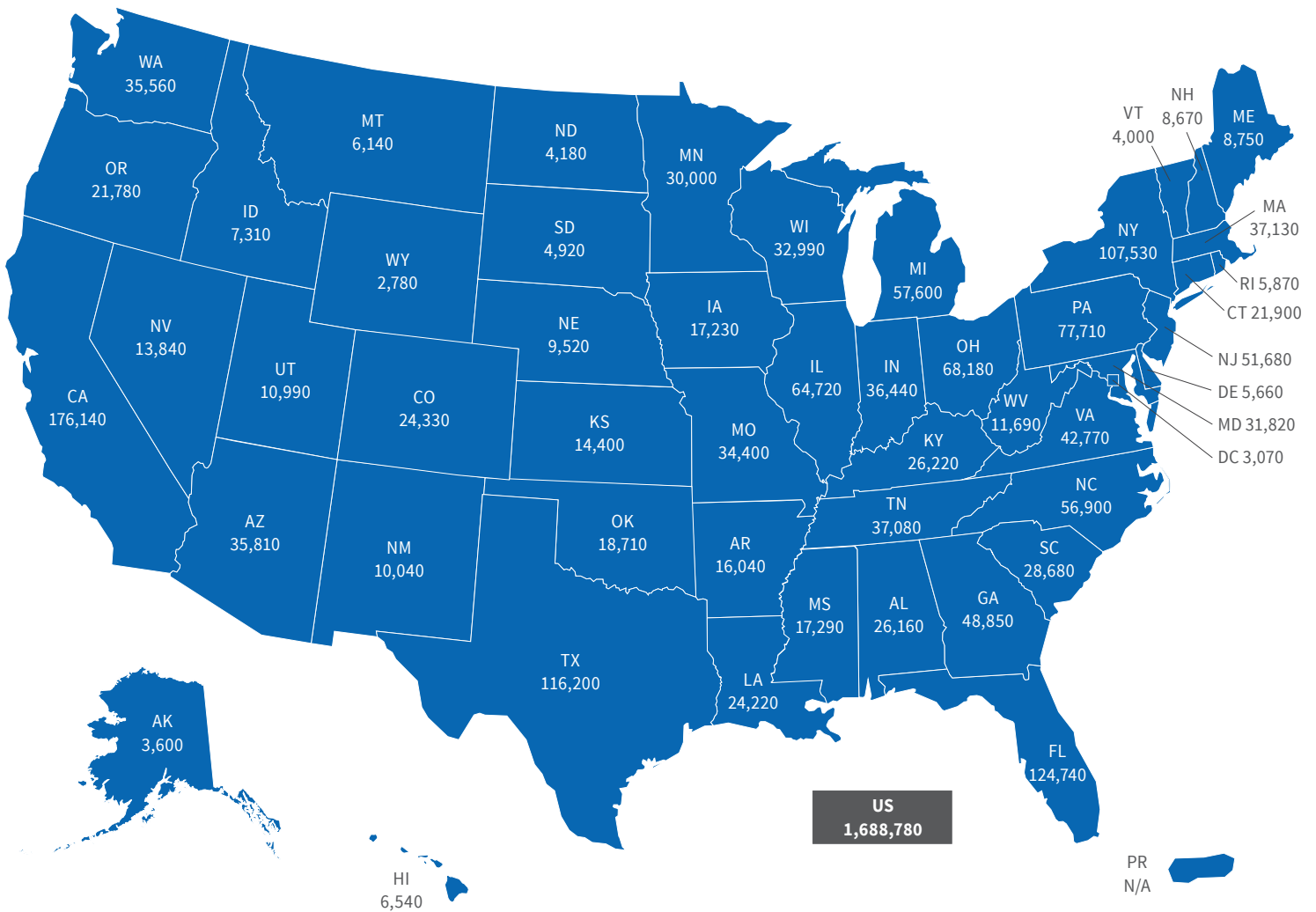


Cancer Facts & Figures 2017



Estimated numbers of new cancer cases for 2017, excluding basal cell and squamous cell skin cancers and in situ carcinomas except urinary bladder. Estimates are not available for Puerto Rico.

Note: State estimates are offered as a rough guide and should be interpreted with caution. State estimates may not add to US total due to rounding.

Contents

Basic Cancer Facts	1
Figure 1. Trends in Age-adjusted Cancer Death Rates by Site, Males, US, 1930-2014	2
Figure 2. Trends in Age-adjusted Cancer Death Rates by Site, Females, US, 1930-2014	3
Table 1. Estimated Number of New Cancer Cases and Deaths by Sex, US, 2017	4
Table 2. Estimated Number of New Cases for Selected Cancers by State, US, 2017	5
Table 3. Estimated Number of Deaths for Selected Cancers by State, US, 2017	6
Table 4. Incidence Rates for Selected Cancers by State, US, 2009-2013	7
Table 5. Death Rates for Selected Cancers by State, US, 2010-2014	8
Selected Cancers	10
Figure 3. Leading Sites of New Cancer Cases and Deaths – 2017 Estimates	10
Table 6. Probability (%) of Developing Invasive Cancer during Selected Age Intervals by Sex, US, 2011-2013	14
Table 7. Trends in 5-year Relative Survival Rates (%) by Race, US, 1975-2012	18
Table 8. Five-year Relative Survival Rates (%) by Stage at Diagnosis, US, 2006-2012	21
Special Section: Rare Cancers in Adults	30
Tobacco Use	40
Figure 4. Proportion of Cancer Deaths Attributable to Cigarette Smoking in Adults 35 Years and Older, US, 2011	41
Nutrition & Physical Activity	45
Cancer Disparities	49
Table 9. Incidence Rates for Selected Cancers by Race and Ethnicity, US, 2009-2013	50
Table 10. Death Rates for Selected Cancers by Race and Ethnicity, US, 2010-2014	51
Figure 5. Geographic Patterns in Lung Cancer Death Rates by State, US, 2010-2014	52
The Global Cancer Burden	53
The American Cancer Society	56
Sources of Statistics	69
American Cancer Society Recommendations for the Early Detection of Cancer in Average-risk Asymptomatic People	71

*This publication attempts to summarize current scientific information about cancer.
Except when specified, it does not represent the official policy of the American Cancer Society.*

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Basic Cancer Facts

What Is Cancer?

Cancer is a group of diseases characterized by the uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death. Although the reason for many cancers, particularly those that occur during childhood, remains unknown, established cancer causes include lifestyle (external) factors, such as tobacco use and excess body weight, and non-modifiable (internal) factors, such as inherited genetic mutations, hormones, and immune conditions. These risk factors may act simultaneously or in sequence to initiate and/or promote cancer growth. Ten or more years often pass between exposure to external factors and detectable cancer.

Can Cancer Be Prevented?

A substantial proportion of cancers could be prevented, including all cancers caused by tobacco use and heavy alcohol consumption. In 2017, about 190,500 of the estimated 600,920 cancer deaths in the US will be caused by cigarette smoking, according to a recent study by American Cancer Society epidemiologists. In addition, the World Cancer Research Fund estimates that 20% of all cancers diagnosed in the US are caused by a combination of excess body weight, physical inactivity, excess alcohol consumption, and poor nutrition, and thus could also be prevented. Certain cancers caused by infectious agents, such as human papillomavirus (HPV), hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV), and *Helicobacter pylori* (*H. pylori*), could be prevented through behavioral changes, vaccination, or treatment of the infection. Many of the more than 5 million skin cancer cases that are diagnosed annually could be prevented by protecting skin from excessive sun exposure and not using indoor tanning devices.

Screening can help prevent colorectal and cervical cancers by allowing for the detection and removal of precancerous lesions. Screening also offers the opportunity to detect some cancers early, when treatment is less extensive and more likely to be successful. Screening is known to help

reduce mortality for cancers of the breast, colon, rectum, cervix, and lung (among long-term and/or heavy smokers). In addition, a heightened awareness of changes in certain parts of the body, such as the breast, skin, mouth, eyes, or genitalia, may also result in the early detection of cancer. For complete cancer screening guidelines, see page 71.

How Many People Alive Today Have Ever Had Cancer?

More than 15.5 million Americans with a history of cancer were alive on January 1, 2016. Some of these individuals were diagnosed recently and are still undergoing treatment, while most were diagnosed many years ago and have no current evidence of cancer.

How Many New Cases and Deaths Are Expected to Occur in 2017?

About 1,688,780 new cancer cases are expected to be diagnosed in 2017 (Table 1, page 4). This estimate does not include carcinoma in situ (noninvasive cancer) of any site except urinary bladder, nor does it include basal cell or squamous cell skin cancers because these are not required to be reported to cancer registries. Table 2 (page 5) provides estimated new cancer cases in 2017 by state.

About 600,920 Americans are expected to die of cancer in 2017, which translates to about 1,650 people per day (Table 1, page 4). Cancer is the second most common cause of death in the US, exceeded only by heart disease, and accounts for nearly 1 of every 4 deaths. Table 3 (page 6) provides estimated cancer deaths by state in 2017.

How Much Progress Has Been Made against Cancer?

Trends in cancer death rates are the best measure of progress against cancer. The overall cancer death rate rose during most of the 20th century because of the tobacco epidemic, peaking in 1991 at 215 cancer deaths per 100,000 persons. However, as of 2014 the rate had dropped to 161 per 100,000 (a decline of 25%) because of reductions in smoking, as well as improvements in early detection and treatment. This decline translates into

more than 2.1 million fewer cancer deaths over the past two decades, progress that is driven by rapid declines in death rates for the four most common cancer types – lung, colorectal, breast, and prostate (Figures 1 and 2).

Do Cancer Incidence and Death Rates Vary by State?

Tables 4 (page 7) and 5 (page 8) provide average annual incidence (new diagnoses) and death rates for selected cancer types by state. The variation by state is much larger for some cancers (e.g., lung) than for others (e.g., non-Hodgkin lymphoma). For more information about geographic disparities in cancer occurrence, see page 53.

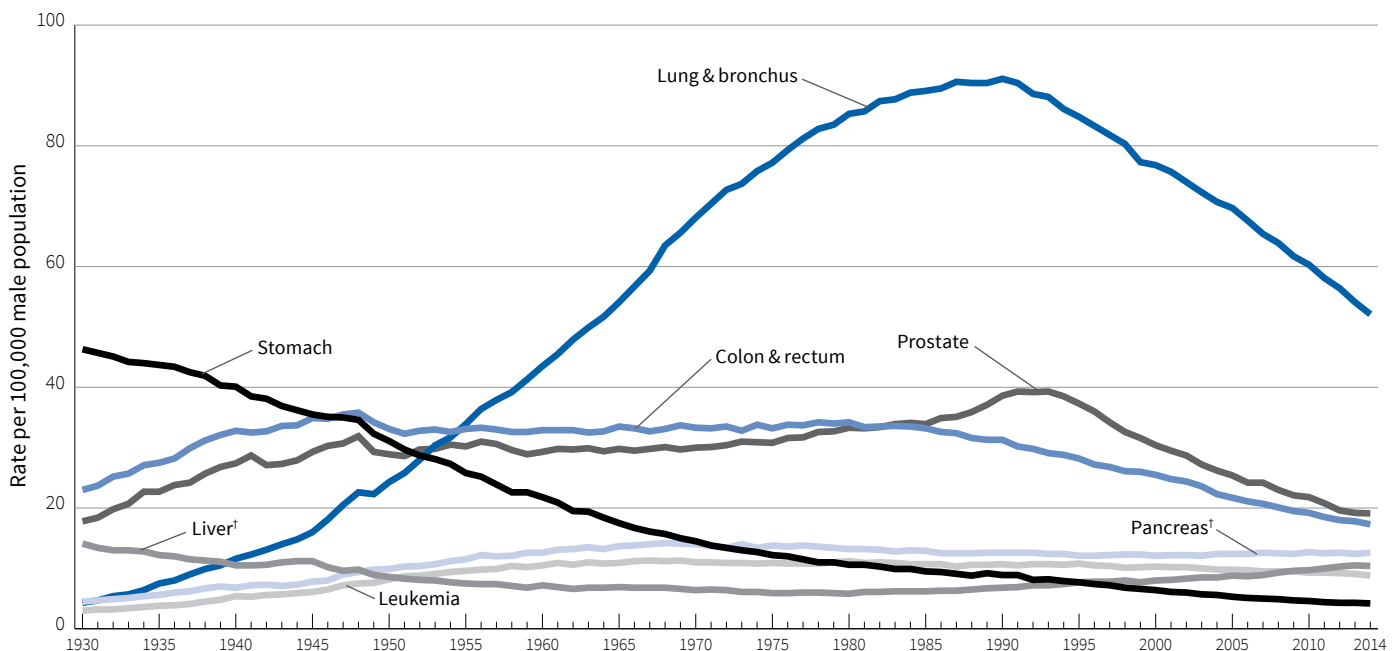
Who Is at Risk of Developing Cancer?

Cancer usually develops in older people; 87% of all cancers in the United States are diagnosed in people 50 years of age or older. Certain behaviors also increase risk, such as smoking, eating an unhealthy diet, or not being

physically active. In the US, approximately 41 out of 100 men and 38 out of 100 women will develop cancer during their lifetime (Table 6, page 14). These probabilities are estimated based on cancer occurrence in the general population and may overestimate or underestimate individual risk because of differences in exposures (e.g., smoking), family history, and/or genetic susceptibility.

Relative risk is the strength of the relationship between exposure to a given risk factor and cancer. It is measured by comparing cancer occurrence in people with a certain exposure or trait to cancer occurrence in people without this characteristic. For example, men and women who smoke are about 25 times more likely to develop lung cancer than nonsmokers, so their relative risk of lung cancer is 25. Most relative risks are not this large. For example, women who have a mother, sister, or daughter with a history of breast cancer are about twice as likely to develop breast cancer as women who do not have this family history; in other words, their relative risk is about 2. For most types of cancer, risk is higher with a family

Figure 1. Trends in Age-adjusted Cancer Death Rates* by Site, Males, US, 1930-2014



*Per 100,000, age adjusted to the 2000 US standard population. †Mortality rates for pancreatic and liver cancers are increasing.

Note: Due to changes in ICD coding, numerator information has changed over time. Rates for cancers of the liver, lung and bronchus, uterus, and colon and rectum are affected by these coding changes.

Source: US Mortality Volumes 1930 to 1959 and US Mortality Data 1960 to 2014, National Center for Health Statistics, Centers for Disease Control and Prevention.

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history of the disease. It is now thought that many familial cancers arise from the interplay between common gene variations and similar exposures among family members to lifestyle/environmental risk factors. Only a small proportion of cancers are strongly hereditary, that is, caused by an inherited genetic alteration that confers a very high risk.

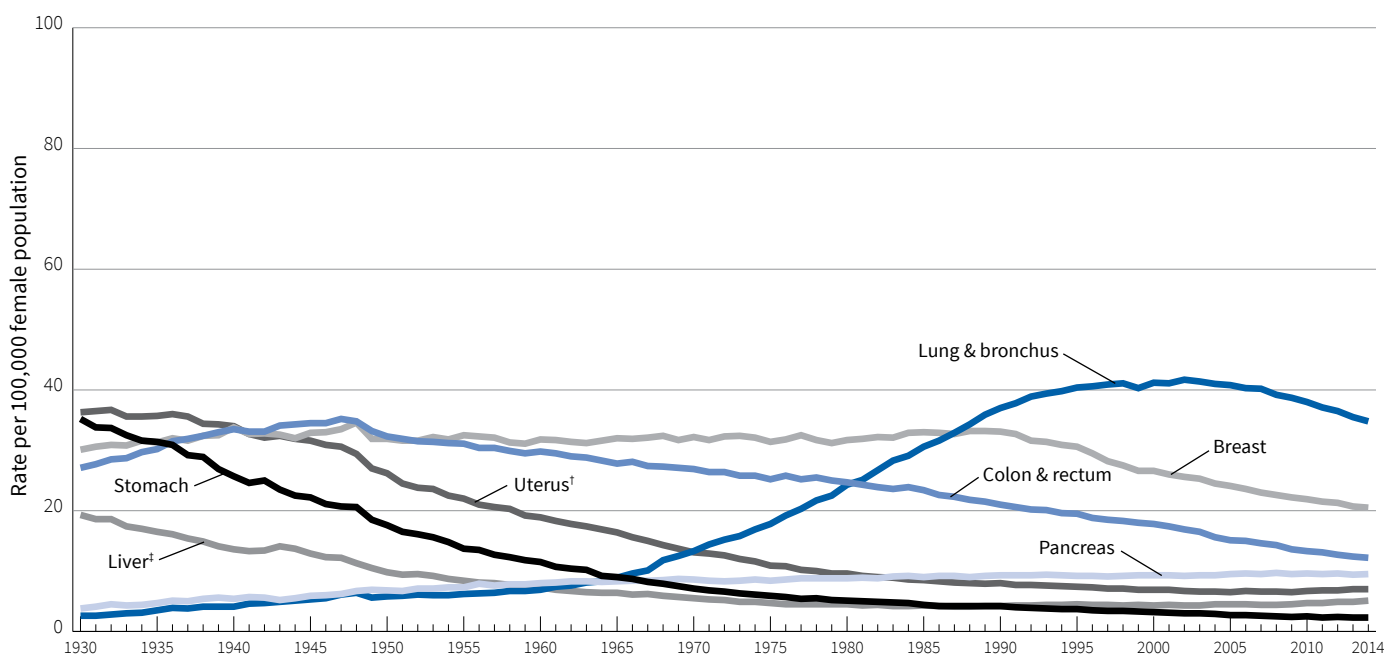
What Percentage of People Survive Cancer?

Over the past three decades, the 5-year relative survival rate for all cancers combined increased 20 percentage points among whites and 24 percentage points among blacks, yet it remains substantially lower for blacks (68% versus 61%, respectively). Improvements in survival (Table 7, page 18) reflect improvements in treatment, as well as earlier diagnosis for some cancers. Survival varies greatly by cancer type and stage at diagnosis (Table 8, page 21).

Relative survival is the percentage of people who are alive a designated time period (usually 5 years) after a cancer diagnosis divided by the percentage of people expected to be alive in the absence of cancer based on normal life expectancy. It does not distinguish between patients who have no evidence of cancer and those who have relapsed or are still in treatment, nor does it represent the proportion of people who are cured because cancer deaths also occur beyond 5 years after diagnosis. For information about how survival rates were calculated for this report, see “Sources of Statistics” on page 69.

