5	4.1	41.2	12.9	8.5	5.2
Contra Costa	40.9	29.9	5.7	2.0	17.0	4.2	14.5	3.3	36.4	12.4	8.7	6.7
Del Norte	53.4	36.8	9.4	~	20.9	4.5	13.9	4.0	34.6	13.1	10.8	7.8
El Dorado	45.2	31.4	8.2	~	21.6	5.2	14.1	3.6	32.2	11.4	6.7	4.8
Fresno	43.1	31.3	8.7	2.6	16.3	3.7	17.4	3.8	34.5	12.3	12.5	9.4
Glenn	57.5	43.4	10.2	~	21.1	5.8	19.5	4.1	41.2	12.9	8.5	5.2
Humboldt	53.4	36.8	9.4	~	20.9	4.5	13.9	4.0	34.6	13.1	10.8	7.8
Imperial	35.7	21.5	7.7	~	10.6	2.7	20.5	3.9	35.6	10.9	16.5	9.2
Inyo	40.0	27.7	~	~	11.4	~	10.5	~	27.3	10.7	~	~
Kern	46.3	34.5	9.1	3.1	16.6	5.1	19.2	4.2	35.1	12.3	10.1	7.7
Kings	45.2	38.2	8.9	~	12.2	4.1	17.0	4.8	34.6	14.2	11.8	7.4
Lake	72.4	49.8	~	~	24.3	5.5	17.4	4.1	37.7	13.9	8.7	6.5
Lassen	44.3	33.8	~	~	18.7	4.5	15.4	5.4	30.3	10.7	6.8	3.6
Los Angeles	35.9	26.2	7.6	2.6	14.8	3.5	13.8	3.1	35.4	13.3	9.3	8.1
Madera	45.8	32.2	8.8	~	17.6	4.4	16.8	3.7	33.6	12.7	10.8	7.7
Marin	33.8	21.7	5.9	~	19.8	3.0	11.9	2.3	33.1	8.7	7.4	4.5
Mariposa	45.1	33.3	~	~	24.3	5.5	13.9	4.3	30.8	11.6	8.6	5.3
Mendocino	47.8	35.5	10.1	~	22.7	4.6	13.9	4.2	37.3	13.6	9.3	9.1
Merced	46.7	35.8	9.0	3.6	13.7	4.2	16.9	4.6	38.1	14.2	11.4	9.6
Modoc	44.3	33.8	~	~	18.7	4.5	15.4	5.4	30.3	10.7	6.8	3.6
Mono	40.0	27.7	~	~	11.4	~	10.5	~	27.3	10.7	~	~
Monterey	34.5	25.6	8.9	2.9	14.5	3.6	12.1	3.4	31.5	10.0	9.5	7.0
Napa	43.9	33.3	6.0	~	21.2	5.2	19.7	3.7	33.9	11.1	9.1	6.6
Nevada	39.9	28.2	4.2	~	20.5	6.3	12.1	4.1	30.1	11.7	6.9	5.6

Abbreviations: IR=Incidence Rate, MR=Mortality Rate, IBD=Intrahepatic Bile Duct

IR, MR above state average highlighted in red

[a]Includes invasive and in situ cases

~Rate calculations suppressed for counties with fewer than 15 cases

For IR and MR, the following counties were collapsed together: (1) Alpine, Amador, Calaveras; (2) Colusa, Glenn, Tehama; (3) Del Norte, Humboldt; (4) Inyo, Mono; (5) Lassen, Modoc, Plumas; (6) Mariposa, Tuolumne; (7) Sierra, Yuba; (8) Siskiyou, Trinity.

Source: California Cancer Registry

APPENDIX TABLE 1. COUNTY SPECIFIC INCIDENCE AND MORTALITY RATES (2013-2017), CALIFORNIA, CONT.