Although relative survival rates provide some indication about the average experience of cancer patients in a given population, they should be interpreted with caution. First, 5-year survival rates do not reflect the most recent advances in detection and treatment because they are based on patients who were diagnosed several years in the past. Second, they do not account for many factors that affect individual survival, such as treatment, other illnesses, and biological or behavioral differences. Third,

Figure 2. Trends in Age-adjusted Cancer Death Rates* by Site, Females, US, 1930-2014



*Per 100,000, age adjusted to the 2000 US standard population. †Uterus refers to uterine cervix and uterine corpus combined. ‡The mortality rate for liver cancer is increasing. Note: Due to changes in ICD coding, numerator information has changed over time. Rates for cancer of the liver, lung and bronchus, uterus, and colon and rectum are affected by these coding changes.

Source: US Mortality Volumes 1930 to 1959, US Mortality Data 1960 to 2014, National Center for Health Statistics, Centers for Disease Control and Prevention.

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Table 1. Estimated Number* of New Cancer Cases and Deaths by Sex, US, 2017

	Estimated New Cases			Estimated Deaths		
	Both sexes	Male	Female	Both sexes	Male	Female
All Sites	1,688,780	836,150	852,630	600,920	318,420	282,500
Oral cavity & pharynx	49,670	35,720	13,950	9,700	7,000	2,700
Tongue	16,400	11,880	4,520	2,400	1,670	730
Mouth	13,210	7,800	5,410	2,580	1,680	900
Pharynx	17,000	13,780	3,220	3,050	2,340	710
Other oral cavity	3,060	2,260	800	1,670	1,310	360
Digestive system	310,440	175,650	134,790	157,700	92,350	65,350
Esophagus	16,940	13,360	3,580	15,690	12,720	2,970
Stomach	28,000	17,750	10,250	10,960	6,720	4,240
Small intestine	10,190	5,380	4,810	1,390	770	620
Colon†	95,520	47,700	47,820	50,260	27,150	23,110
Rectum	39,910	23,720	16,190			
Anus, anal canal, & anorectum	8,200	2,950	5,250	1,100	450	650
Liver & intrahepatic bile duct	40,710	29,200	11,510	28,920	19,610	9,310
Gallbladder & other biliary	11,740	5,320	6,420	3,830	1,630	2,200
Pancreas	53,670	27,970	25,700	43,090	22,300	20,790
Other digestive organs	5,560	2,300	3,260	2,460	1,000	1,460
Respiratory system	243,170	133,050	110,120	160,420	88,100	72,320
Larynx	13,360	10,570	2,790	3,660	2,940	720
Lung & bronchus	222,500	116,990	105,510	155,870	84,590	71,280
Other respiratory organs	7,310	5,490	1,820	890	570	320
Bones & joints	3,260	1,820	1,440	1,550	890	660
Soft tissue (including heart)	12,390	6,890	5,500	4,990	2,670	2,320
Skin (excluding basal & squamous)	95,360	57,140	38,220	13,590	9,250	4,340
Melanoma of the skin	87,110	52,170	34,940	9,730	6,380	3,350
Other nonepithelial skin	8,250	4,970	3,280	3,860	2,870	990
Breast	255,180	2,470	252,710	41,070	460	40,610
Genital system	279,800	172,330	107,470	59,100	27,500	31,600
Uterine cervix	12,820		12,820	4,210		4,210
Uterine corpus	61,380		61,380	10,920		10,920
Ovary	22,440		22,440	14,080		14,080
Vulva	6,020		6,020	1,150		1,150
Vagina & other genital, female	4,810		4,810	1,240		1,240
Prostate	161,360	161,360		26,730	26,730	
Testis	8,850	8,850		410	410	
Penis & other genital, male	2,120	2,120		360	360	
Urinary system	146,650	103,480	43,170	32,190	22,260	9,930
Urinary bladder	79,030	60,490	18,540	16,870	12,240	4,630
Kidney & renal pelvis	63,990	40,610	23,380	14,400	9,470	4,930
Ureter & other urinary organs	3,630	2,380	1,250	920	550	370
Eye & orbit	3,130	1,800	1,330	330	180	150
Brain & other nervous system	23,800	13,450	10,350	16,700	9,620	7,080
Endocrine system	59,250	15,610	43,640	3,010	1,440	1,570
Thyroid	56,870	14,400	42,470	2,010	920	1,090
Other endocrine	2,380	1,210	1,170	1,000	520	480
Lymphoma	80,500	44,730	35,770	21,210	12,080	9,130
Hodgkin lymphoma	8,260	4,650	3,610	1,070	630	440
Non-Hodgkin lymphoma	72,240	40,080	32,160	20,140	11,450	8,690
Myeloma	30,280	17,490	12,790	12,590	6,660	5,930
Leukemia	62,130	36,290	25,840	24,500	14,300	10,200
Acute lymphocytic leukemia	5,970	3,350	2,620	1,440	800	640
Chronic lymphocytic leukemia	20,110	12,310	7,800	4,660	2,880	1,780
Acute myeloid leukemia	21,380	11,960	9,420	10,590	6,110	4,480
Chronic myeloid leukemia	8,950	5,230	3,720	1,080	610	470
Other leukemia‡	5,720	3,440	2,280	6,730	3,900	2,830
Other & unspecified primary sites‡	33,770	18,230	15,540	42,270	23,660	18,610

*Rounded to the nearest 10; cases exclude basal cell and squamous cell skin cancer and in situ carcinoma except urinary bladder. About 63,410 cases of carcinoma in situ of the female breast and 74,680 cases of melanoma in situ will be diagnosed in 2017. †Deaths for colon and rectal cancers are combined because a large number of deaths from rectal cancer are misclassified as colon. ‡More deaths than cases may reflect lack of specificity in recording underlying cause of death on death certificates and/or an undercount in the case estimate.

Source: Estimated new cases are based on 1999-2013 incidence data reported by the North American Association of Central Cancer Registries (NAACCR). Estimated deaths are based on 2000-2014 US mortality data, National Center for Health Statistics, Centers for Disease Control and Prevention.

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Table 2. Estimated Number* of New Cases for Selected Cancers by State, US, 2017

State	All sites	Female breast	Uterine cervix	Colon & rectum	Uterine corpus	Leukemia	Lung & bronchus	Melanoma of the skin	Non-Hodgkin lymphoma	Prostate	Urinary bladder
Alabama	26,160	3,960	210	2,210	720	770	3,880	1,320	960	2,410	1,090
Alaska	3,600	500	†	280	120	100	450	130	140	320	150
Arizona	35,810	4,870	240	2,630	1,110	1,170	3,940	2,050	1,410	2,990	1,670
Arkansas	16,040	2,100	150	1,390	480	580	2,620	610	660	1,440	710
California	176,140	27,980	1,490	13,890	6,280	6,740	18,270	9,180	7,880	14,520	7,500
Colorado	24,330	3,840	170	1,770	890	960	2,420	1,590	1,090	2,880	1,120
Connecticut	21,900	3,420	120	1,600	890	800	2,540	970	950	2,140	1,220
Delaware	5,660	840	†	440	200	180	850	340	250	590	270
Dist. of Columbia	3,070	520	†	210	110	90	310	120	110	380	90
Florida	124,740	18,170	1,040	9,930	4,230	5,070	19,000	7,610	5,410	12,830	6,430
Georgia	48,850	7,820	410	4,040	1,510	1,550	6,610	2,930	1,890	5,410	1,880
Hawaii	6,540	1,120	50	660	290	210	700	460	260	500	240
Idaho	7,310	1,080	50	610	290	310	980	550	370	870	480
Illinois	64,720	10,210	520	5,580	2,740	2,350	8,600	2,810	2,750	6,410	3,070
Indiana	36,440	5,140	290	3,080	1,370	1,280	5,540	1,730	1,560	3,410	1,710
Iowa	17,230	2,400	100	1,510	700	760	2,410	1,020	800	1,430	870
Kansas	14,400	2,180	110	1,170	540	560	1,880	830	630	1,320	640
Kentucky	26,220	3,590	210	2,250	830	1,050	4,830	1,410	1,070	2,050	1,190
Louisiana	24,220	3,320	230	2,150	630	770	3,510	960	990	2,620	980
Maine	8,750	1,350	†	710	380	310	1,380	450	380	720	570
Maryland	31,820	5,250	220	2,430	1,200	1,000	4,020	1,700	1,260	3,400	1,390
Massachusetts	37,130	5,940	200	2,760	1,600	1,220	4,890	1,890	1,630	3,930	2,050
Michigan	57,600	8,160	370	4,660	2,320	2,010	8,190	2,780	2,480	5,350	3,050
Minnesota	30,000	4,230	140	2,170	1,080	1,290	3,620	1,330	1,370	2,750	1,320
Mississippi	17,290	2,340	140	1,520	410	530	2,570	560	560	1,380	620
Missouri	34,400	4,930	240	2,860	1,250	1,210	5,620	1,690	1,420	2,990	1,610
Montana	6,140	900	†	500	220	260	750	400	280	750	350
Nebraska	9,520	1,450	60	840	380	380	1,220	490	440	840	450
Nevada	13,840	2,010	110	1,160	400	460	1,680	560	560	1,190	700
New Hampshire	8,670	1,260	†	620	350	290	1,150	470	340	770	520
New Jersey	51,680	7,890	360	4,000	2,100	1,990	5,540	2,790	2,380	5,180	2,560
New Mexico	10,040	1,410	80	800	350	370	1,010	490	400	960	390
New York	107,530	16,310	810	8,490	4,420	4,320	12,700	4,900	4,760	10,060	5,410
North Carolina	56,900	8,580	400	4,290	1,810	1,970	7,940	3,060	2,180	5,560	2,500
North Dakota	4,180	550	†	330	140	150	480	210	170	360	200
Ohio	68,180	9,430	460	5,510	2,670	2,270	10,660	3,140	2,860	5,840	3,360
Oklahoma	18,710	2,690	170	1,610	590	760	3,050	790	840	1,700	860
Oregon	21,780	3,450	140	1,620	870	730	2,900	1,580	970	2,060	1,070
Pennsylvania	77,710	11,300	520	6,300	3,270	2,800	9,930	4,140	3,310	7,320	4,190
Rhode Island	5,870	930	†	480	250	190	860	270	260	780	350
South Carolina	28,680	4,250	210	2,270	890	990	4,320	1,740	1,120	3,250	1,260
South Dakota	4,920	690	†	410	180	200	590	240	210	430	240
Tennessee	37,080	5,510	290	3,080	1,090	1,300	5,830	1,840	1,490	2,830	1,620
Texas	116,200	17,060	1,300	9,690	3,890	4,550	14,560	4,240	5,250	12,550	4,270
Utah	10,990	1,460	70	740	400	460	850	950	490	1,240	430
Vermont	4,000	580	†	280	160	110	510	220	170	380	240
Virginia	42,770	7,020	280	3,260	1,490	1,380	5,400	2,500	1,720	3,950	1,870
Washington	35,560	5,950	250	2,720	1,380	1,390	4,390	2,590	1,740	3,580	1,830
West Virginia	11,690	1,520	80	1,050	450	410	1,980	700	480	840	610
Wisconsin	32,990	4,850	180	2,650	1,360	1,460	4,280	1,590	1,380	3,570	1,670
Wyoming	2,780	410	†	220	100	100	320	190	120	320	150
United States	1,688,780	252,710	12,820	135,430	61,380	62,130	222,500	87,110	72,240	161,360	79,030

*Rounded to nearest 10. Excludes basal and squamous cell skin cancers and in situ carcinomas except urinary bladder. †Estimate is fewer than 50 cases. These estimates are offered as a rough guide and should be interpreted with caution. State estimates may not sum to US total due to rounding and exclusion of state estimates fewer than 50 cases.

Please note: Estimated cases for additional cancer sites by state can be found in Supplemental Data at cancer.org/statistics or via the Cancer Statistics Center at cancerstatisticscenter.cancer.org.

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Table 3. Estimated Number* of Deaths for Selected Cancers by State, US, 2017

State	All sites	Brain/ nervous system	Female breast	Colon & rectum	Leukemia	Liver†	Lung & bronchus	Non- Hodgkin lymphoma	Ovary	Pancreas	Prostate
Alabama	10,530	320	650	940	420	470	3,200	320	250	710	450
Alaska	1,070	†	70	100	†	60	280	†	†	80	50
Arizona	12,050	380	810	1,020	550	660	2,820	430	310	930	600
Arkansas	6,800	180	420	600	250	280	2,160	210	150	430	260
California	59,400	1,830	4,440	5,240	2,610	3,750	12,000	2,140	1,530	4,510	3,130
Colorado	7,840	270	570	660	340	380	1,640	260	240	580	450
Connecticut	6,610	190	430	450	300	300	1,630	230	170	490	310
Delaware	2,050	50	130	150	70	110	590	70	50	150	90
Dist. of Columbia	1,060	†	100	90	†	90	220	†	†	100	70
Florida	43,870	1,250	2,910	3,620	1,800	2,020	11,790	1,510	970	3,170	2,050
Georgia	17,280	490	1,320	1,540	620	850	4,720	510	420	1,160	780
Hawaii	2,520	50	140	240	90	170	590	100	50	220	100
Idaho	2,900	100	190	250	110	120	680	110	70	230	170
Illinois	24,040	610	1,680	2,030	990	1,040	6,470	790	570	1,650	1,040
Indiana	13,590	350	860	1,110	550	520	4,030	450	300	900	550
Iowa	6,460	190	380	570	260	240	1,740	240	150	440	280
Kansas	5,440	170	330	470	260	230	1,500	180	120	400	230
Kentucky	10,400	250	590	830	390	400	3,560	330	200	640	340
Louisiana	9,240	220	620	830	320	520	2,610	300	170	700	370
Maine	3,260	100	170	220	130	120	960	110	60	220	140
Maryland	10,650	280	820	860	410	560	2,630	340	260	840	470
Massachusetts	12,620	350	760	910	540	670	3,270	410	320	950	550
Michigan	21,050	570	1,410	1,680	830	860	5,650	760	500	1,560	830
Minnesota	9,860	280	610	760	480	390	2,450	390	230	710	470
Mississippi	6,560	220	420	650	230	300	1,940	170	110	460	280
Missouri	14,380	330	860	1,070	550	580	4,030	390	250	910	500
Montana	2,030	60	130	170	80	80	510	70	50	140	120
Nebraska	3,520	110	230	330	150	130	900	120	70	250	180
Nevada	5,200	150	380	500	200	230	1,400	160	120	360	270
New Hampshire	2,710	80	170	200	110	90	760	80	60	200	120
New Jersey	15,880	420	1,250	1,420	640	700	3,760	510	410	1,270	700
New Mexico	3,630	90	250	340	150	220	760	110	100	250	200
New York	35,960	910	2,410	2,870	1,460	1,680	8,660	1,210	910	2,750	1,560
North Carolina	20,020	600	1,360	1,530	760	940	5,830	620	440	1,350	840
North Dakota	1,290	†	70	120	60	†	340	†	†	90	70
Ohio	25,430	640	1,690	2,130	990	990	7,300	860	570	1,810	1,020
Oklahoma	8,200	200	530	710	340	360	2,450	270	200	520	350
Oregon	8,140	260	520	660	320	440	2,030	290	230	580	410
Pennsylvania	28,510	700	1,900	2,390	1,210	1,220	7,420	1,010	690	2,110	1,200
Rhode Island	2,160	50	120	170	90	110	610	60	50	140	90
South Carolina	10,320	260	700	830	380	440	2,920	300	230	710	460
South Dakota	1,660	60	110	160	90	60	450	50	†	110	70
Tennessee	14,830	380	920	1,220	570	670	4,590	470	310	950	550
Texas	40,260	1,100	2,830	3,700	1,690	2,620	9,540	1,380	920	2,780	1,650
Utah	3,180	130	270	260	170	150	460	120	100	270	210
Vermont	1,400	50	70	100	50	50	400	†	†	110	70
Virginia	14,870	390	1,060	1,190	550	670	3,810	490	370	1,080	650
Washington	12,720	410	850	970	520	680	3,100	460	330	920	620
West Virginia	4,780	110	280	430	190	170	1,450	160	90	280	160
Wisconsin	11,710	360	740	880	540	440	3,070	420	220	870	570
Wyoming	960	†	60	80	60	†	220	†	†	70	†
United States	600,920	16,700	40,610	50,260	24,500	28,920	155,870	20,140	14,080	43,090	26,730

*Rounded to nearest 10. †Estimate is fewer than 50 deaths. ‡Liver includes intrahepatic bile duct. These estimates are offered as a rough guide and should be interpreted with caution. State estimates may not sum to US total due to rounding and exclusion of state estimates fewer than 50 deaths.

Please note: Estimated deaths for additional cancer sites by state can be found in Supplemental Data at cancer.org/statistics or via the Cancer Statistics Center at cancerstatisticscenter.cancer.org.

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Table 4. Incidence Rates* for Selected Cancers by State, US, 2009-2013

State	All sites		Breast	Colon & rectum		Lung & bronchus		Non-Hodgkin lymphoma		Prostate	Urinary bladder	
	Male	Female	Female	Male	Female	Male	Female	Male	Female	Male	Male	Female
Alabama	548.1	395.6	119.3	52.8	37.3	95.3	53.4	19.8	13.9	139.1	34.0	7.7
Alaska	459.7	411.9	123.5	49.2	40.4	71.6	55.6	21.4	14.3	100.3	34.7	10.8
Arizona	418.1	375.1	111.0	39.6	30.5	58.0	46.4	18.6	13.5	84.1	32.1	8.0
Arkansas	531.2	390.7	111.5	50.1	37.0	99.6	59.4	20.8	14.8	128.4	35.7	7.2
California	473.0	390.9	121.4	43.8	33.7	53.6	41.2	22.8	15.3	118.7	32.0	7.6
Colorado	458.0	393.8	124.8	38.7	31.0	49.8	42.4	21.5	14.9	122.1	32.7	8.3
Connecticut	541.8	459.1	137.8	46.5	35.1	70.9	57.7	25.3	17.7	130.3	47.4	12.5
Delaware	581.7	451.2	130.0	44.3	33.3	83.4	62.3	25.0	17.3	151.1	41.8	11.1
Dist. of Columbia	543.1	444.8	143.0	47.9	41.1	72.0	49.7	22.1	13.9	169.1	24.4	9.3
Florida	490.1	398.5	115.3	43.4	33.1	73.6	54.4	21.3	14.8	111.2	34.1	8.3
Georgia	542.5	409.6	123.4	48.8	36.2	86.7	53.2	21.7	14.6	139.8	33.6	7.7
Hawaii	454.0	408.7	134.4	53.1	36.4	58.0	38.7	21.8	14.9	96.5	23.3	6.1
Idaho	496.0	408.7	119.4	42.2	32.2	56.4	46.9	20.7	16.1	131.8	39.0	8.7
Illinois	531.6	437.6	128.5	53.4	38.9	81.0	58.5	23.5	16.2	128.8	38.2	9.5
Indiana	503.2	425.9	120.0	49.5	39.4	91.1	61.7	23.3	16.4	102.0	36.4	8.9
Iowa	536.5	438.8	122.6	52.2	39.7	80.2	52.7	26.7	18.5	119.2	39.7	8.8
Kansas	529.0	426.8	122.0	48.8	36.0	73.6	53.5	23.6	16.6	133.5	38.8	9.2
Kentucky	593.8	470.2	122.0	59.6	43.7	118.3	80.2	25.4	17.1	118.1	40.0	9.7
Louisiana	585.0	420.0	123.4	57.3	41.8	92.1	55.5	24.0	16.6	154.4	34.2	8.0
Maine	529.7	450.8	124.5	44.8	35.6	86.0	66.1	24.0	17.6	106.5	46.6	12.5
Maryland	506.0	421.0	130.2	42.5	33.8	67.9	52.9	21.2	15.1	135.0	36.0	9.2
Massachusetts	522.5	454.4	136.0	43.8	35.0	72.7	61.9	23.8	16.7	124.9	41.5	11.4
Michigan	530.2	428.3	123.0	45.2	34.9	78.9	59.1	24.5	17.2	137.0	39.5	10.2
Minnesota†	518.7	431.8	130.1	44.6	35.3	62.9	50.1	27.2	18.5	130.3	38.3	9.5
Mississippi	567.0	405.4	116.1	58.9	42.6	103.1	56.5	20.8	14.4	142.7	30.9	7.3
Missouri	504.9	427.6	124.8	50.5	37.3	90.8	64.7	22.3	15.3	106.3	33.6	8.5
Montana	500.4	425.5	122.7	45.7	34.5	62.6	54.9	23.3	15.8	127.3	37.0	10.5
Nebraska	493.8	414.0	120.7	49.5	38.9	70.4	49.9	24.0	17.8	119.2	34.8	8.4
Nevada†‡	496.9	397.1	113.9	50.7	35.1	67.9	58.6	20.5	14.2	135.4	38.0	11.1
New Hampshire	544.2	460.9	138.1	41.4	34.7	73.5	64.4	26.2	17.9	133.5	50.1	12.8
New Jersey	555.2	452.9	131.4	49.5	38.8	67.7	53.1	25.4	17.8	148.7	41.6	11.0
New Mexico†§	424.2	365.8	112.9	41.1	30.6	49.6	36.8	17.8	13.8	106.1	25.5	6.0
New York	557.3	450.6	128.4	47.9	36.6	72.0	54.7	26.3	18.0	145.2	41.4	10.6
North Carolina	534.8	419.5	128.4	44.8	33.4	90.5	55.9	21.7	15.0	130.2	36.1	8.8
North Dakota	515.5	415.5	124.6	54.5	40.2	69.8	47.5	22.7	18.3	130.9	38.5	8.7
Ohio	513.8	423.8	122.0	48.9	36.2	85.6	59.7	22.9	15.7	119.7	38.8	9.3
Oklahoma	511.4	409.8	117.7	49.9	38.1	87.7	58.5	21.7	14.9	120.6	33.8	8.1
Oregon	478.5	424.0	128.1	42.2	32.5	65.3	54.9	22.5	15.4	110.6	37.5	9.2
Pennsylvania	550.8	460.4	129.0	51.3	38.6	80.0	56.5	26.1	17.8	125.4	44.1	11.0
Rhode Island	528.3	459.2	130.4	42.7	35.3	78.3	64.0	25.0	17.8	117.4	46.3	13.3
South Carolina	530.6	409.6	125.6	45.5	34.4	87.8	54.3	20.4	13.4	129.0	34.2	8.7
South Dakota	487.0	428.6	130.6	50.9	39.8	67.4	50.9	23.6	16.3	119.6	33.8	9.4
Tennessee	540.5	420.6	121.7	47.6	36.6	97.6	61.2	22.0	15.1	126.3	35.1	8.1
Texas	474.1	381.1	112.3	47.0	32.8	70.1	45.5	21.5	15.2	106.4	27.9	6.5
Utah	468.6	369.8	112.7	36.1	28.2	34.4	24.2	23.4	15.1	144.4	30.2	5.8
Vermont	505.6	439.3	128.3	41.2	33.4	74.2	61.2	25.4	18.2	109.8	40.0	9.8
Virginia	473.3	399.3	125.5	42.2	33.5	75.2	52.2	21.1	14.4	116.5	31.7	8.3
Washington	513.3	442.2	135.6	41.7	34.0	67.1	54.7	25.6	17.0	125.7	37.8	9.5
West Virginia	533.4	440.0	114.4	54.3	40.8	101.0	65.9	22.1	16.1	106.6	39.9	10.9
Wisconsin	517.9	433.5	127.2	44.6	34.3	70.3	54.5	25.0	17.3	122.0	40.0	10.0
Wyoming	458.1	380.7	109.6	44.0	31.6	52.6	43.1	18.4	14.4	116.0	36.7	10.5
United States	512.1	418.5	123.3	46.9	35.6	75.0	53.5	23.0	15.9	123.2	36.2	8.9

*Per 100,000, age adjusted to the 2000 US standard population. † This state's data are not included in US combined rates because they did not meet high-quality standards for one or more years during 2009-2013 according to the North American Association of Central Cancer Registries (NAACCR). ‡ Rates are based on incidence data for 2009-2010. § Rates are based on incidence data for 2009-2012.

Source: NAACCR, 2016. Data are collected by cancer registries participating in the National Cancer Institute's SEER program and the Centers for Disease Control and Prevention's National Program of Cancer Registries.

Table 5. Death Rates* for Selected Cancers by State, US, 2010-2014

State	All sites		Breast	Colon & rectum		Lung & bronchus		Non-Hodgkin lymphoma		Pancreas		Prostate
	Male	Female	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
Alabama	235.7	148.2	22.0	20.6	13.3	77.1	39.5	7.5	4.8	13.2	9.7	23.8
Alaska	203.5	146.7	20.4	18.5	13.5	54.7	41.7	7.1	3.7	11.9	9.9	20.5
Arizona	174.2	126.2	19.5	15.6	11.2	42.9	30.4	6.8	4.3	11.5	9.0	18.2
Arkansas	237.0	153.8	22.1	21.8	14.6	81.0	43.9	7.6	5.2	12.7	9.4	20.8
California	176.7	130.4	20.4	15.9	11.5	39.8	28.5	7.1	4.4	11.8	9.2	20.0
Colorado	166.4	125.1	19.2	14.5	11.1	36.4	28.1	6.6	4.0	10.9	8.6	21.7
Connecticut	182.5	133.5	19.1	13.8	10.4	46.3	34.4	7.1	4.3	12.5	9.8	18.6
Delaware	208.3	150.5	21.9	17.1	10.8	62.3	42.6	7.8	4.6	14.1	9.6	19.2
Dist. of Columbia	210.0	160.0	29.3	18.6	15.5	49.6	33.5	6.1	3.3	15.5	12.1	33.6
Florida	189.4	132.7	20.2	16.3	11.3	54.1	35.5	7.2	4.2	12.0	8.9	17.6
Georgia	212.3	140.5	22.5	19.4	12.6	64.1	35.6	7.1	4.1	12.3	9.1	23.4
Hawaii	167.3	114.9	15.0	17.5	10.7	40.8	25.1	6.7	4.0	12.4	9.8	13.7
Idaho	185.4	132.6	20.4	15.9	11.1	43.7	31.4	7.9	5.1	12.8	9.7	23.3
Illinois	208.3	150.3	22.5	19.1	13.2	59.0	39.4	7.8	4.6	12.8	9.8	20.9
Indiana	224.8	153.7	21.8	19.3	13.4	71.2	42.9	8.6	5.1	13.1	9.6	21.0
Iowa	206.5	142.2	19.4	19.2	13.9	59.1	36.0	8.7	5.1	12.7	9.3	19.8
Kansas	200.9	143.0	20.1	18.4	12.6	57.3	38.4	7.7	4.9	13.0	9.9	19.1
Kentucky	249.4	167.1	21.9	20.9	14.2	89.6	54.7	9.0	5.1	13.3	9.6	19.8
Louisiana	237.7	157.1	24.2	21.7	14.9	72.9	41.5	8.6	5.0	15.1	11.3	22.4
Maine	215.7	150.4	18.0	16.5	11.8	64.4	43.3	7.6	5.3	11.8	10.6	19.8
Maryland	198.1	143.3	22.8	17.6	12.1	52.2	36.6	7.1	4.2	13.9	9.9	20.3
Massachusetts	196.6	140.2	18.8	15.9	11.3	51.8	38.0	7.1	4.4	12.6	9.9	19.4
Michigan	209.2	151.6	22.4	17.7	12.7	60.8	41.5	8.8	5.2	13.3	10.1	19.5
Minnesota	188.7	135.8	18.8	15.2	11.5	47.6	33.9	8.6	5.2	12.4	8.8	20.6
Mississippi	252.2	158.5	23.9	23.7	16.1	82.7	41.0	7.2	4.2	14.3	11.0	26.2
Missouri	216.6	154.5	22.5	19.1	13.2	69.3	44.7	7.5	4.7	13.0	9.9	18.2
Montana	182.5	138.2	20.2	16.2	11.1	46.2	37.2	7.5	4.1	10.5	9.0	21.4
Nebraska	197.1	138.3	20.1	18.5	14.2	54.3	34.6	7.2	5.1	12.5	8.9	20.8
Nevada	194.1	145.4	22.7	20.2	13.8	52.8	41.4	6.9	4.0	12.2	9.0	21.1
New Hampshire	197.7	143.4	20.3	14.0	13.3	53.9	40.7	6.8	4.1	12.9	9.5	19.9
New Jersey	191.3	141.6	22.9	18.2	12.8	48.4	33.7	7.3	4.4	13.2	10.2	19.4
New Mexico	176.2	123.8	19.3	17.3	11.3	38.1	26.4	6.0	4.1	10.9	8.1	20.7
New York	187.1	138.0	20.6	16.9	12.1	49.0	33.8	7.3	4.4	13.0	9.9	19.5
North Carolina	215.1	142.1	21.6	17.3	11.6	67.9	37.9	7.4	4.5	12.6	9.2	21.6
North Dakota	189.6	128.0	17.8	17.9	13.1	52.0	31.4	6.9	4.5	12.1	7.9	19.8
Ohio	219.6	155.0	23.1	19.8	13.6	66.5	42.7	8.5	5.1	13.3	10.0	19.9
Oklahoma	227.2	157.4	23.4	20.6	13.8	71.5	44.9	8.3	5.0	12.4	9.9	20.8
Oregon	196.2	145.9	20.8	16.6	12.2	50.5	39.1	8.2	4.9	12.5	9.5	21.2
Pennsylvania	210.5	149.4	22.2	18.9	13.5	59.0	37.1	8.3	4.9	13.6	10.0	19.7
Rhode Island	209.2	143.5	18.8	16.4	12.9	59.1	41.8	6.8	4.7	12.6	9.1	19.8
South Carolina	223.0	145.7	22.7	18.7	12.9	67.0	37.8	7.2	4.4	13.1	9.7	23.4
South Dakota	196.9	138.5	20.2	19.8	12.8	55.5	35.2	7.5	4.3	11.6	9.1	19.5
Tennessee	236.2	153.9	22.1	20.1	14.0	78.4	43.7	8.3	4.8	12.6	10.0	20.7
Texas	195.1	133.2	20.4	18.3	11.9	52.2	31.7	7.4	4.4	11.7	9.0	18.7
Utah	151.0	111.2	20.8	13.0	9.7	24.6	16.2	6.8	4.7	11.4	8.6	22.1
Vermont	202.5	147.0	18.6	15.8	12.7	54.3	41.5	8.0	4.4	12.7	10.0	21.1
Virginia	201.9	141.3	21.9	17.0	12.0	57.4	36.5	7.5	4.4	12.9	9.4	21.0
Washington	191.4	140.1	20.1	15.2	11.2	49.9	36.3	7.9	4.8	12.3	9.8	20.4
West Virginia	236.7	163.3	22.1	22.1	15.0	77.2	47.2	8.1	5.3	12.2	8.7	18.2
Wisconsin	202.0	144.0	20.5	16.4	12.1	53.4	37.5	8.1	4.9	13.2	10.0	21.8
Wyoming	177.9	134.9	18.9	17.1	10.6	41.9	32.5	6.6	4.6	10.8	8.4	18.5
United States	200.4	141.5	21.2	17.7	12.4	55.9	36.3	7.6	4.6	12.6	9.5	20.0

*Per 100,000, age adjusted to the 2000 US standard population.

Source: US Mortality Data, National Center for Health Statistics, Centers for Disease Control and Prevention, 2016.

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improvements in survival rates over time do not always indicate progress against cancer. For example, increases in average survival time occur if screening results in the detection of cancers that would not have caused harm if left undetected (overdiagnosis). Screening also results in artificially inflated survival rates when early diagnosis, before symptoms arise, does not increase lifespan.

How Is Cancer Staged?

Staging describes the extent or spread of cancer at the time of diagnosis. Proper staging is essential for optimizing therapy and assessing prognosis. A cancer's stage is based on the size or extent of the primary tumor and whether it has spread to nearby lymph nodes or other areas of the body. A number of different staging systems are used to classify cancer. A system of summary staging is used for descriptive and statistical analysis of tumor registry data and is particularly useful for looking at trends over time. According to this system, if cancer cells are present only in the layer of cells where they developed and have not spread, the stage is in situ. If cancer cells have penetrated beyond the original layer of tissue, the cancer has become invasive and is categorized as local, regional, or distant based on the extent of spread. (For a more detailed description of these categories, see the footnotes in Table 8 on page 21.)

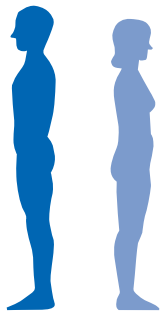
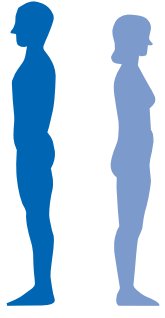
Clinicians mainly use a different staging system, called TNM. The TNM system assesses cancer growth and spread in 3 ways: extent of the primary tumor (T), absence or presence of regional lymph node involvement (N), and absence or presence of distant metastases (M). Once the T, N, and M categories are determined, a stage of 0, I, II, III, or IV is assigned, with stage 0 being in situ, stage I being early, and stage IV being the most advanced disease. Some cancers (e.g., lymphoma) have alternative staging systems. As the biology of cancer has become better understood, additional tumor-specific features have been incorporated into treatment plans and/or staging for some cancers.

What Are the Costs of Cancer?

The Agency for Healthcare Research and Quality estimates that the direct medical costs (total of all health care expenditures) for cancer in the US in 2014 were \$87.8 billion. Fifty-eight percent of those costs were for hospital outpatient or office-based provider visits, and 27% were for inpatient hospital stays. These estimates are based on a set of large-scale surveys of individuals and their medical providers called the Medical Expenditure Panel Survey (MEPS), the most complete, nationally representative data on health care and expenditures. Visit meps.ahrq.gov/mepsweb/ for more information.

Lack of health insurance and other barriers prevents many Americans from receiving optimal health care. According to the US Census Bureau, 29 million Americans (9%) were uninsured during the entire 2015 calendar year, down almost 13 million from 2013 because of the implementation in January 2014 of several new provisions of the Affordable Care Act. The largest increase in health insurance coverage was among those with the lowest education and income. Hispanics and blacks continue to be the most likely to be uninsured, 16% and 11%, respectively, compared to 7% of non-Hispanic whites. The percentage of uninsured ranged from 3% in Massachusetts to 17% in Texas. Uninsured patients and those from many ethnic minority groups are substantially more likely to be diagnosed with cancer at a later stage, when treatment is often more extensive, costlier, and less successful. To learn more about how the Affordable Care Act helps save lives from cancer, see “Advocacy” on page 66.

Figure 3. Leading Sites of New Cancer Cases and Deaths – 2017 Estimates

	Male				Female		
Estimated New Cases	Prostate	161,360	19%		Breast	252,710	30%
	Lung & bronchus	116,990	14%		Lung & bronchus	105,510	12%
	Colon & rectum	71,420	9%		Colon & rectum	64,010	8%
	Urinary bladder	60,490	7%		Uterine corpus	61,380	7%
	Melanoma of the skin	52,170	6%		Thyroid	42,470	5%
	Kidney & renal pelvis	40,610	5%		Melanoma of the skin	34,940	4%
	Non-Hodgkin lymphoma	40,080	5%		Non-Hodgkin lymphoma	32,160	4%
	Leukemia	36,290	4%		Leukemia	25,840	3%
	Oral cavity & pharynx	35,720	4%		Pancreas	25,700	3%
	Liver & intrahepatic bile duct	29,200	3%		Kidney & renal pelvis	23,380	3%
	All sites	836,150	100%		All sites	852,630	100%
Estimated Deaths	Male				Female		
	Lung & bronchus	84,590	27%		Lung & bronchus	71,280	25%
	Colon & rectum	27,150	9%		Breast	40,610	14%
	Prostate	26,730	8%		Colon & rectum	23,110	8%
	Pancreas	22,300	7%		Pancreas	20,790	7%
	Liver & intrahepatic bile duct	19,610	6%		Ovary	14,080	5%
	Leukemia	14,300	4%		Uterine corpus	10,920	4%
	Esophagus	12,720	4%		Leukemia	10,200	4%
	Urinary bladder	12,240	4%		Liver & intrahepatic bile duct	9,310	3%
	Non-Hodgkin lymphoma	11,450	4%		Non-Hodgkin lymphoma	8,690	3%
	Brain & other nervous system	9,620	3%		Brain & other nervous system	7,080	3%
	All sites	318,420	100%		All sites	282,500	100%

Estimates are rounded to the nearest 10, and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder.