	Lung/Bronchus		Uterine Cervix		Urinary Bladder[a]		Kidney/Renal Pelvis		Colon/Rectum		Liver/IBD	
County	IR	MR	IR	MR	IR	MR	IR	MR	IR	MR	IR	MR
Orange	38.3	27.2	6.6	1.7	16.0	3.7	13.1	3.0	32.2	11.1	8.8	7.1
Placer	44.3	29.1	5.9	1.5	20.1	4.6	16.6	3.4	34.9	11.1	6.8	5.5
Plumas	44.3	33.8	~	~	18.7	4.5	15.4	5.4	30.3	10.7	6.8	3.6
Riverside	42.7	32.0	8.4	2.9	17.9	4.3	14.5	3.6	35.7	13.7	8.1	6.9
Sacramento	52.1	35.9	8.1	2.6	17.9	4.5	16.9	4.0	37.8	13.5	12.0	9.4
San Benito	36.5	25.5	~	~	15.1	~	14.9	~	36.0	11.3	9.8	7.8
San Bernardino	40.3	32.9	8.7	3.4	15.1	4.5	16.2	4.4	38.7	15.4	10.1	8.8
San Diego	42.4	29.8	6.9	2.2	17.2	4.3	14.8	3.5	34.0	12.6	10.0	7.6
San Francisco	43.9	28.6	6.8	1.3	14.0	3.0	12.1	2.5	34.7	12.0	16.2	9.9
San Joaquin	48.4	35.4	7.1	2.8	19.2	4.3	16.5	4.2	37.7	15.1	10.7	9.4
San Luis Obispo	43.0	30.1	5.4	1.5	17.9	4.5	13.2	3.1	32.3	12.0	6.8	5.1
San Mateo	37.7	23.8	4.8	1.1	18.1	3.6	14.4	2.6	31.4	10.5	9.0	7.1
Santa Barbara	38.3	24.7	5.3	2.1	18.5	4.2	15.6	3.4	32.3	9.9	9.3	7.1
Santa Clara	37.2	25.1	5.0	1.0	14.7	2.9	12.9	3.0	32.2	10.2	10.4	7.7
Santa Cruz	34.1	24.4	7.5	~	19.8	2.9	12.0	2.6	31.3	10.0	7.8	5.6
Shasta	61.7	45.8	7.9	~	25.4	5.1	14.0	4.0	36.6	15.4	9.1	8.7
Sierra	66.1	51.4	8.6	~	16.1	4.1	17.7	4.5	40.4	16.2	11.3	8.8
Siskiyou	52.4	37.2	~	~	17.5	5.3	14.8	4.0	31.3	12.8	6.1	5.9
Solano	50.7	35.4	6.8	1.8	17.8	5.7	18.5	4.0	38.1	13.9	12.6	10.3
Sonoma	41.9	31.2	6.4	1.5	20.3	4.6	13.8	3.1	35.9	13.3	9.3	7.3
Stanislaus	48.1	38.1	8.7	2.8	18.5	4.7	18.1	4.4	38.7	16.0	9.9	8.6
Sutter	52.2	37.6	7.7	~	14.6	4.1	15.5	4.7	32.5	9.1	13.0	8.2
Tehama	57.5	43.4	10.2	~	21.1	5.8	19.5	4.1	41.2	12.9	8.5	5.2
Trinity	52.4	37.2	~	~	17.5	5.3	14.8	4.0	31.3	12.8	6.1	5.9
Tulare	38.8	31.9	11.9	3.4	13.9	3.2	15.9	3.8	35.5	13.3	9.4	7.4
Tuolumne	45.1	33.3	~	~	24.3	5.5	13.9	4.3	30.8	11.6	8.6	5.3
Ventura	39.3	26.5	7.1	1.9	17.2	3.9	14.1	3.7	33.7	13.1	8.4	6.4
Yolo	46.2	29.8	8.7	~	16.4	3.8	15.6	4.0	33.4	11.4	9.9	8.3
Yuba	66.1	51.4	8.6	~	16.1	4.1	17.7	4.5	40.4	16.2	11.3	8.8
State	40.9	29.4	7.2	2.3	16.5	3.9	14.5	3.4	34.8	12.6	9.7	7.7

Abbreviations: IR=Incidence Rate, MR=Mortality Rate, IBD=Intrahepatic Bile Duct
IR, MR above state average highlighted in red
[a]Includes invasive and in situ cases
~Rate calculations suppressed for counties with fewer than 15 cases
For IR and MR, the following counties were collapsed together: (1) Alpine, Amador, Calaveras; (2) Colusa, Glenn, Tehama; (3) Del Norte, Humboldt; (4) Inyo, Mono; (5) Lassen, Modoc, Plumas; (6) Mariposa, Tuolumne; (7) Sierra, Yuba; (8) Siskiyou, Trinity.
Source: California Cancer Registry

APPENDIX TABLE 1. COUNTY SPECIFIC INCIDENCE AND MORTALITY RATES (2013-2017), CALIFORNIA, CONT.