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Selected Cancers

This section provides basic information on risk factors, symptoms, early detection, and treatment, as well as statistics on incidence, mortality, and survival, for the most commonly diagnosed cancers and may have limited relevance to rare cancer subtypes. However, information on some rare subtypes can be found in the Special Section on page 30.

Breast

New cases: In 2017, invasive breast cancer will be diagnosed in about 252,710 women and 2,470 men in the US. An additional 63,410 new cases of in situ lesions of the breast will be diagnosed in women. Breast cancer is the most frequently diagnosed cancer in women (Figure 3).

Incidence trends: From 2004 to 2013, the most recent 10 years for which data are available, invasive breast cancer incidence rates were stable in white women and increased

by 0.5% per year in black women, a trend that has resulted in the convergence of rates in these two groups.

Deaths: An estimated 41,070 breast cancer deaths (40,610 women, 460 men) will occur in 2017. Breast cancer is the second-leading cause of cancer death in women.

Mortality trends: The female breast cancer death rate declined by 38% from its peak in 1989 to 2014 due to improvements in early detection (through increased awareness and screening) and treatment, translating to 297,300 fewer breast cancer deaths. In contrast to incidence, recent trends in the death rate were similar in white and black women, with a decline of about 1.8% per year from 2005 to 2014.

Signs and symptoms: The most common symptom of breast cancer is a lump or mass in the breast. Less common symptoms include other persistent changes to the breast, such as thickening, swelling, distortion, tenderness, skin irritation, redness, scaliness, and nipple abnormalities or spontaneous nipple discharge.

Risk factors: Many breast cancer risk factors influence lifetime exposure of breast tissue to hormones. Potentially modifiable factors associated with increased breast cancer risk include weight gain after the age of 18 and/or being overweight or obese (for postmenopausal breast cancer), postmenopausal hormone use (combined estrogen and progestin), physical inactivity, and alcohol consumption. In addition, recent research suggests that long-term, heavy smoking may also increase breast cancer risk, particularly among women who start smoking before their first pregnancy. Shift work, particularly at night (i.e., that disrupts sleep patterns), may be associated with an increased risk.

Non-modifiable factors associated with increased breast cancer risk include older age; a personal or family history of breast or ovarian cancer; inherited mutations (genetic alterations) in *BRCA1*, *BRCA2*, or other breast cancer susceptibility genes; certain benign breast conditions (such as atypical hyperplasia); a history of ductal or lobular carcinoma in situ; high-dose radiation to the chest at a young age (e.g., for treatment of conditions such as lymphoma); high breast tissue density (the amount of glandular tissue relative to fatty tissue measured on a mammogram); and type 2 diabetes (independent of obesity). Reproductive factors that increase risk include a long menstrual history (menstrual periods that start early and/or end later in life), recent use of oral contraceptives, never having children, having one's first child after age 30, and high natural levels of sex hormones.

Factors associated with a decreased risk include breastfeeding for at least one year, regular moderate or vigorous physical activity, and maintaining a healthy body weight. Two medications – tamoxifen and raloxifene – have been approved to reduce breast cancer risk in women at high risk. Raloxifene appears to have a lower risk of certain side effects, but is only approved for use in postmenopausal women. Another type of medication, aromatase inhibitors, have recently been shown to also help prevent breast cancer.

Early detection: Mammography is a low-dose x-ray procedure used to detect breast cancer at an early stage. Numerous studies have shown that early detection with mammography helps save lives. However, like any

screening tool, mammography is not perfect. For example, it can miss cancer (false negative), possibly more often in women with very dense breasts. A mammogram can also appear abnormal in the absence of cancer (false positive). Among the 1 in 10 women who have an abnormal mammogram, most (95%) do not have cancer. Mammography also detects some invasive cancers and in situ lesions (e.g., ductal carcinoma in situ [DCIS]) that would never have caused harm, resulting in overdiagnoses and overtreatment. For women at average risk of breast cancer, recently updated American Cancer Society screening guidelines recommend that those 40 to 44 years of age have the option to begin annual mammography; those 45 to 54 should undergo annual mammography; and those 55 years of age and older may transition to biennial mammography or continue annual mammography. Women should continue mammography as long as overall health is good and life expectancy is 10 or more years. For some women at high risk of breast cancer, annual magnetic resonance imaging (MRI) is recommended in addition to mammography, typically starting at age 30. For more information on breast cancer screening, see the American Cancer Society's screening guidelines on page 71.

Treatment: Treatment usually involves either breast-conserving surgery (surgical removal of the tumor and surrounding tissue, sometimes called a lumpectomy) or mastectomy (surgical removal of the breast), depending on tumor characteristics (e.g., size, hormone receptor status, and extent of spread) and patient preference. The vast majority of patients having breast-conserving surgery will be recommended to receive radiation to the breast. For women with early breast cancer (without spread to the skin, chest wall, or distant organs), studies indicate that breast-conserving surgery plus radiation therapy results in long-term outcomes equivalent to, and possibly even better than, mastectomy. Underarm lymph nodes (axillary lymph nodes) are usually removed and evaluated during surgery to determine whether the tumor has spread beyond the breast. Women undergoing mastectomy who elect breast reconstruction have several options, including the type of tissue or implant-based strategies that restore breast shape. Reconstruction may be performed at the time of mastectomy (also called immediate reconstruction) or as a second procedure

(delayed reconstruction), but often requires more than one surgery to complete the process. Radiation is sometimes recommended after mastectomy in the case of larger tumors or node-involved breast cancers.

Treatment may also involve chemotherapy (before or after surgery), hormonal therapy, and/or targeted therapy. Women with early stage breast cancer that tests positive for hormone receptors benefit from treatment with hormonal therapy for 5 or more years. For women whose cancer overexpresses the growth-promoting protein HER2, several targeted therapies are available.

Survival: The 5- and 10-year relative survival rates for invasive breast cancer are 90% and 83%, respectively. Most cases (61%) are diagnosed at a localized stage (no spread to lymph nodes, nearby structures, or other locations outside the breast), for which the 5-year survival is 99% (Table 8, page 21). Survival rates have increased over time for both white and black women, although they remain 11% lower, in absolute terms, for black women (Table 7, page 18).

See *Breast Cancer Facts & Figures 2015-2016* at cancer.org/statistics for more detailed information.

Childhood Cancer (Ages 0-14 years)

New cases: An estimated 10,270 new cancer cases will be diagnosed among children 0 to 14 years of age in the US in 2017.

Incidence trends: Childhood cancer incidence rates have slowly increased by 0.6% per year since 1975.

Deaths: An estimated 1,190 cancer deaths will occur among children in 2017. Cancer is the second-leading cause of death in children ages 1-14 years, exceeded only by accidents.

Mortality trends: Childhood cancer death rates declined by more than two-thirds from 1969 (6.5 per 100,000) to 2014 (2.0 per 100,000), largely due to improvements in treatment and high rates of participation in clinical trials.

Signs and symptoms: The early diagnosis of childhood cancer is often hampered by nonspecific symptoms that

are similar to those of more common childhood conditions. Parents should ensure that children have regular medical checkups and be alert to unusual, persistent symptoms. These include an unusual mass or swelling; unexplained paleness or loss of energy; a sudden increase in the tendency to bruise or bleed; a persistent, localized pain or limping; a prolonged, unexplained fever or illness; frequent headaches, often with vomiting; sudden eye or vision changes; and excessive, rapid weight loss. Following are the major categories of pediatric cancer according to the International Classification of Childhood Cancer, their occurrence as a percentage of all childhood cancers (including benign/borderline malignant brain tumors), and more specific symptoms.

- Leukemia (29% of all childhood cancers), which may cause bone and joint pain, weakness, pale skin, bleeding or bruising easily, and fever or infection
- Brain and other central nervous system tumors (26%), which may cause headaches, nausea, vomiting, blurred or double vision, seizures, dizziness, and difficulty walking or handling objects
- Neuroblastoma (6%), which is a cancer of the nervous system that is most common in children younger than 5 years of age and usually appears as a swelling in the abdomen
- Wilms tumor (5%), a kidney cancer (also called nephroblastoma) that may appear as swelling or a lump in the abdomen
- Non-Hodgkin lymphoma, including Burkitt lymphoma, (5%) and Hodgkin lymphoma (3%), which is most common during adolescence and often causes swelling of lymph nodes in the neck, armpit, or groin, as well as fatigue, weight loss, and fever
- Rhabdomyosarcoma (3%), a soft tissue sarcoma that can occur in the head and neck, genitourinary area, trunk, and extremities, and may cause pain and/or a mass or swelling
- Osteosarcoma (2%), a bone cancer that most often occurs in adolescents and commonly appears as sporadic pain in the affected bone and that may worsen at night or with activity and eventually progresses to local swelling

- Retinoblastoma (2%), an eye cancer that usually occurs in children younger than 5 years of age and is typically recognized because the pupil appears white or pink instead of the normal red color in flash photographs or during an eye examination
- Ewing sarcoma (1%), another type of cancer usually arising in the bone that is most common in adolescents, and typically appears as pain at the tumor site

Risk factors: There are few known risk factors for childhood cancer. Exposure to ionizing radiation increases the risk of childhood leukemia and possibly other cancers. A small percentage of childhood cancers are caused by a genetic mutation that is inherited or arises during fetal development. Children with certain genetic syndromes, such as Down syndrome, are at increased risk for leukemia.

Treatment: Childhood cancers are treated with surgery, radiation, and/or chemotherapy/targeted therapy based on the type and stage of cancer. Treatment is coordinated by a team of experts, including pediatric oncologists and nurses, social workers, psychologists, and others trained to assist children and their families. Outcomes are most successful when treatment is managed by specialists at a children's cancer center. If the child is eligible, placement in a clinical trial, which compares a new treatment to the best current treatment, should be considered.

Survival: Survival for all invasive childhood cancers combined has improved markedly over the past 30 years due to new and improved treatments. The 5-year relative survival for the most recent time period (2006-2012) is 83%, although rates vary considerably depending on cancer type, patient age, and other characteristics. For example, the 5-year survival for Hodgkin lymphoma is 98%; for retinoblastoma it is 95%; Wilms tumor, 92%; non-Hodgkin lymphoma, 91%; leukemia, 86% (90% for acute lymphoid leukemia and 64% for acute myeloid leukemia); neuroblastoma, 80%; Ewing sarcoma, 79%; brain and other central nervous system tumors (excluding benign brain tumors), 73%; osteosarcoma, 70%; and rhabdomyosarcoma, 70%. Pediatric cancer

survivors may experience treatment-related side effects long after active treatment, including impairment in the function of specific organs (e.g., cognitive defects) and secondary cancers. The Children's Oncology Group (COG) has developed guidelines for screening for and management of late effects in survivors of childhood cancer. See the COG website at survivorshipguidelines.org for more information. The Childhood Cancer Survivor Study, which has followed more than 14,000 long-term childhood cancer survivors, has provided valuable information about the late effects of cancer treatment; visit ccss.stjude.org for more information.

See the *Cancer Facts & Figures 2014* Special Section: Childhood & Adolescent Cancers at cancer.org/statistics for more detailed information.

Colon and Rectum

New cases: An estimated 95,520 cases of colon cancer and 39,910 cases of rectal cancer will be diagnosed in the US in 2017. Colorectal cancer is the third most common cancer in both men and women.

Incidence trends: Colorectal cancer incidence rates have been declining for several decades due to changing patterns in risk factors and the uptake of screening. However, trends differ by age. During the most recent 10 data years (2004 to 2013), incidence rates declined by about 3% per year among adults 50 years of age and older, but increased by about 2% per year among those younger than age 50, largely driven by an increase in rectal cancer.

Deaths: An estimated 50,260 deaths from colorectal cancer will occur in 2017. Colorectal cancer is the second-leading cause of cancer death in men and the third-leading cause in women; it is the second-leading cause of cancer death when men and women are combined. Unfortunately, accurate statistics on deaths from colon and rectal cancers separately are not available because a large number of deaths from rectal cancer are misclassified as colon cancer on death certificates. The substantial misclassification is thought to be caused by the widespread use of the term "colon cancer" to refer to both colon and rectal cancers in educational messaging.

Table 6. Probability (%) of Developing Invasive Cancer during Selected Age Intervals by Sex, US, 2011-2013*

		Birth to 49	50 to 59	60 to 69	70 and older	Birth to death
All sites†	Male	3.4 (1 in 30)	6.3 (1 in 16)	14.0 (1 in 7)	33.3 (1 in 3)	40.8 (1 in 2)
	Female	5.4 (1 in 18)	6.0 (1 in 17)	10.0 (1 in 10)	25.9 (1 in 4)	37.5 (1 in 3)
Breast	Female	1.9 (1 in 52)	2.3 (1 in 44)	3.5 (1 in 29)	6.8 (1 in 15)	12.4 (1 in 8)
Colon & rectum	Male	0.3 (1 in 294)	0.7 (1 in 149)	1.2 (1 in 84)	3.5 (1 in 28)	4.6 (1 in 22)
	Female	0.3 (1 in 318)	0.5 (1 in 198)	0.8 (1 in 120)	3.2 (1 in 31)	4.2 (1 in 24)
Kidney & renal pelvis	Male	0.2 (1 in 457)	0.3 (1 in 289)	0.6 (1 in 157)	1.3 (1 in 75)	2.1 (1 in 48)
	Female	0.1 (1 in 729)	0.2 (1 in 582)	0.3 (1 in 315)	0.7 (1 in 135)	1.2 (1 in 83)
Leukemia	Male	0.2 (1 in 410)	0.2 (1 in 574)	0.6 (1 in 259)	1.4 (1 in 72)	1.8 (1 in 57)
	Female	0.2 (1 in 509)	0.1 (1 in 901)	0.4 (1 in 447)	0.9 (1 in 113)	1.2 (1 in 81)
Lung & bronchus	Male	0.2 (1 in 643)	0.7 (1 in 149)	1.9 (1 in 53)	6.2 (1 in 16)	7.0 (1 in 14)
	Female	0.2 (1 in 598)	0.6 (1 in 178)	1.5 (1 in 68)	4.8 (1 in 21)	6.0 (1 in 17)
Melanoma of the skin‡	Male	0.5 (1 in 220)	0.5 (1 in 198)	0.9 (1 in 111)	2.5 (1 in 40)	3.5 (1 in 28)
	Female	0.6 (1 in 155)	0.4 (1 in 273)	0.5 (1 in 212)	1.0 (1 in 97)	2.3 (1 in 44)
Non-Hodgkin lymphoma	Male	0.3 (1 in 385)	0.3 (1 in 353)	0.4 (1 in 175)	1.8 (1 in 55)	2.4 (1 in 42)
	Female	0.2 (1 in 547)	0.2 (1 in 483)	0.2 (1 in 245)	1.3 (1 in 74)	1.9 (1 in 54)
Prostate	Male	0.3 (1 in 354)	1.9 (1 in 52)	5.4 (1 in 19)	9.1 (1 in 11)	12.9 (1 in 8)
Thyroid	Male	0.2 (1 in 533)	0.1 (1 in 799)	0.2 (1 in 620)	0.2 (1 in 429)	0.6 (1 in 163)
	Female	0.8 (1 in 127)	0.4 (1 in 275)	0.3 (1 in 292)	0.4 (1 in 258)	1.8 (1 in 57)
Uterine cervix	Female	0.3 (1 in 371)	0.1 (1 in 868)	0.1 (1 in 899)	0.2 (1 in 594)	0.6 (1 in 161)
Uterine corpus	Female	0.3 (1 in 352)	0.6 (1 in 169)	1.0 (1 in 105)	1.3 (1 in 76)	2.8 (1 in 36)

*For those who are free of cancer at the beginning of each age interval. †All sites excludes basal and squamous cell skin cancers and in situ cancers except urinary bladder. ‡Statistic is for non-hispanic whites.

Source: DevCan: Probability of Developing or Dying of Cancer Software, Version 6.7.4. Statistical Research and Applications Branch, National Cancer Institute, 2016. srab.cancer.gov/devcan.

Please note: The probability of developing cancer for additional sites, as well as the probability of cancer death, can be found in Supplemental Data at cancer.org/research/cancerfactsstatistics/index.

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Mortality trends: The colorectal cancer death rate in 2014 (14 per 100,000) was half that in 1975 (28 per 100,000) because of declines in incidence and improvements in early detection and treatment. From 2005 to 2014, the rate declined by 2.5% per year.

Signs and symptoms: Early stage colorectal cancer typically does not have symptoms, which is why screening is usually necessary to detect this cancer early. Symptoms may include rectal bleeding, blood in the stool, a change in bowel habits or stool shape (e.g., narrower than usual), the feeling that the bowel is not completely empty, cramping pain in the lower abdomen, decreased appetite, or weight loss. In some cases, blood loss from the cancer leads to anemia (low number of red blood cells), causing symptoms such as weakness and fatigue. Timely evaluation of these symptoms is essential for adults of all ages.

Risk factors: Modifiable factors that increase risk include obesity, physical inactivity, long-term smoking, high

consumption of red or processed meat, low calcium intake, moderate to heavy alcohol consumption, and very low intake of fruits and vegetables. (Processed meat was classified as a carcinogen by the International Agency for Research on Cancer in 2016 based on its consistent association with colorectal cancer.) Consumption of whole-grain fiber reduces risk. Hereditary and medical factors that increase risk include a personal or family history of colorectal cancer and/or polyps, certain inherited genetic conditions (e.g., Lynch syndrome, also known as hereditary nonpolyposis colorectal cancer [HNPCC], and familial adenomatous polyposis [FAP]), a personal history of chronic inflammatory bowel disease (e.g., ulcerative colitis or Crohn disease), and type 2 diabetes.

Regular long-term use of nonsteroidal anti-inflammatory drugs, such as aspirin, reduces risk, but these drugs can have serious adverse health effects, such as stomach bleeding. The American Cancer Society has not made recommendations about the use of these drugs for cancer prevention. However, based on a review of aspirin's

overall harms and benefits, the US Preventive Services Task Force, a government-appointed expert panel, recommends daily, low-dose aspirin for prevention of cardiovascular disease and colorectal cancer for certain individuals in their 50s and 60s who are at higher risk for cardiovascular disease. Decisions about aspirin use should be discussed with a health care provider.

Early detection: Beginning at the age of 50, men and women who are at average risk for developing colorectal cancer should begin screening. Screening can prevent colorectal cancer through the detection and removal of precancerous growths, as well as detect cancer at an early stage, when treatment is usually less extensive and more successful. There are a number of recommended screening options that differ in terms of how well they detect precancerous lesions; how often they should be performed; whether bowel preparation is required; potential harms; and cost. For the Society's recommendations for colorectal cancer screening, see page 71.