	Stomach		Pancreas		Larynx		Oral Cavity & Pharynx		Acute Myeloid Leukemia		Esophagus[b]	
County	IR	MR	IR	MR	IR	MR	IR	MR	IR	MR	IR	MR
Alameda	7.4	4.1	11.7	9.8	1.7	0.4	9.5	2.1	4.0	2.8	1.7	2.7
Alpine	4.0	~	10.8	8.8	2.9	~	13.3	~	3.2	~	~	5.3
Amador	4.0	~	10.8	8.8	2.9	~	13.3	~	3.2	~	~	5.3
Butte	5.9	1.8	12.5	10.4	2.7	~	12.9	2.6	4.2	3.2	1.5	5.2
Calaveras	4.0	~	10.8	8.8	2.9	~	13.3	~	3.2	~	~	5.3
Colusa	6.9	3.0	13.0	11.2	2.8	~	15.5	3.4	3.6	3.2	~	3.8
Contra Costa	6.3	3.3	12.0	10.1	1.8	0.5	9.3	1.9	4.1	2.7	1.8	3.0
Del Norte	6.0	2.9	11.6	9.8	1.6	~	16.2	3.3	5.0	4.0	~	4.9
El Dorado	3.3	~	11.7	8.5	2.6	~	12.7	3.1	4.3	2.3	1.7	4.0
Fresno	7.6	3.9	12.6	10.6	2.0	0.8	9.7	2.6	4.3	2.5	1.2	3.0
Glenn	6.9	3.0	13.0	11.2	2.8	~	15.5	3.4	3.6	3.2	~	3.8
Humboldt	6.0	2.9	11.6	9.8	1.6	~	16.2	3.3	5.0	4.0	~	4.9
Imperial	8.5	4.6	11.9	8.4	2.2	~	7.2	2.1	4.0	2.0	~	2.2
Inyo	~	~	10.9	10.2	~	~	11.6	~	~	~	~	~
Kern	6.2	2.8	12.6	10.9	2.3	0.9	9.7	2.7	3.8	2.5	1.4	3.6
Kings	7.3	3.7	10.3	10.2	~	~	6.9	~	4.4	2.7	~	2.9
Lake	5.7	~	13.1	12.5	~	~	14.5	3.8	4.1	3.3	~	5.7
Lassen	6.8	~	11.4	9.5	~	~	15.0	~	4.7	~	~	3.5
Los Angeles	9.1	5.2	11.5	10.4	1.8	0.6	8.6	2.3	3.9	2.7	1.5	2.5
Madera	6.1	3.8	10.9	10.2	~	~	9.3	1.9	5.3	2.4	~	3.3
Marin	4.5	1.5	12.1	9.9	1.8	~	13.0	1.8	4.2	2.8	2.1	2.7
Mariposa	3.9	2.9	10.5	10.6	~	~	11.3	~	4.2	3.6	~	4.7
Mendocino	3.9	~	10.8	8.1	~	~	10.8	~	2.8	3.2	~	2.3
Merced	8.3	3.6	13.0	11.2	2.6	~	9.2	2.8	4.6	2.8	~	2.3
Modoc	6.8	~	11.4	9.5	~	~	15.0	~	4.7	~	~	3.5
Mono	~	~	10.9	10.2	~	~	11.6	~	~	~	~	~
Monterey	7.8	3.8	11.9	10.4	1.9	~	8.5	2.0	5.0	2.6	1.9	3.5
Napa	6.8	3.3	11.9	10.6	1.8	~	12.3	2.6	3.8	3.0	~	3.5
Nevada	5.0	2.1	11.8	10.1	1.8	~	9.9	1.9	4.3	~	~	5.8

Abbreviations: IR=Incidence Rate, MR=Mortality Rate
IR, MR above state average highlighted in red
[b]IRs are for squamous cell carcinoma of the esophagus
~Rate calculations suppressed for counties with fewer than 15 cases
For IR and MR, the following counties were collapsed together: (1) Alpine, Amador, Calaveras; (2) Colusa, Glenn, Tehama; (3) Del Norte, Humboldt; (4) Inyo, Mono; (5) Lassen, Modoc, Plumas; (6) Mariposa, Tuolumne; (7) Sierra, Yuba; (8) Siskiyou, Trinity.
Source: California Cancer Registry

APPENDIX TABLE 1. COUNTY SPECIFIC INCIDENCE AND MORTALITY RATES (2013-2017), CALIFORNIA, CONT.

	Stomach		Pancreas		Larynx		Oral Cavity & Pharynx		Acute Myeloid Leukemia		Esophagus[b]	
County	IR	MR	IR	MR	IR	MR	IR	MR	IR	MR	IR	MR
Orange	7.2	3.6	11.7	10.4	1.6	0.4	10.4	2.3	4.1	2.9	1.5	3.0
Placer	5.3	2.2	13.0	11.6	1.7	~	12.7	2.6	3.9	3.0	2.1	4.2
Plumas	6.8	~	11.4	9.5	~	~	15.0	~	4.7	~	~	3.5
Riverside	6.4	3.4	11.3	10.3	1.9	0.6	9.4	2.4	3.5	2.3	1.4	3.5
Sacramento	7.2	3.5	12.3	10.9	2.4	0.8	11.3	2.8	4.6	2.8	1.8	3.3
San Benito	5.4	~	10.4	11.6	~	~	8.6	~	~	~	~	~
San Bernardino	7.4	4.4	10.9	9.6	1.8	0.8	9.3	2.9	3.6	2.3	1.6	3.4
San Diego	6.2	3.3	12.0	10.7	1.9	0.7	11.4	2.9	3.6	2.6	1.8	3.2
San Francisco	8.6	4.8	11.8	9.7	1.8	0.6	11.7	2.8	4.1	2.8	2.9	2.8
San Joaquin	7.4	4.1	11.4	10.1	2.5	0.8	10.5	2.8	3.7	2.3	1.7	3.5
San Luis Obispo	5.0	2.1	12.2	9.9	1.9	~	12.3	1.9	4.3	3.0	~	3.4
San Mateo	7.4	3.1	12.2	9.7	1.7	0.5	10.0	2.1	3.1	2.3	1.7	3.0
Santa Barbara	5.8	3.2	13.4	11.2	1.9	~	12.1	2.0	3.9	3.0	2.3	3.1
Santa Clara	7.6	4.1	11.3	9.4	1.3	0.4	9.3	2.1	3.8	3.1	1.8	2.8
Santa Cruz	5.9	2.8	11.8	10.1	1.6	~	10.5	1.9	3.6	2.8	1.5	3.3
Shasta	7.0	2.2	13.6	10.7	3.1	~	15.8	4.2	4.0	3.3	2.3	5.5
Sierra	6.5	~	10.6	10.3	~	~	10.9	4.3	3.8	~	~	6.3
Siskiyou	4.4	~	9.9	7.3	3.8	~	15.2	5.7	4.9	~	~	6.7
Solano	6.5	3.0	13.6	11.2	1.8	1.0	10.4	2.6	4.3	2.9	1.5	4.0
Sonoma	6.3	3.3	12.0	9.9	1.7	0.5	10.7	2.5	4.5	2.9	2.2	3.5
Stanislaus	6.8	3.8	12.5	11.7	2.4	1.0	8.5	2.8	3.8	2.9	1.7	3.9
Sutter	5.7	~	9.8	8.6	~	~	11.3	3.3	4.5	3.0	~	3.9
Tehama	6.9	3.0	13.0	11.2	2.8	~	15.5	3.4	3.6	3.2	~	3.8
Trinity	4.4	~	9.9	7.3	3.8	~	15.2	5.7	4.9	~	~	6.7
Tulare	6.9	4.1	9.8	9.6	2.4	0.8	9.1	3.2	3.7		1.6	3.6
Tuolumne	3.9	2.9	10.5	9.5	~	~	11.3	~	4.2	3.6	~	4.7
Ventura	6.7	3.6	12.0	11.3	1.7	0.5	11.8	2.7	4.3	3.2	1.6	3.6
Yolo	6.4	3.5	11.7	8.5	1.6	~	11.5	3.0	2.7	2.2	~	3.2
Yuba	6.5	~	10.6	10.3	~	~	10.9	4.3	3.8	~	~	6.3
State	7.4	3.9	11.7	10.3	1.9	0.6	10.0	2.5	3.9	2.7	1.7	3.1