Treatment: Surgery is the most common treatment for colorectal cancers that have not spread. A permanent colostomy (creation of an abdominal opening for elimination of body waste) is not usually required for rectal cancer and is rarely necessary for colon cancer. Chemotherapy, alone for colon cancer or in combination with radiation for rectal cancer, is given before (neoadjuvant) or after (adjuvant) surgery to most patients whose cancer has penetrated the bowel wall deeply or spread to lymph nodes. For colorectal cancer that has spread to other parts of the body (metastatic colorectal cancer), treatments typically include chemotherapy and/or targeted therapy.

Survival: The 5- and 10-year relative survival rates for colorectal cancer are 65% and 58%, respectively. Only 39% of patients are diagnosed with localized disease, for which 5-year survival is 90% (Table 8, page 21). Five-year survival declines to 71% for regional stage and 14% for distant-stage disease.

See *Colorectal Cancer Facts & Figures* at cancer.org/statistics for more detailed information.

Kidney & Renal Pelvis

New cases: An estimated 63,990 new cases of kidney (renal) cancer will be diagnosed in the US in 2017. These are primarily renal cell carcinomas, which occur in the body of the kidney, but also include cancers of the renal pelvis (5%), which behave more like bladder cancer, and Wilms tumor (1%), a childhood cancer that usually develops before the age of 5 (see "Childhood Cancer [Ages 0-14 years]" on page 12). Men are twice as likely as women to be diagnosed with kidney cancer.

Incidence trends: Kidney cancer incidence rates increased over the past several decades, in part due to incidental diagnoses during abdominal imaging, but appear to have stabilized in recent years.

Deaths: An estimated 14,400 deaths from kidney cancer will occur in 2017.

Mortality trends: Kidney cancer death rates have been decreasing by about 1% per year since 2002.

Signs and symptoms: Early stage kidney cancer usually has no symptoms. As the tumor progresses, symptoms may include blood in the urine, a pain or lump in the lower back or abdomen, fatigue, weight loss, fever, or swelling in the legs and ankles.

Risk factors: Obesity and tobacco smoking are strong risk factors for kidney cancer. High blood pressure; chronic renal failure; and occupational exposure to certain chemicals, such as trichloroethylene, also increase risk. Radiation exposure (e.g., for cancer treatment) slightly increases risk. A small proportion of renal cell cancers are the result of rare hereditary conditions (e.g., von Hippel-Lindau disease and hereditary papillary renal cell carcinoma).

Treatment: Surgery is the primary treatment for most kidney cancers, although active surveillance (observation) may be an option for some patients with small tumors. Patients who are not surgical candidates may be offered ablation therapy, a procedure that uses heat or cold to destroy the tumor. So far, adjuvant treatment has not been shown to be helpful after surgery, although several

targeted therapies are being studied. For metastatic disease, targeted therapies are typically the main treatment, sometimes along with removal of the kidney.

Survival: The 5-year relative survival rate for kidney and renal pelvis cancer is 74%. Two-thirds of cases are diagnosed at a local stage, for which the 5-year relative survival rate is 93% (Table 8, page 21).

Leukemia

New cases: An estimated 62,130 new cases of leukemia will be diagnosed in the US in 2017. Leukemia is a cancer of the bone marrow and blood. The four main groups of leukemia, which is classified according to cell type and rate of growth, are: acute lymphocytic (ALL), chronic lymphocytic (CLL), acute myeloid (AML), and chronic myeloid (CML). Although leukemia is often thought of as a childhood cancer, the majority (92%) of cases are diagnosed in adults 20 years of age and older. Among adults, the most common types are CLL (37%) and AML (31%), while ALL is most common in those 0 to 19 years, accounting for 75% of cases. (Although CLL is still included with leukemias in this report, it is now often classified as a lymphoma because it is basically the same disease as a type of non-Hodgkin lymphoma called small lymphocytic lymphoma (SLL). The only difference between these two cancers is that in CLL most of the cancer cells are located in the blood and bone marrow, whereas in SLL they are located in the lymph nodes.)

Incidence trends: From 2004 to 2013, the overall leukemia incidence rate increased by almost 2% per year, driven primarily by AML, which increased from 3.4 (per 100,000) in 2004 to 5.1 in 2013. Rates for ALL and CML increased by 1% to 2% per year, while CLL increased slightly by 0.5% per year.

Deaths: An estimated 24,500 leukemia deaths will occur in 2017.

Mortality trends: In contrast to incidence, death rates from 2005 to 2014 decreased by about 1% per year for ALL, CLL, and CML, but remained stable for AML.

Signs and symptoms: Symptoms may include fatigue, paleness, weight loss, repeated infections, fever, bleeding or bruising easily, bone or joint pain, and swelling in the lymph nodes or abdomen. In acute leukemia, these signs can appear suddenly because it is a fast-growing cancer. Chronic leukemia typically progresses slowly with few symptoms and is often diagnosed during routine blood tests.

Risk factors: Exposure to ionizing radiation increases the risk of most types of leukemia. Medical radiation, such as that used in cancer treatment, is one of the most common sources of radiation exposure. The risk of leukemia is also increased in patients treated with chemotherapy and in children with Down syndrome and certain other genetic abnormalities. Some occupational exposures increase risk, such as the rubber-manufacturing industry.

Some risk factors are most closely associated with specific types of leukemia. For example, family history is a strong risk factor for CLL. Cigarette smoking is a risk factor for AML in adults, and there is accumulating evidence that parental smoking before and after childbirth may also increase leukemia risk in children. There is limited evidence that maternal exposure to paint fumes also increases the risk of childhood leukemia. Exposure to certain chemicals, such as formaldehyde and benzene, increases the risk of myeloid leukemia. Infection with human T-cell leukemia virus type I (HTLV-I) can cause a rare type of leukemia called adult T-cell leukemia/lymphoma. HTLV-I infection is most common in southern Japan and the Caribbean, and infected individuals in the US tend to be immigrants (or their descendants) from these regions. Studies suggest that obesity may increase risk of some leukemia subtypes.

Early detection: Although there are currently no recommended screening tests for the early detection of leukemia, it is sometimes diagnosed early because of abnormal results on blood tests performed for other indications.

Treatment: Chemotherapy is used to treat most acute leukemias. Various anticancer drugs are used, either in combination or as single agents. Several targeted drugs

(e.g., imatinib) are effective for treating CML because they attack cells with the Philadelphia chromosome, the genetic abnormality that is the hallmark of CML. Some of these drugs are also used to treat a type of ALL involving a similar genetic defect. People diagnosed with CLL that is not progressing or causing symptoms may not require treatment. For patients who do require treatment, promising new targeted drugs have changed how CLL is treated in recent years. Certain types of leukemia may be treated with high-dose chemotherapy followed by stem cell transplantation under appropriate conditions. Newer experimental treatments that boost the body's immune system, such as chimeric antigen receptor (CAR) T-cell therapy, have recently shown much promise, even against some hard-to-treat leukemias.

Survival: Survival rates vary substantially by leukemia subtype, ranging from a current (2006-2012) 5-year relative survival of 27% for patients diagnosed with AML to 83% for those with CLL. Advances in treatment have resulted in a dramatic improvement in survival over the past three decades for most types of leukemia (Table 7, page 18). For example, from 1975-1977 to 2006-2012, the overall 5-year relative survival for ALL increased from 41% to 71%. In large part due to the discovery of targeted drugs, the 5-year survival rate for CML has more than doubled over the past two decades, from 31% for patients diagnosed in the early 1990s to 66% for those diagnosed from 2006 to 2012.

Liver

New cases: An estimated 40,710 new cases of liver cancer (including intrahepatic bile duct cancers) will be diagnosed in the US during 2017, approximately three-fourths of which will be hepatocellular carcinoma (HCC). Liver cancer is about 3 times more common in men than in women.

Incidence trends: Liver cancer incidence has more than tripled since 1980; from 2004 to 2013, the rate increased by about 4% per year.

Deaths: An estimated 28,920 liver cancer deaths will occur in 2017.

Mortality trends: Liver cancer death rates have increased by almost 3% per year since 2000.

Signs and symptoms: Symptoms, which do not usually appear until the cancer is advanced, include abdominal pain and/or swelling, weight loss, weakness, loss of appetite, jaundice (a yellowish discoloration of the skin and eyes), and fever. Enlargement of the liver is the most common physical sign.

Risk factors: The most important risk factors for liver cancer in the US are chronic infection with hepatitis B virus (HBV) and/or hepatitis C virus (HCV), heavy alcohol consumption, obesity, diabetes, tobacco smoking, and certain rare genetic disorders, such as hemochromatosis.

Prevention: A vaccine that protects against HBV has been available since 1982. There is no vaccine available to prevent HCV infection, although new combination antiviral therapies can often clear the infection and substantially reduce cancer risk among those already infected. The Centers for Disease Control and Prevention (CDC) recommends one-time HCV testing for everyone born from 1945 to 1965 because people born in these years account for about three-fourths of HCV-infected individuals in the US. Preventive measures for HCV infection include screening of donated blood, organs, and tissues; adherence to infection control practices during medical and dental procedures; needle-exchange programs for injection drug users, and practicing safe sex. Visit the CDC website at cdc.gov/hepatitis/ for more information on viral hepatitis.

Early detection: Although screening for liver cancer has not been shown to reduce mortality, many health care providers in the US test individuals at high risk for the disease (e.g., those with cirrhosis) with ultrasound or blood tests.

Treatment: Early stage liver cancer can sometimes be treated successfully with surgery to remove part of the liver (partial hepatectomy); however, few patients have sufficient healthy liver tissue for this option. Liver transplantation may be possible for individuals with small tumors who are not candidates for partial

Table 7. Trends in 5-year Relative Survival Rates* (%) by Race, US, 1975-2012

	All races			White			Black		
	1975-77	1987-89	2006-12	1975-77	1987-89	2006-12	1975-77	1987-89	2006-12
Brain & other nervous system	22	29	35	22	28	33	25	32	44
Breast (female)	75	84	91	76	85	92	62	71	82
Colon & rectum	50	60	66	50	60	67	45	52	59
Esophagus	5	9	21	6	11	22	4	7	13
Hodgkin lymphoma	72	79	89	72	80	89	70	72	86
Kidney & renal pelvis	50	57	75	50	57	75	49	55	75
Larynx	66	66	62	67	67	64	58	56	52
Leukemia	34	43	63	35	44	64	33	35	58
Liver & intrahepatic bile duct	3	5	18	3	6	18	2	3	13
Lung & bronchus	12	13	19	12	13	19	11	11	16
Melanoma of the skin	82	88	93	82	88	93	57†	79†	69
Myeloma	25	27	50	24	27	50	29	30	52
Non-Hodgkin lymphoma	47	51	73	47	51	74	49	46	65
Oral cavity & pharynx	53	54	67	54	56	69	36	34	47
Ovary	36	38	46	35	38	46	42	34	38
Pancreas	3	4	9	3	3	9	2	6	8
Prostate	68	83	99	69	84	>99	61	71	97
Stomach	15	20	31	14	18	30	16	19	30
Testis	83	95	97	83	95	97	73††	88	90
Thyroid	92	94	98	92	94	99	90	92	97
Urinary bladder	72	79	79	73	80	79	50	63	66
Uterine cervix	69	70	69	70	73	71	65	57	58
Uterine corpus	87	82	83	88	84	86	60	57	66

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 9 areas from 1975 to 77, 1987 to 89, and 2006 to 2012, all followed through 2013. †The standard error is between 5 and 10 percentage points. ‡Survival rate is for cases diagnosed from 1978 to 1980.

Source: Howlader N, Noone AM, Krapcho M, et al. (eds). *SEER Cancer Statistics Review, 1975-2013*, National Cancer Institute, Bethesda, MD, www.seer.cancer.gov/csr/1975_2013/, based on November 2015 SEER data submission, posted to the SEER website April 2016.

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hepatectomy. Other treatment options include tumor ablation (destruction) or embolization (blocking blood flow).

Fewer treatment options exist for patients diagnosed at an advanced stage. Sorafenib (Nexavar®) is a targeted drug approved for the treatment of HCC in patients who are not candidates for surgery and do not have severe cirrhosis.

Survival: The 5-year relative survival rates for patients with liver cancer is 18%. Forty-three percent of patients are diagnosed with a localized stage of disease, for which 5-year survival is 31% (Table 8, page 21).

Lung and Bronchus

New cases: Lung cancer is the second most commonly diagnosed cancer in both men and women in the US. An estimated 222,500 new cases of lung cancer will be diagnosed in 2017, accounting for about 25% of all cancer diagnoses.

Incidence trends: The incidence rate has been declining since the mid-1980s in men, but only since the mid-2000s in women, because of gender differences in historical patterns of smoking uptake and cessation. From 2004 to 2013, lung cancer incidence rates decreased by about 2% per year in men and 1% per year in women.

Deaths: Lung cancer is the leading cause of cancer death in both men and women. With an estimated 155,870 deaths in 2017, it will account for 1 in 4 cancer deaths.

Mortality trends: The lung cancer death rate has declined by 43% since 1990 in men and by 17% since 2002 in women due to reductions in smoking, with the pace of decline quickening in recent years; from 2010 to 2014, the rate decreased by 3.5% per year in men and by 2.0% per year in women.

Signs and symptoms: Symptoms do not usually occur until the cancer is advanced, and may include persistent cough, sputum streaked with blood, chest pain, voice change, worsening shortness of breath, and recurrent pneumonia or bronchitis.

Risk factors: Cigarette smoking is by far the most important risk factor for lung cancer; 80% of lung cancer deaths in the US are still caused by smoking. Risk increases with both quantity and duration of smoking. Cigar and pipe smoking also increase risk. Exposure to radon gas released from soil and building materials is thought to be the second-leading cause of lung cancer in the US. Other risk factors include occupational or environmental exposure to secondhand smoke, asbestos (particularly among smokers), certain metals (chromium, cadmium, arsenic), some organic chemicals, radiation, air pollution, and diesel exhaust. Additional occupational exposures that increase risk include rubber manufacturing, paving, roofing, painting, and chimney sweeping. Risk is also probably increased among people with a history of tuberculosis. Genetic susceptibility plays a role in the development of lung cancer, especially in those who develop the disease at a young age.

Early detection: Screening with low-dose spiral computed tomography (LDCT) has been shown to reduce lung cancer mortality by about 20% compared to standard chest x-ray among adults with at least a 30 pack-year smoking history who were current smokers or had quit within 15 years. The American Cancer Society guidelines for the early detection of lung cancer endorse a process of informed and shared decision making between clinicians who have access to high-volume, high-quality lung cancer screening programs and current or former smokers (quit within 15 years) who are 55 to 74 years of age, in good health, and have at least a 30 pack-year history of smoking. The decision-making discussion should include a description of the benefits, uncertainties, and harms associated with lung cancer

screening. The US Preventive Services Task Force has issued similar guidelines. For more information on lung cancer screening, see the American Cancer Society's screening guidelines on page 71.

Treatment: Appropriate treatment for lung cancer is based on whether the tumor is small cell (13%) or non-small cell (84%), as well as other tumor characteristics. Based on type, stage, and molecular characteristics of the cancer, treatment can include surgery, radiation therapy, chemotherapy, immunotherapy, and/or targeted therapy. For early stage non-small cell lung cancers, surgery is usually the treatment of choice; chemotherapy (sometimes in combination with radiation therapy) may be given as well. Advanced-stage non-small cell lung cancer patients are usually treated with chemotherapy, targeted drugs (or a combination of the two), or immunotherapy. Chemotherapy, alone or combined with radiation, is the usual treatment for small cell lung cancer; on this regimen, a large percentage of patients experience remission, although the cancer often returns.

Survival: The 5-year relative survival rate for lung cancer is 15% for men and 21% for women. Only 16% of lung cancers are diagnosed at a localized stage, for which the 5-year survival is 55% (Table 8, page 21).

Lymphoma

New cases: An estimated 80,500 new cases of lymphoma will be diagnosed in the US in 2017. This cancer begins in certain immune system cells, and is broadly classified as either Hodgkin lymphoma (8,260 cases) or non-Hodgkin lymphoma (NHL, 72,240 cases). Hodgkin lymphoma and NHL are further classified into subtypes based on cell type, molecular characteristics, anatomic site, certain infections, and other features. The most common subtypes of NHL are diffuse large B-cell lymphoma and follicular lymphoma. (CLL is also classified as an NHL because of its similarity to small lymphocytic lymphoma, but in this document CLL is presented within the leukemia section.)

Incidence trends: Overall, incidence rates for both Hodgkin lymphoma and NHL were stable from 2004 to 2013, although patterns varied by subtype.

Deaths: In 2017, there will be an estimated 1,070 deaths from Hodgkin lymphoma and 20,140 deaths from NHL.

Mortality trends: Due to improvements in treatment, the death rate has been declining since at least 1975 for Hodgkin lymphoma and since the mid-1990s for NHL. For NHL, reductions in incidence and improvements in survival for HIV-associated subtypes has also contributed to the decline. From 2005 to 2014, rates decreased by almost 4% per year for Hodgkin lymphoma and by about 2% per year for NHL.

Signs and symptoms: The most common symptoms of lymphoma are caused by swollen lymph nodes, and include lumps under the skin; chest pain; shortness of breath; and abdominal fullness and loss of appetite. Other symptoms can include itching, night sweats, fatigue, unexplained weight loss, and intermittent fever.

Risk factors: Like most cancers, the risk of NHL increases with age. In contrast, the risk of Hodgkin lymphoma increases during adolescence and early adulthood, decreases during middle age, and then increases again later in life. Most of the known risk factors for lymphoma are associated with severely altered immune function. For example, risk is elevated in people who receive immune suppressants to prevent organ transplant rejection. Certain infectious agents (e.g., Epstein-Barr virus) increase the risk of some lymphoma subtypes, as well as chronic infection with agents that cause immunosuppression (e.g., human immunodeficiency virus [HIV]) or that cause the immune system to be continuously active (e.g., *Helicobacter pylori* and hepatitis C virus). Some autoimmune disorders (e.g., Sjogren syndrome, lupus, and rheumatoid arthritis) are also associated with increased risk for lymphoma. A family history of lymphoma confers increased risk of all Hodgkin lymphoma and NHL subtypes, and a growing number of confirmed common genetic variations are associated with modestly increased risk. Studies also suggest a role for some behavioral risk factors (e.g., body weight) and environmental exposures for some subtypes.

Treatment: NHL patients are usually treated with chemotherapy; radiation, alone or in combination with chemotherapy, is also sometimes used. Targeted or

immunotherapy drugs directed at lymphoma cells are used for some NHL subtypes, as are antibodies linked to a chemotherapy drug or a radioactive atom. If NHL persists or recurs after standard treatment, stem cell transplantation may be an option.

Hodgkin lymphoma is usually treated with chemotherapy, radiation therapy, or a combination of the two, depending on disease stage and cell type. If these treatments are not effective, options may include stem cell transplantation and/or treatment with a monoclonal antibody linked to a chemotherapy drug or immunotherapy.

Survival: Survival varies widely by subtype and stage of disease and is slightly better for females than for males. The overall 5-year relative survival rate for Hodgkin lymphoma is 85% for males and 87% for females, and for NHL is 69% and 72%, respectively.

Oral Cavity and Pharynx

New cases: An estimated 49,670 new cases of cancer of the oral cavity and pharynx (throat) will be diagnosed in the US in 2017. Incidence rates are more than twice as high in men as in women.

Incidence trends: From 2004 to 2013, incidence rates decreased by about 2% per year among blacks, but increased by about 1% per year among whites, largely driven by rising rates for a subset of cancers in the tongue, oropharynx, and tonsils associated with human papillomavirus (HPV) infection.

Deaths: An estimated 9,700 deaths from cancers of the oral cavity and pharynx will occur in 2017.

Mortality trends: The long-term decline in death rates for cancers of the oral cavity and pharynx has stalled in recent years, with rates stable from 2005 to 2014.

Signs and symptoms: Symptoms may include a lesion in the throat or mouth that bleeds easily and does not heal; a persistent red or white patch, lump, or thickening in the throat or mouth; ear pain; a neck mass; or coughing up blood. Difficulty chewing, swallowing, or moving the tongue or jaws are often late symptoms.

Table 8. Five-year Relative Survival Rates* (%) by Stage at Diagnosis, US, 2006-2012

	All stages	Local	Regional	Distant		All stages	Local	Regional	Distant
Breast (female)	90	99	85	26	Ovary	46	92	73	29
Colon & rectum	65	90	71	14	Pancreas	8	29	11	3
Esophagus	18	41	23	5	Prostate	99	>99	>99	29
Kidney†	74	93	66	12	Stomach	30	67	31	5
Larynx	61	76	45	35	Testis	95	99	96	74
Liver‡	18	31	11	3	Thyroid	98	>99	98	55
Lung & bronchus	18	55	28	4	Urinary bladder§	78	70	35	5
Melanoma of the skin	92	98	62	18	Uterine cervix	68	91	57	17
Oral cavity & pharynx	64	83	63	38	Uterine corpus	82	95	69	17

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 18 areas from 2006-2012, all followed through 2013. †Includes renal pelvis. ‡Includes intrahepatic bile duct. §Rate for in situ cases is 96%.

Local: an invasive malignant cancer confined entirely to the organ of origin. **Regional:** a malignant cancer that 1) has extended beyond the limits of the organ of origin directly into surrounding organs or tissues; 2) involves regional lymph nodes; or 3) has both regional extension and involvement of regional lymph nodes. **Distant:** a malignant cancer that has spread to parts of the body remote from the primary tumor either by direct extension or by discontinuous metastasis to distant organs, tissues, or via the lymphatic system to distant lymph nodes.

Source: Howlander N, Noone AM, Krapcho M, et al. (eds). *SEER Cancer Statistics Review, 1975-2013*, National Cancer Institute, Bethesda, MD, http://seer.cancer.gov/csr/1975_2013/, based on November 2015 SEER data submission, posted to the SEER website April 2016.

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Risk factors: Known risk factors include tobacco use in any form (smoked and smokeless) and excessive alcohol consumption. Many studies have reported a synergistic relationship between smoking and alcohol, resulting in a 30-fold increased risk for individuals who both smoke and drink heavily. HPV infection of the mouth and throat, believed to be transmitted through sexual contact, also increases risk.

Prevention: Although clinical trials demonstrated the efficacy of HPV vaccines only against genital diseases, they also will likely prevent some fraction of HPV-associated oral cancers. Unfortunately, vaccine uptake in the US remains very low compared to other countries, with only 28% of boys and 42% of girls ages 13 to 17 years receiving the recommended 3 doses in 2015.

Early detection: Cancer can affect any part of the oral cavity, including the lip, tongue, mouth, and throat. Visual inspection by dentists and physicians can often detect premalignant abnormalities and cancer at an early stage, when treatment may be less extensive and more successful.

Treatment: Radiation therapy and surgery, separately or in combination, are standard treatments; chemotherapy is added for advanced disease. Targeted therapy may be combined with radiation in initial treatment or used to treat recurrent cancer. Immunotherapy is a newer option for advanced or recurrent cancer.

Survival: The 5-year relative survival rate for cancers of the oral cavity and pharynx combined is 66% for whites and 47% for blacks. About one-third (30%) of cases are diagnosed at a local stage, for which 5-year survival is 83% and 79%, respectively. Studies indicate that survival is better when cancer tests positive for HPV than when it does not, which may contribute to higher survival in whites.

Ovary

New cases: An estimated 22,440 new cases of ovarian cancer will be diagnosed in the US in 2017.

Incidence trends: Over the past two decades, ovarian cancer incidence rates have been decreasing by about 1% per year in white women and by 0.4% per year in black women.

Deaths: An estimated 14,080 ovarian cancer deaths will occur in 2017. Ovarian cancer accounts for 5% of cancer deaths among women, causing more deaths than any other gynecologic cancer.

Mortality trends: Ovarian cancer death rates have been generally declining since 1975. From 2005 to 2014, the rate decreased by about 2% per year among white women and 1% per year among black women.

Signs and symptoms: Early ovarian cancer usually has no obvious symptoms. However, studies indicate that some women experience persistent, nonspecific symptoms, such as bloating, pelvic or abdominal pain, difficulty eating or feeling full quickly, or urinary urgency or frequency for several months prior to diagnosis. Women who experience such symptoms daily for more than a few weeks should seek prompt medical evaluation. The most common sign of ovarian cancer is swelling of the abdomen, which is caused by the accumulation of fluid. Abnormal vaginal bleeding is rarely a symptom of ovarian cancer, though it is a symptom of cervical and uterine cancers.

Risk factors: The most important risk factor is a strong family history of breast or ovarian cancer. Women who have had breast cancer and/or who have tested positive for inherited mutations in cancer susceptibility genes, such as *BRCA1* or *BRCA2*, are at increased risk. Preventive surgery to remove the ovaries and fallopian tubes in these women decreases the risk of ovarian cancer. Other medical conditions associated with increased risk include pelvic inflammatory disease and Lynch syndrome. The International Agency for Research on Cancer recently concluded that obesity increases risk. Postmenopausal hormone use (estrogen alone and estrogen combined with progesterone) also increases risk. Tobacco smoking increases the risk of a rare type of ovarian cancer (mucinous). Pregnancy, long-term use of oral contraceptives, and fallopian tube ligation or removal (salpingectomy) reduce risk. Genital talcum powder use may slightly increase the risk of ovarian cancer, but studies remain inconclusive.

Early detection: There is currently no sufficiently accurate screening test recommended for the early detection of ovarian cancer in average-risk women. A pelvic exam, sometimes in combination with a transvaginal ultrasound, may be used to evaluate women with symptoms, but only occasionally detects ovarian cancer, generally when the disease is advanced. For women who are at high risk, a thorough pelvic exam in combination with transvaginal ultrasound and a blood test for the tumor marker CA125 may be offered, although this strategy has not proven effective in reducing ovarian cancer mortality when used as a screening tool in average-risk women. There is some

indication that changes in the value of CA125 over time may be more useful for predicting risk than a fixed cut-point.

Treatment: Treatment includes surgery and often chemotherapy. Surgery usually involves removal of both ovaries and fallopian tubes (bilateral salpingo-oophorectomy), the uterus (hysterectomy), and the omentum (fatty tissue attached to some of the organs in the belly), along with biopsies of the peritoneum (lining of the abdominal cavity). In younger women with very early stage tumors who want to preserve fertility, only the involved ovary and fallopian tube may be removed. Among patients with early ovarian cancer, more accurate surgical staging (microscopic examination of tissue from different parts of the pelvis and abdomen) has been associated with better outcomes. For some women with advanced disease, chemotherapy administered directly into the abdomen improves survival; however, in 2012, less than half of eligible women received this treatment, perhaps because of the high risk for side effects. Targeted drugs can sometimes be used after other treatments to shrink tumors or slow growth of advanced cancers.

Survival: The 5-year relative survival rate for ovarian cancer is relatively low (46%) because most patients (60%) are diagnosed with distant-stage disease, for which survival is 29%. For the 15% of patients diagnosed with localized disease, 5-year survival is 92%. Survival also varies substantially by age, with women younger than 45 much more likely to survive 5 years than women 75 and older (77% versus 20%).

Pancreas

New cases: An estimated 53,670 new cases of pancreatic cancer will be diagnosed in the US in 2017. Most (94%) will develop in the exocrine tissue of the pancreas, which makes up the majority of the pancreas and produces enzymes to digest food. Endocrine tumors (6%) develop in the hormone-producing cells of the pancreas and have a younger median age at diagnosis and better prognosis.

Incidence trends: From 2004 to 2013, pancreatic cancer incidence rates increased by about 1% per year in whites, but were stable in blacks.

Deaths: Pancreatic cancer is the fourth-leading cause of cancer death in both men and women, with an estimated 43,090 deaths in 2017.

Mortality trends: From 2005 to 2014, death rates for pancreatic cancer increased by 0.3% per year in white men, were stable in white women, and decreased by 0.5% per year in black men and women.

Signs and symptoms: Symptoms for pancreatic cancer, which usually do not appear until the disease has progressed, include weight loss, abdominal discomfort that may radiate to the back, and occasionally the development of diabetes. Tumors that develop near the common bile duct can cause jaundice (yellowing of the skin and eyes), which sometimes facilitates an early stage diagnosis. Signs of advanced stage disease may include severe abdominal pain, nausea, and vomiting.

Risk factors: The risk of pancreatic cancer in cigarette smokers is about twice that for never smokers. Use of smokeless tobacco also increases risk. Other risk factors include a family history of pancreatic cancer, a personal history of chronic pancreatitis or diabetes, and obesity. Excessive alcohol consumption may increase risk. Individuals with Lynch syndrome and certain other genetic syndromes, as well as *BRCA1* and *BRCA2* mutation carriers, are also at increased risk.

Treatment: Surgery, radiation therapy, and chemotherapy are treatment options that may extend survival and/or relieve symptoms, but seldom produce a cure. Less than 20% of patients are candidates for surgery because pancreatic cancer is usually detected after it has spread beyond the pancreas. For those who undergo surgery, adjuvant treatment with chemotherapy (and sometimes radiation) may lower the risk of recurrence. For advanced disease, chemotherapy (sometimes along with a targeted therapy drug) may lengthen survival. Clinical trials are testing several new agents for their ability to improve survival.

Survival: For all stages combined, the 5-year relative survival rate is 8%. Even for the small percentage of people diagnosed with local disease (9%), the 5-year survival is only 29%. About half (52%) of patients are diagnosed at a distant stage, for which 5-year survival is 3%.

Prostate

New cases: An estimated 161,360 new cases of prostate cancer will be diagnosed in the US during 2017. Prostate cancer is the most frequently diagnosed cancer in men aside from skin cancer. The risk of prostate cancer is 74% higher in blacks than in whites for reasons that remain unclear, but may include inherited susceptibility.

Incidence trends: In the late 1980s and early 1990s, incidence rates for prostate cancer spiked dramatically, in large part because of widespread screening with the prostate-specific antigen (PSA) blood test. The decline in rates since around 2000 has accelerated in recent years, likely due to recommendations against routine PSA screening beginning in 2008. From 2009 to 2013, the rate decreased by about 8% per year.

Deaths: With an estimated 26,730 deaths in 2017, prostate cancer is the third-leading cause of cancer death in men.

Mortality trends: Prostate cancer death rates have been decreasing since the early 1990s in men of all races/ethnicities, although they remain more than twice as high in blacks as in any other group (see Table 10, page 51). Overall, the prostate cancer death rate has been decreasing by about 3% per year since 1999.

Signs and symptoms: Early prostate cancer usually has no symptoms. With more advanced disease, men may experience weak or interrupted urine flow; difficulty starting or stopping urine flow; the need to urinate frequently, especially at night; blood in the urine; or pain or burning with urination. Advanced prostate cancer commonly spreads to the bones, which can cause pain in the hips, spine, ribs, or other areas.

Risk factors: The only well-established risk factors for prostate cancer are increasing age, African ancestry, a family history of the disease, and certain inherited genetic conditions. Black men in the US and Caribbean men of African descent have the highest documented prostate cancer incidence rates in the world. Genetic studies suggest that strong familial predisposition may be responsible for 5%-10% of prostate cancers. Inherited conditions associated with increased risk include Lynch

syndrome and *BRCA1* and *BRCA2* mutations. Smoking may increase the risk of fatal prostate cancer.

Prevention: The chemoprevention of prostate cancer is an active area of research. Two drugs of interest, finasteride and dutasteride, reduce the amount of certain male hormones in the body and are approved to treat the symptoms of benign prostatic hyperplasia. Although these drugs also seem to reduce prostate cancer risk, neither is approved for the prevention of prostate cancer because the benefits have not been shown to outweigh the harms, such as side effects like erectile dysfunction and decreased sexual drive.

Early detection: No organizations presently endorse routine prostate cancer screening for men at average risk because of concerns about the high rate of overdiagnosis (detecting disease that would never have caused symptoms), along with the significant potential for serious side effects associated with prostate cancer treatment. The American Cancer Society recommends that beginning at age 50, men who are at average risk of prostate cancer and have a life expectancy of at least 10 years have a conversation with their health care provider about the benefits and limitations of PSA testing and make an informed decision about whether to be tested based on their personal values and preferences. Men at high risk of developing prostate cancer (black men or those with a close relative diagnosed with prostate cancer before the age of 65) should have this discussion beginning at age 45, and men at even higher risk (those with several close relatives diagnosed at an early age) should have this discussion beginning at age 40.

Treatment: Treatment options vary depending on age, stage, and grade of cancer, as well as other medical conditions and patient values and preferences. Careful observation (called active surveillance) instead of immediate treatment is appropriate for many patients, particularly those diagnosed at an early stage, men with less aggressive tumors, and older men. Treatment options include surgery, external beam radiation, or radioactive seed implants (brachytherapy). Hormonal therapy may be used along with surgery or radiation in more advanced cases. Treatment often impacts a man's quality of life due

to side effects or complications, such as urinary and erectile difficulties, which may be temporary or long term. Current research is exploring new biologic markers for prostate cancer in order to improve the distinction between indolent and aggressive disease to minimize unnecessary treatment.

Disease that has spread to distant sites is treated with hormonal therapy, chemotherapy, radiation therapy, and/or other treatments. Hormone treatment may control advanced prostate cancer for long periods of time by shrinking the size or limiting the growth of the cancer, thus helping to relieve pain and other symptoms. Chemotherapy is often used if hormone treatments are no longer effective, although recent studies have shown that adding chemotherapy to initial hormone therapy may lengthen survival. An option for some men with advanced prostate cancer that is no longer responding to hormones is a cancer vaccine designed to stimulate the patient's immune system to specifically attack prostate cancer cells. Newer forms of hormone therapy have been shown to be beneficial for the treatment of metastatic disease that is resistant to initial hormone therapy and/or chemotherapy. Other types of drugs can be used to treat prostate cancer that has spread to the bones.

Survival: The majority (92%) of prostate cancers are discovered at a local or regional stage, for which the 5-year relative survival rate approaches 100%. The 5-year survival for distant-stage disease is 29%. Ten- and 15-year survival rates for prostate cancer are 98% and 96%, respectively.

Skin

New cases: Skin cancer is the most commonly diagnosed cancer in the US. However, the actual number of the most common types – basal cell and squamous cell skin cancer (i.e., keratinocyte carcinoma or KC), also referred to as nonmelanoma skin cancer – is very difficult to estimate because these cases are not required to be reported to cancer registries. The most recent study of KC occurrence estimated that in 2012, 5.4 million cases were diagnosed among 3.3 million people (many people are diagnosed with more than one KC).

Invasive melanoma accounts for only about 1% of all skin cancer cases, but the vast majority of skin cancer deaths. An estimated 87,110 new cases of melanoma will be diagnosed in the US in 2017. It is most commonly diagnosed in non-Hispanic whites, with an annual incidence rate of 26 (per 100,000), compared to 5 in Hispanics and 1 in blacks. Incidence rates are higher in women than in men before age 50, but by age 65, rates in men are double those in women, and by age 80 they are triple. This pattern reflects age and sex differences in occupational and recreational exposure to ultraviolet radiation (including the use of indoor tanning), and perhaps early detection practices and use of health care.

Incidence trends: The incidence of melanoma of the skin has risen rapidly over the past 30 years, although current trends differ by age. From 2004 to 2013, the rate increased by 2% to 3% per year among men and women ages 50 and older, but had stabilized among men and women younger than age 50.

Deaths: In 2017, an estimated 9,730 deaths from melanoma will occur.

Mortality trends: Like incidence, mortality trends for melanoma differ by age. From 2005 to 2014, the death rate was stable in adults 50 years of age and older, but declined by 2.6% per year in individuals younger than 50.

Signs and symptoms: Warning signs of all skin cancers include changes in the size, shape, or color of a mole or other skin lesion, the appearance of a new growth on the skin, or a sore that doesn't heal. Changes that progress over a month or more should be evaluated by a health care provider. Basal cell carcinoma may appear as a growth that is flat, or as a small, raised pink or red translucent, shiny area that may bleed following minor injury. Squamous cell carcinoma may appear as a growing lump, often with a rough surface, or as a flat, reddish patch that grows slowly.