Abbreviations: IR=Incidence Rate, MR=Mortality Rate
IR, MR above state average highlighted in red
[b]IRs are for squamous cell carcinoma of the esophagus
~Rate calculations suppressed for counties with fewer than 15 cases
For IR and MR, the following counties were collapsed together: (1) Alpine, Amador, Calaveras; (2) Colusa, Glenn, Tehama; (3) Del Norte, Humboldt; (4) Inyo, Mono; (5) Lassen, Modoc, Plumas; (6) Mariposa, Tuolumne; (7) Sierra, Yuba; (8) Siskiyou, Trinity.
Source: California Cancer Registry

APPENDIX TABLE 2. COUNTY SPECIFIC CIGARETTE USE OVERALL (2016-2018) AND TOBACCO USE FOR CANCER PATIENTS (2012-2017), CALIFORNIA

	Cigarette use of adults by county[a]		Tobacco use[b] of cancer patients[c] by county[d]				Number of tobacco-related cancers[c,d]
County	Current	Former	Current	Former	Never	Unknown	
Alameda	10.1%	21.0%	9.7%	24.6%	24.3%	41.4%	15,481
Alpine	17.9%	25.5%	~	~	~	~	~
Amador	17.9%	25.5%	17.9%	35.3%	16.6%	30.2%	728
Butte	18.5%	23.8%	17.7%	26.5%	17.7%	38.2%	3,200
Calaveras	17.9%	25.5%	14.4%	30.9%	14.3%	40.4%	799
Colusa	17.2%	23.2%	19.7%	31.2%	22.2%	26.9%	234
Contra Costa	10.4%	23.2%	8.8%	26.0%	21.8%	43.3%	12,074
Del Norte	22.0%	29.4%	24.6%	28.0%	16.2%	31.2%	346
El Dorado	13.9%	26.5%	11.4%	27.0%	19.6%	42.1%	2,520
Fresno	12.9%	19.1%	15.9%	26.3%	26.7%	31.1%	8,894
Glenn	17.2%	23.2%	17.5%	33.0%	21.7%	27.8%	388
Humboldt	15.1%	30.7%	18.8%	25.7%	20.1%	35.4%	1,853
Imperial	10.9%	22.8%	5.8%	12.0%	16.9%	65.3%	1,630
Inyo	17.9%	25.5%	16.2%	17.0%	17.0%	49.8%	247
Kern	17.6%	18.5%	13.4%	20.9%	16.7%	49.1%	7,488
Kings	13.7%	22.9%	16.6%	27.5%	22.8%	33.1%	1,223
Lake	26.6%	31.7%	22.0%	29.6%	11.5%	36.9%	1,225
Lassen	22.0%	29.4%	12.7%	14.7%	13.6%	59.0%	354
Los Angeles	10.3%	20.5%	8.1%	17.1%	22.4%	52.4%	92,753
Madera	16.2%	21.2%	11.6%	28.2%	19.5%	40.6%	1,521
Marin	6.7%	28.5%	8.9%	38.2%	29.5%	23.4%	3,395
Mariposa	17.9%	25.5%	17.9%	26.7%	17.5%	37.9%	285
Mendocino	16.2%	30.6%	20.6%	26.7%	18.7%	34.0%	1,284
Merced	14.1%	23.6%	16.0%	25.7%	23.0%	35.3%	2,382
Modoc	22.0%	29.4%	10.9%	19.1%	8.8%	61.2%	147
Mono	17.9%	25.5%	6.1%	14.1%	14.1%	65.7%	99
Monterey	11.7%	21.0%	13.7%	32.8%	27.4%	26.1%	3,770
Napa	10.3%	26.3%	10.6%	23.8%	19.9%	45.7%	1,918
Nevada	17.4%	30.4%	11.9%	29.1%	18.5%	40.4%	1,491

[a]Source: California Health Interview Survey. CHIS 2016, CHIS 2017, and CHIS 2018 Adult Files. The following counties were collapsed together: (1) Alpine, Amador, Calaveras, Inyo, Mariposa, Mono, Tuolumne; (2) Colusa, Glenn, Tehama; (3) Del Norte, Lassen, Modoc, Plumas, Sierra, Siskiyou, Trinity; (4) Napa, Sonoma; (5) San Benito, Santa Cruz; and (6) Santa Barbara, Ventura. Information on smokeless tobacco and other tobacco products was not collected until 2018 and therefore not included here.
[b]Includes cigarettes, other tobacco products, smokeless tobacco. Does not include vape products.
[c]Patients diagnosed with one of the 12 tobacco-related cancers
[d]Source: California Cancer registry
~Calculations suppressed for counties with fewer than 15 cases

APPENDIX TABLE 2. COUNTY SPECIFIC CIGARETTE USE OVERALL (2016-2018) AND TOBACCO USE FOR CANCER PATIENTS (2012-2017), CALIFORNIA, CONT.