Risk factors: For melanoma, major risk factors include a personal or family history of melanoma and the presence of atypical, large, or numerous (more than 50) moles. High exposure to ultraviolet (UV) radiation, from sunlight or use of indoor tanning, is a risk factor for all

types of skin cancer. (The International Agency for Research on Cancer has classified indoor tanning devices as “carcinogenic to humans” based on an extensive review of scientific evidence.) Risk is also increased for people with sun sensitivity (e.g., sunburning easily, difficulty tanning, or natural blond or red hair color); a history of excessive sun exposure, including sunburns; diseases or treatments that suppress the immune system; and a past history of skin cancer.

Prevention: Skin cancer risk can be reduced by minimizing skin exposure to intense UV radiation by seeking shade; wearing protective clothing (long sleeves, long pants or skirts, tightly woven fabric, and a wide-brimmed hat); wearing sunglasses that block ultraviolet rays; applying broad-spectrum sunscreen that has a sun protection factor (SPF) of 30 or higher to unprotected skin; and not sunbathing or indoor tanning. Children should be especially protected from the sun because severe sunburns in childhood may increase the risk of melanoma. In July 2014, the US Surgeon General released a Call to Action to Prevent Skin Cancer, citing the elevated and growing burden of this disease. The purpose of this initiative is to increase awareness and encourage all Americans to engage in behaviors that reduce the risk of skin cancer. See surgeongeneral.gov/library/calls/prevent-skin-cancer/call-to-action-prevent-skin-cancer.pdf for more information.

Early detection: Although the US Preventive Services Task Force recently reported that there is insufficient evidence to recommend for or against visual skin examination by a clinician for people at average risk of skin cancer, the best way to detect skin cancer early is to be aware of new or changing skin growths, particularly those that look unusual. Any new lesions, or a progressive change in a lesion's appearance (size, shape, or color, etc.), should be evaluated promptly by a physician. The ABCDE rule outlines warning signs of the most common type of melanoma: A is for asymmetry (one half of the mole does not match the other half); B is for border irregularity (the edges are ragged, notched, or blurred); C is for color (the pigmentation is not uniform, with variable degrees of tan, brown, or black); D is for diameter greater than 6 millimeters (about the size of a pencil eraser); and E is for evolution, meaning a change in the mole's appearance

over time. Not all melanomas have these signs, so be alert for any new or changing skin growths or spots.

Treatment: Most early skin cancers are diagnosed and treated by removal and microscopic examination of the cells. Early stage KC can be treated in most cases by one of several methods: surgical excision, electrodesiccation and curettage (tissue destruction by electric current and removal by scraping with a curette), or cryosurgery (tissue destruction by freezing). Radiation therapy and certain topical medications may be used. For melanoma, the primary growth and surrounding normal tissue are removed and sometimes a sentinel lymph node is biopsied to determine stage. More extensive lymph node surgery may be needed if the sentinel lymph nodes contain cancer. Melanomas with deep invasion or that have spread to lymph nodes may be treated with surgery, immunotherapy, chemotherapy, and/or radiation therapy. The treatment of advanced melanoma has changed greatly in recent years with the FDA approval of several new immunotherapy and targeted drugs, which shrink many melanomas. Chemotherapy might be used, although it is usually much less effective than newer treatments.

Survival: Almost all cases of KC can be cured, especially if the cancer is detected and treated early. Although melanoma is also highly curable when detected in its earliest stages, it is more likely than KC to spread to other parts of the body; the 5-year relative survival rate is 98% for localized stage, 62% for regional stage, and 18% for distant-stage disease.

Thyroid

New cases: An estimated 56,870 new cases of thyroid cancer will be diagnosed in the US in 2017, with 3 out of 4 cases occurring in women. It is the most commonly diagnosed cancer among women 20 to 34 years of age.

Incidence trends: Thyroid cancer has been increasing worldwide over the past few decades and is the most rapidly increasing cancer in the US, largely due to increased detection because of more sensitive diagnostic procedures, which has probably resulted in some overdiagnoses. In the US, the rate increased by about 5%

per year in men and women from 2004 to 2013, although the magnitude of the increase appears to be slowing in recent years.

Deaths: An estimated 2,010 deaths from thyroid cancer will occur in 2017.

Mortality trends: The death rate for thyroid cancer has increased slightly, from 0.48 (per 100,000) in 2005 to 0.50 in 2014.

Signs and symptoms: The most common symptom of thyroid cancer is a lump in the neck that is noticed by a patient or felt by a clinician during an exam. Other symptoms include a tight or full feeling in the neck, difficulty breathing or swallowing, hoarseness, swollen lymph nodes, and pain in the throat or neck that does not go away. Many thyroid cancers are diagnosed incidentally in people without symptoms because an abnormality is seen on an imaging test.

Risk factors: Risk factors for thyroid cancer include being female, having a history of goiter (enlarged thyroid) or thyroid nodules, a family history of thyroid cancer, and radiation exposure early in life (e.g., as a result of medical treatment). People who test positive for a mutation in a gene called *RET*, which causes a hereditary form of thyroid cancer (familial medullary thyroid carcinoma), can lower their risk of developing the disease by having the thyroid gland surgically removed. Certain rare genetic syndromes, such as familial adenomatous polyposis (FAP), also increase risk. The International Agency for Research on Cancer recently concluded that obesity slightly increases risk.

Treatment: Most thyroid cancers are highly curable, but about 5% (medullary and anaplastic thyroid cancers) are more aggressive and more likely to spread to other organs. Treatment depends on the cell type, tumor size, and extent of disease. The first choice of treatment is usually surgery to partially or totally remove the thyroid gland (thyroidectomy) and sometimes nearby lymph nodes. Treatment with radioactive iodine (I-131) after complete thyroidectomy to destroy any remaining thyroid tissue may be recommended for large tumors or

when cancer has spread outside the thyroid. Thyroid hormone replacement therapy is given after thyroidectomy to replace hormones normally made by the thyroid gland and to prevent the body from making thyroid-stimulating hormone, decreasing the likelihood of recurrence. For some types of advanced thyroid cancer, targeted drugs can be used to help shrink or slow tumor growth.

Survival: The 5-year relative survival rate is 98%. However, survival varies by stage (Table 8, page 21), age at diagnosis, and disease subtype.

Urinary Bladder

New cases: An estimated 79,030 new cases of bladder cancer will be diagnosed in the US in 2017. Bladder cancer incidence is about 4 times higher in men than in women and almost 2 times higher in white men than in black men.

Incidence trends: After decades of slowly increasing, bladder cancer incidence has begun to decline in whites, but not in blacks. From 2009 to 2013, the rate decreased by about 1% per year in white men and women, increased by 0.5% per year in black men, and was stable in black women.

Deaths: An estimated 16,870 deaths from bladder cancer will occur in 2017.

Mortality trends: In contrast to incidence patterns, the death rate for urinary bladder cancer from 2005 to 2014 decreased by 1% per year in black men and women, by 0.3% per year in white women, and was stable in white men.

Signs and symptoms: Bladder cancer is usually detected early because of blood in the urine or other symptoms, including increased frequency or urgency of urination or pain or irritation during urination.

Risk factors: Smoking is the most well-established risk factor for bladder cancer, accounting for about half of all cases. Risk is also increased among workers in the dye, rubber, leather, and aluminum industries; painters; people who live in communities with high levels of arsenic in the drinking water; and people with certain bladder birth defects.

Early detection: There is currently no screening method recommended for people at average risk. Bladder cancer is diagnosed by microscopic examination of cells from urine or bladder tissue and examination of the bladder wall with a cystoscope, a slender tube fitted with a lens and light that is inserted through the urethra. These and other tests may be used to screen people at increased risk, as well as during follow-up after bladder cancer treatment to detect recurrent or new tumors.

Treatment: Surgery, alone or in combination with other treatments, is used in more than 90% of cases. Early stage cancers may be treated by removing the tumor and then administering immunotherapy or chemotherapy drugs directly into the bladder. More advanced cancers may require removal of the entire bladder (cystectomy). Patient outcomes are improved with the use of chemotherapy, alone or with radiation, before cystectomy. Timely follow-up care is extremely important because of the high rate of bladder cancer recurrence. Distant-stage cancers are typically treated with chemotherapy, sometimes along with radiation. Immunotherapy is a newer option if chemotherapy is no longer working.

Survival: The 5-year relative survival rate is 79% for white men, 74% for white women, 69% for black men, and 54% for black women.

Uterine Cervix

New cases: An estimated 12,820 cases of invasive cervical cancer will be diagnosed in the US in 2017.

Incidence trends: The cervical cancer incidence rate declined by more than half between 1975 (14.8 per 100,000) and 2013 (6.5 per 100,000) due to the widespread uptake of screening, primarily with the Pap test. However, declines have begun to slow in recent years, particularly among whites. From 2004 to 2013, the incidence rate in women younger than 50 years of age was stable in whites and decreased by about 3% per year in blacks, while in women 50 or older, it decreased by about 2% per year in whites and by about 4% per year in blacks.

Deaths: An estimated 4,210 deaths from cervical cancer will occur in 2017.

Mortality trends: Like incidence, the cervical cancer death rate in 2014 (2.3 per 100,000) was less than half that in 1975 (5.6 per 100,000) due to declines in incidence and the early detection of cancer with the Pap test. However, the magnitude of the decline has slowed in recent years, perhaps indicating that rates are approaching a lower limit. From 2005 to 2014, the death rate was stable among women younger than 50 years of age and decreased by 0.9% per year among those 50 or older.

Signs and symptoms: Preinvasive cervical lesions often have no symptoms. Once abnormal cervical cells become cancerous and invade nearby tissue, the most common symptom is abnormal vaginal bleeding, which may start and stop between regular menstrual periods or occur after sexual intercourse, douching, or a pelvic exam. Menstrual bleeding may last longer and be heavier than usual. Bleeding after menopause and increased vaginal discharge may also be symptoms.

Risk factors: Most cervical cancers are caused by persistent infection with certain types of human papillomavirus (HPV). However, HPV infections are common in healthy women and only rarely cause cervical cancer. While women who begin having sex at an early age or who have had many sexual partners are at increased risk for HPV infection and cervical cancer, a woman may be infected with HPV even if she has had only one sexual partner. Several factors are known to increase the risk of both persistent HPV infection and progression to cancer, including a suppressed immune system, a high number of childbirths, and cigarette smoking. Long-term use of oral contraceptives is also associated with increased risk of cervical cancer.

Prevention: Vaccines are available for use in ages 9 to 26 years to protect against the most common types of HPV that cause cervical cancer. In October 2016, the CDC reduced the recommended number of doses of the vaccine from three to two for ages 9 to 14 years, while ages 15 to 26 years still require a 3-dose series for full

protection. Unfortunately, HPV vaccine coverage remains low in the US, especially in comparison to other high-income countries; in 2015, only 42% of US adolescent girls had completed the series compared to 77% in Australia.

HPV vaccines cannot protect against established infections, nor do they protect against all types of HPV, which is why vaccinated women should still be screened for cervical cancer. Screening can also prevent cervical cancer by detecting precancerous lesions that can be treated so they do not progress to cancer. As screening has become more common, precancerous lesions of the cervix are detected far more frequently than invasive cancer. The Pap test is a simple procedure in which a small sample of cells is collected from the cervix and examined under a microscope. HPV tests, which detect HPV infections associated with cervical cancer, can forecast cervical cancer risk many years into the future and are currently recommended to be used in conjunction with the Pap test in women ages 30 to 65, or when Pap test results are uncertain. HPV tests can also identify women at risk for a type of cervical cancer (adenocarcinoma) that is often missed by Pap tests, but accounts for 28% of cases in the US.

Most cervical precancers develop slowly, so cancer can usually be prevented if a woman is screened regularly. It is important for all women, even those who have received the HPV vaccine, to follow cervical cancer screening guidelines.

Early detection: In addition to preventing cervical cancer, screening can detect invasive cancer early, when treatment is more successful. Most women diagnosed with cervical cancer have not been screened recently. The American Cancer Society, in collaboration with the American Society for Colposcopy and Cervical Pathology and the American Society for Clinical Pathology, recommends screening for women ages 21 to 65, with an emphasis on the incorporation of HPV testing in addition to the Pap test for ages 30 to 65. For more detailed information on the American Cancer Society's screening guidelines for the early detection of cervical cancer, see page 71.

Treatment: Precancerous cervical lesions may be treated with a loop electrosurgical excision procedure (LEEP), which removes abnormal tissue with a wire loop heated by electric current; cryotherapy (the destruction of cells by extreme cold); laser ablation (destruction of tissue using a laser beam); or conization (the removal of a cone-shaped piece of tissue containing the abnormal tissue). Invasive cervical cancers are generally treated with surgery or radiation combined with chemotherapy. Chemotherapy alone is often used to treat advanced disease. However, for women with metastatic, recurrent, or persistent cervical cancer, the addition of targeted therapy to standard chemotherapy has been shown to improve overall survival.

Survival: The 5-year relative survival rate for cervical cancer is 69% for white women and 57% for black women. Five-year survival is 91% for the 46% of patients diagnosed when the cancer is localized; 5-year survival falls to 57% and 17% for women diagnosed with regional and distant-stage disease, respectively (Table 8, page 21).

Uterine Corpus (Endometrium)

New cases: An estimated 61,380 cases of cancer of the uterine corpus (body of the uterus) will be diagnosed in the US in 2017. Cancer of the uterine corpus is often referred to as endometrial cancer because most cases (92%) occur in the endometrium (lining of the uterus).

Incidence trends: From 2004 to 2013, the incidence rate increased by 1% per year among white women and by 3% per year among black women.

Deaths: An estimated 10,920 deaths from uterine corpus cancer will occur in 2017.

Mortality trends: From 2005 to 2014, the death rate for cancer of the uterine corpus increased by about 1% per year among white women and 2% per year among black women.

Signs and symptoms: Abnormal uterine bleeding or spotting (especially in postmenopausal women) is a frequent early sign. Pain during urination, intercourse, or in the pelvic area can also be a symptom.

Risk factors: Obesity and abdominal fatness increase the risk of uterine cancer, most likely by increasing the amount of circulating estrogen, which is a strong risk factor. Other factors that increase estrogen exposure include use of postmenopausal estrogen, late menopause, never having children, and a history of polycystic ovary syndrome. (Use of postmenopausal estrogen plus progestin does not appear to increase risk.) Tamoxifen, a drug used to treat breast cancer, increases risk slightly because it has estrogen-like effects on the uterus. Medical conditions that increase risk include Lynch syndrome and diabetes. Pregnancy, use of oral contraceptives or intrauterine devices, and physical activity are associated with reduced risk.

Early detection: There is no standard or routine screening test for women at average risk. However, most cases (67%) are diagnosed at an early stage because of postmenopausal bleeding. Women are encouraged to report any unexpected bleeding or spotting to their physicians. The American Cancer Society recommends that women with known or suspected Lynch syndrome be offered annual screening with endometrial biopsy and/or transvaginal ultrasound beginning at age 35.

Treatment: Uterine cancers are usually treated with surgery, radiation, hormones, and/or chemotherapy, depending on the stage of disease.

Survival: The 5-year relative survival rate for uterine cancer is 84% for white women and 62% for black women, partly because white women are more likely than black women to be diagnosed with early stage disease; however, survival is substantially lower for black women for every stage.

Special Section: Rare Cancers in Adults

Introduction

Any cancer diagnosis is difficult, but rare cancers can be especially challenging for patients, their caregivers, and even clinicians. For many rare cancers, research to identify causes or develop strategies for prevention or early

detection is extremely difficult. In addition, rare cancers can be extremely challenging to diagnose, often resulting in numerous physician visits, misdiagnoses, and substantial delays in diagnosis. After diagnosis, patients and caregivers often have a hard time finding information about their cancer, and treatment options are usually more limited and less effective than for more common cancers. This is partly because there are fewer clinical trials for rare cancers, and they are often limited to select, high-volume cancer centers. Consequently, rare cancers are an area of priority for researchers and public health advocates.¹

Table S1. Statistics for Select Rare Cancers, Ages 20+ Years

	Incidence				Mortality		Relative survival
	Rate* 2009-2013	Male: female rate ratio	Trend (APC) 2004-2013	% local stage 2009-2013	Rate* 2010-2014	Trend (APC) 2005-2014	5-year (%) 2006-2012
Oral cavity & pharynx							
Lip	0.8	3.4	-2.4†	83	<0.1	-3.4†	89
Tongue	4.7	2.8	1.9†	33	0.9	-0.3†	65
Salivary gland	1.7	1.8	0.3†	43	0.3	1.0†	72
Floor of mouth	0.8	2.5	-3.2†	44	<0.1	-8.1†	52
Gum & other mouth	2.2	1.5	-0.2	40	0.5	-0.2	59
Nasopharynx‡	0.7	2.7	-0.9†	9	0.3	-1.4†	60
Tonsil	2.9	4.9	3.1†	12	0.3	1.3†	73
Oropharynx	0.7	3.6	1.3†	14	0.3	2.5†	43
Hypopharynx	0.9	4.7	-2.6†	17	0.1	-1.3	33
Digestive system							
Small intestine	3.2	1.3	1.7†	32	0.5	0.1	67
Anus, anal canal, & anorectum	2.5	0.7	1.6†	47	0.3	3.0†	66
Gallbladder	1.6	0.6	-0.6†	10	0.9	-0.7†	19
Retroperitoneum	0.5	1.1	-0.2	43	0.1	-3.4†	53
Peritoneum, omentum, & mesentery	0.8	0.1	-2.3†	18	0.4	0.0	33
Respiratory system							
Nose, nasal cavity, & middle ear	0.9	1.8	-0.6†	27	0.2	-2.0†	56
Larynx	5.0	4.5	-2.5†	53	1.4	-2.1†	61
Trachea, mediastinum	0.2	2.5	-1.3†	30	0.1	-3.8†	46
Genitourinary system							
Vagina	1.0	–	-0.9†	32	0.3	-1.3†	47
Vulva	3.6	–	0.5†	60	0.7	0.6	72
Penis	1.2	–	-0.1	57	0.2	-0.6†	69
Testis	7.2	–	0.2	68	0.3	-0.4†	95
Ureter	0.8	2.2	-1.5	45	0.2	-0.7†	47
Other rare cancers							
Male breast cancer	1.9	–	0.2	47	0.4	-1.1†	84
Bones & joints	1.0	1.4	-0.2†	40	0.5	-0.4†	66
Soft tissue, including heart	4.2	1.5	0.4	58	1.8	0.5†	64
Eye & orbit	1.0	1.4	-0.7	73	0.1	1.5	80
Mesothelioma	1.4	4.3	-1.8†	9	1.1	-1.4†	10
Kaposi sarcoma	0.5	9.6	-3.4†	56	<0.1	1.3	73

APC= annual percent change. *Rate per 100,000 population. †Indicates APC significantly different from zero, p<0.05. ‡Nasopharyngeal cancers are classified with oral cavity/ pharynx here, consistent with SEER coding, but are described in the section on respiratory cancers in the text because the nasopharynx is technically part of the respiratory system. Note: All male:female incidence rate ratios are significantly different from 1.0, p<0.05.