	Cigarette use of adults by county[c]		Tobacco use[b] of cancer patients[c] by county[d]				Number of tobacco-related cancers[c,d]
County	Current	Former	Current	Former	Never	Unknown	
Orange	9.9%	22.3%	8.9%	26.0%	27.2%	37.9%	30,464
Placer	9.8%	25.3%	11.9%	37.4%	25.5%	25.2%	4,898
Plumas	22.0%	29.4%	14.7%	28.5%	12.5%	44.2%	319
Riverside	12.1%	24.7%	9.1%	20.4%	18.1%	52.5%	23,331
Sacramento	12.0%	23.3%	16.7%	30.9%	25.7%	26.7%	16,784
San Benito	12.2%	25.0%	10.1%	18.6%	20.1%	51.2%	523
San Bernardino	13.1%	22.4%	9.9%	14.9%	17.3%	57.9%	18,663
San Diego	10.2%	21.3%	12.7%	25.5%	23.0%	38.9%	32,133
San Francisco	11.9%	19.0%	13.7%	28.2%	30.8%	27.3%	10,159
San Joaquin	14.8%	14.7%	13.9%	24.4%	21.5%	40.3%	7,380
San Luis Obispo	10.2%	29.0%	14.5%	36.4%	25.6%	23.5%	3,421
San Mateo	8.1%	24.3%	5.7%	19.0%	19.6%	55.7%	8,299
Santa Barbara	8.3%	22.8%	14.8%	33.2%	27.9%	24.1%	4,536
Santa Clara	7.0%	18.8%	3.5%	11.7%	15.6%	69.2%	17,502
Santa Cruz	12.2%	25.0%	4.2%	13.8%	12.6%	69.5%	2,715
Shasta	20.6%	26.2%	21.1%	29.7%	15.7%	33.5%	2,960
Sierra	22.0%	29.4%	25.0%	28.1%	3.1%	43.8%	32
Siskiyou	22.0%	29.4%	18.4%	22.8%	12.9%	45.9%	706
Solano	14.1%	23.8%	11.5%	29.1%	19.3%	40.1%	5,232
Sonoma	10.4%	27.0%	13.3%	35.2%	26.3%	25.2%	6,401
Stanislaus	15.5%	25.7%	14.7%	24.8%	24.1%	36.4%	5,570
Sutter	14.8%	20.1%	14.5%	25.5%	22.1%	37.9%	1,049
Tehama	17.2%	23.2%	18.1%	32.5%	20.7%	28.7%	1,014
Trinity	22.0%	29.4%	29.5%	30.6%	15.9%	24.0%	258
Tulare	11.1%	18.2%	13.1%	22.9%	23.0%	40.9%	3,664
Tuolumne	17.9%	25.5%	22.1%	31.9%	19.0%	27.1%	938
Ventura	8.3%	22.8%	9.4%	21.2%	20.7%	48.7%	8,533
Yolo	4.6%	21.7%	13.7%	27.4%	22.7%	36.3%	1,872
Yuba	18.5%	27.8%	20.1%	27.5%	17.8%	34.7%	856
State	11.1%	21.8%	10.6%	22.8%	22.2%	44.4%	387,948

[c]Source: California Health Interview Survey. CHIS 2016, CHIS 2017, and CHIS 2018 Adult Files. The following counties were collapsed together: (1) Alpine, Amador, Calaveras, Inyo, Mariposa, Mono, Tuolumne; (2) Colusa, Glenn, Tehama; (3) Del Norte, Lassen, Modoc, Plumas, Sierra, Siskiyou, Trinity; (4) Napa, Sonoma; (5) San Benito, Santa Cruz; and (6) Santa Barbara, Ventura.
Information on smokeless tobacco and other tobacco products was not collected until 2018 and therefore not included here.
[b]Includes cigarettes, other tobacco products, smokeless tobacco. Does not include vape products.
[c]Patients diagnosed with one of the 12 tobacco-related cancers
[d]Source: California Cancer registry

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