Sources: Data for overall incidence rate, male: female rate ratio, and percent local stage are from the North American Association for Central Cancer Registries (NAACCR) and include information from all states and DC, except MN, NM, and NV. Incidence trends are based on NAACCR data from 1995 to 2013 from 26 states, representing 67% of the US population. Data for 5-year relative survival are from the Surveillance, Epidemiology, and End Results (SEER) program, 18 SEER registries, covering approximately 28% of the US population. Mortality data for rates and trends cover the entire US and are from the National Center for Health Statistics.

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In this report, we provide incidence and mortality rates and trends, stage at diagnosis, and survival for 28 rare cancers in adults ages 20 and older in the United States, as well as an overview of symptoms and risk factors for a subset of these cancers, to inform policy makers, researchers, and the general public. Childhood cancers are described briefly on page 12 and were the topic of the *Cancer Facts & Figures* Special Section in 2014 (cancer.org/statistics).

What is a rare cancer?

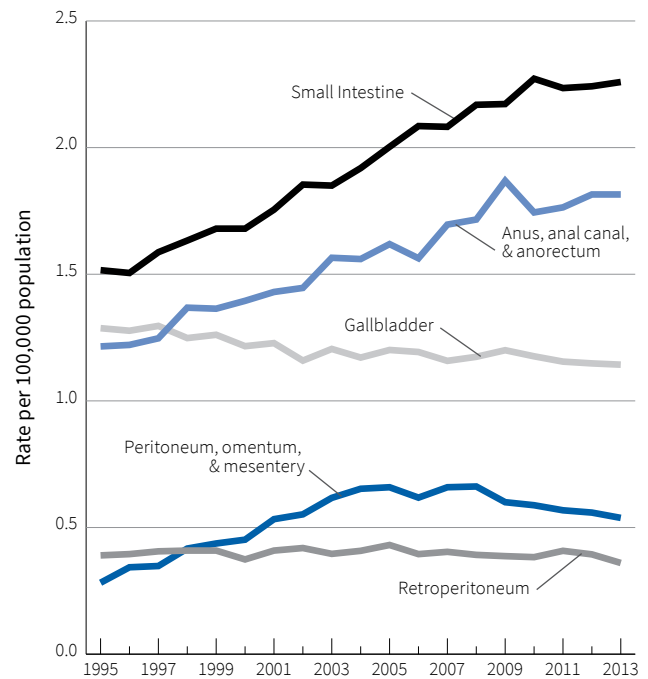
There is no universally adopted definition for rare cancers. The National Cancer Institute definition is fewer than 15 cases per 100,000 people per year. More recently, a consortium from the European Union (RARECARE)² defined rare cancers as those with fewer than 6 cases per 100,000 people per year, which is the definition we use in this report. To put this in perspective, the incidence rate for both breast and prostate cancer, the most common cancers in women and men, respectively, is currently about 123 cases per 100,000.

Historically, cancers have been categorized by the location in the body (anatomic site) and type of tissue (histology) from which they originate. Today, genetic information is increasingly used to group cancers according to a tumor's biological makeup (i.e., molecular subtype), resulting in the subdivision of some more common cancers into a collection of rarer cancers. However, given the limited data on molecular subtypes available from cancer registries, the cancers described herein are primarily defined by site of origin. Although the incidence rate for testicular cancer (7.2 per 100,000) is slightly higher than the threshold for our definition, we included it because it is often considered a rare cancer. Most leukemia subtypes and Hodgkin lymphoma are rare by definition, but are not included here because they are described in detail elsewhere (pages 16 and 19), as are cancers of the oral cavity and pharynx (page 20).

How many rare cancers are expected to be diagnosed in adults in 2017?

Nearly 13% (1 in 8) of all cancers diagnosed in adults ages 20 and older are rare based on our definition, the equivalent of approximately 208,000 new cases in 2017. (This does not include the 8,850 cases of testicular cancer.)

Figure S1. Trends in Incidence Rates for Select Rare Cancers of the Digestive System, Adults 20+, 1995-2013



Source: NAACCR, 2016.

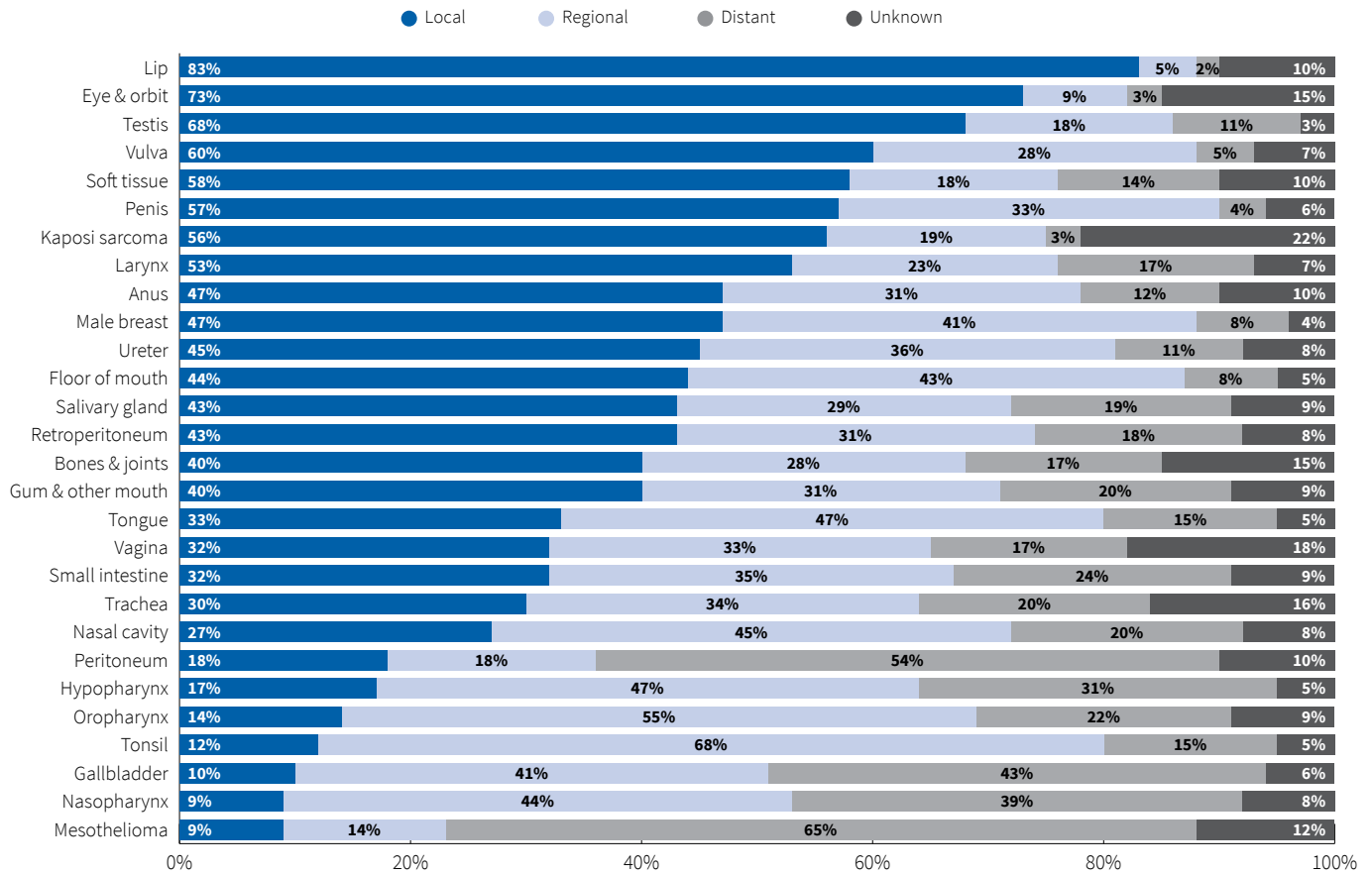
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Selected rare cancers

Digestive system

The most common of the rare cancers of the digestive system is cancer of the small intestine (Table S1). The small intestine is a long coiled tube connecting the stomach to the colon, and consists of three main parts: the duodenum, jejunum, and ileum. Although the small intestine comprises 75% of the length and 90% of the mucosal lining of the gastrointestinal system, only about 4% of gastrointestinal cancers occur there.³ Cancers of the small intestine most commonly arise in the duodenum, the uppermost portion of the small intestine that connects to the stomach. The four main types of cancer that occur in the small intestine are carcinoid tumors (48%), which arise from neuroendocrine cells and secrete hormones; adenocarcinomas (28%), which arise from the glandular cells that line the small intestine; lymphomas (13%), which arise from lymphoid tissue; and sarcomas (9%), most of which are stromal tumors. Risk factors for small intestine cancers include a personal history of colorectal cancer, Crohn disease, or celiac disease, as well as hereditary

Figure S2. Stage Distribution for Select Rare Cancers, Adults 20+, 2009-2013



Source: NAACCR, 2016.

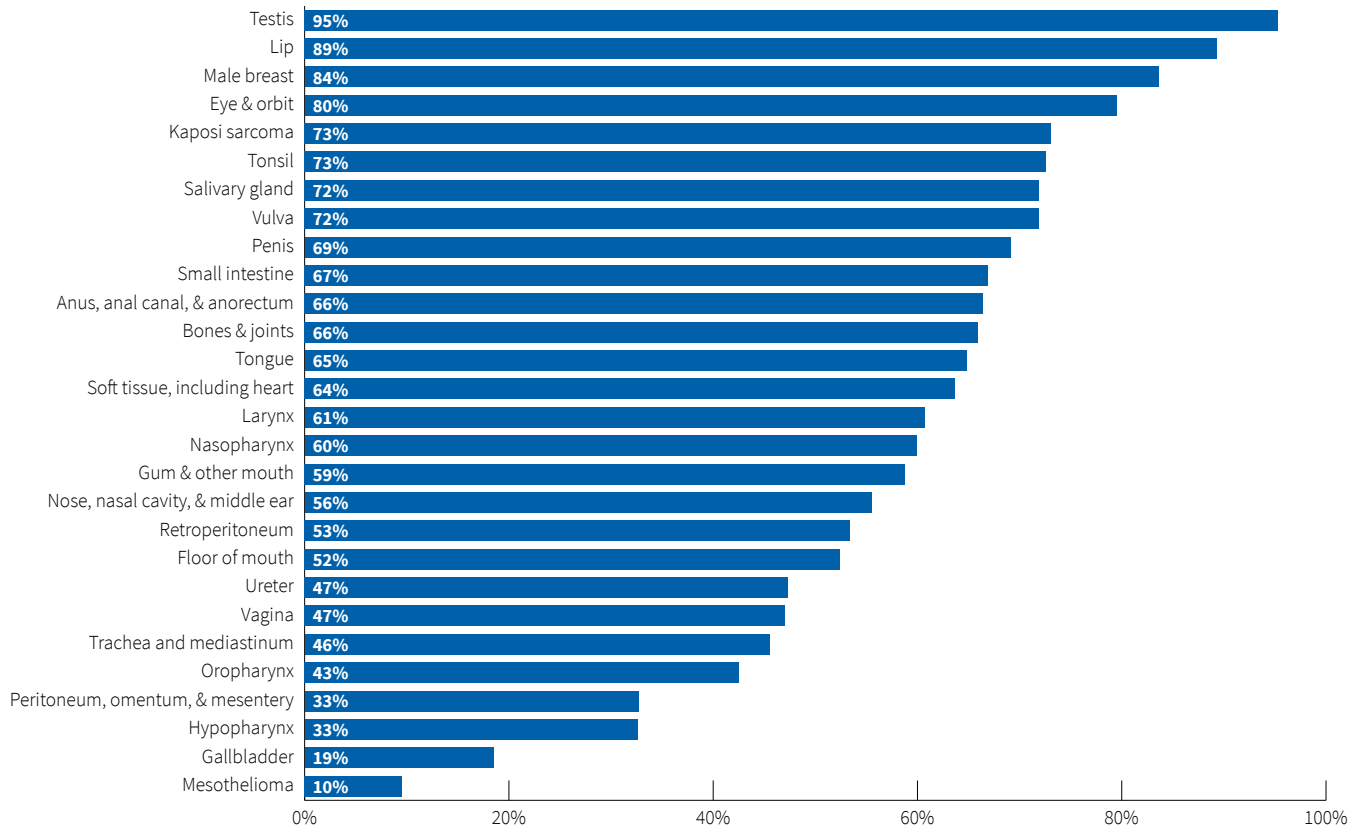
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conditions such as Lynch syndrome and familial adenomatous polyposis.⁴ Some studies suggest that cancers of the small intestine may share risk factors with colorectal cancer, such as obesity and alcohol consumption.⁵⁻⁷ Consistent with colorectal cancer, small intestine cancers are slightly (1.3 times) more common among men than women and the highest rates are in blacks (5.1 per 100,000 versus 3.1 in non-Hispanic whites) (Table S2, page 34). Incidence rates for cancers of the small intestine increased sharply by 2.8% per year from 1995 to 2010, but then were stable through 2013 (Figure S1, page 31). The leveling off of rates in recent years may in part reflect reporting delays rather than reduced occurrence. Similar to colorectal cancer, signs of small intestine cancer usually don't occur until the tumor is advanced and are non-specific, such as abdominal pain and unintended weight loss. More than half (59%) of small intestine cancers are diagnosed at regional or

distant stages (Figure S2). Five-year relative survival rates for cancers of the small intestine by stage at diagnosis are 83%, 73%, and 43% for cancers diagnosed at local, regional, and distant stages, respectively.

The anus is the second most common rare cancer site within the digestive system. The anus, anal canal, and anorectum comprise the final three centimeters of the gastrointestinal tract, from which solid waste passed from the rectum is expelled. More than 90% of anal cancers are caused by human papillomavirus (HPV) infection.⁸ Anal cancer is one of the few cancers more common in women than in men overall,⁹ however, the pattern varies by race/ethnicity and age. Overall, non-Hispanic white women and black men have the highest rates in the US (3.3 and 2.8 per 100,000, respectively). Among whites, rates are higher in women than men in every age group. However, black men have higher rates

Figure S3. Five-year Relative Survival for Select Rare Cancers, Adults 20+, 2006-2012*



*Survival based on patients diagnosed during 2006-2012 and followed through 2013.

Source: SEER 18, 2016.

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than black women before age 60, but the reverse is true among older blacks.³ Anal cancer incidence rates increased by 1.6% per year from 2004-2013 (Figure S1, page 31). Anal cancer death rates also increased sharply by 3.0% per year from 1998 to 2014. The risk of anal cancer is 32 times higher in persons infected with the human immunodeficiency virus (HIV) compared to the general population.¹⁰ The growth and aging of the HIV-infected population is believed to have contributed to the increased anal cancer burden in the US.¹¹ Bleeding is usually the first sign of anal cancer, and nearly half of patients are diagnosed at a localized stage, for which the 5-year relative survival rate is 81%. The overall 5-year relative survival rate for anal cancer is 66% (Figure S3).

The gallbladder is a small organ under the liver that concentrates and stores bile to aid digestion. Gallbladder cancer is unique in that incidence rates are about 66%

higher in women than in men. Risk factors for gallbladder cancer include gallstones (cholelithiasis) and excess body weight (particularly in women).^{12,13} A recent study found that a 5 kg/m² increase in body mass index was associated with a 31% higher risk of gallbladder cancer.¹⁴ Hispanics (2.8 per 100,000) and blacks (2.4 per 100,000) have the highest rates, about 1.5-2 times higher than those in non-Hispanic whites (1.3 per 100,000). However, some studies have shown that rates are even higher among Native Americans in the Southwest and Alaska Natives.¹⁵ Incidence and death rates for gallbladder cancer decreased over the past decade, by 0.6% and 0.7% per year, respectively. Gallbladder cancers usually do not cause symptoms until the disease is advanced. As a result, only 10% of the cancers are diagnosed at a local stage, and overall 5-year survival is just 19% (Table S1, page 30).

Table S2. Incidence Rates* for Rare Cancers for Both Sexes Combined by Race/ethnicity, Ages 20+, 2009-2013

	Non-Hispanic White	Non-Hispanic Black	Hispanic	Asian/Pacific Islander
Oral cavity & pharynx				
Lip	1.0	0.1	0.4	0.1
Tongue	5.4	2.9	2.7	2.5
Salivary gland	1.8	1.5	1.3	1.3
Floor of mouth	0.9	0.8	0.5	0.3
Gum & other mouth	2.2	1.9	1.6	1.8
Nasopharynx†	0.5	0.9	0.5	3.1
Tonsil	3.3	2.2	1.6	0.7
Oropharynx	0.7	1.0	0.4	0.2
Hypopharynx	0.9	1.4	0.7	0.5
Digestive system				
Small Intestine	3.1	5.1	2.4	1.5
Anus, anal canal, & anorectum	2.7	2.6	1.9	0.7
Gallbladder	1.3	2.4	2.8	1.8
Retropertoneum	0.5	0.5	0.5	0.4
Peritoneum, omentum, & mesentery	0.9	0.6	0.6	0.5
Respiratory system				
Nose, nasal cavity, & middle ear	0.9	0.9	0.9	0.7
Larynx	5.1	6.7	3.6	1.6
Trachea & mediastinum	0.2	0.2	0.2	0.2
Genitourinary system				
Vagina	0.9	1.3	1.0	0.6
Vulva	4.0	2.6	2.4	1.1
Penis	1.1	1.4	1.9	0.6
Testis	9.1	2.0	5.6	2.3
Ureter	0.9	0.4	0.4	0.7
Other rare cancers				
Male breast	1.9	2.7	1.1	0.8
Bones & joints	1.0	0.8	0.9	0.6
Soft tissue, including heart	4.2	4.4	3.7	2.9
Eye & orbit	1.2	0.2	0.6	0.2
Mesothelioma	1.5	0.7	1.0	0.5
Kaposi sarcoma	0.3	1.2	0.9	0.2

*Per 100,000 population. †Nasopharyngeal cancers are included in the text with other cancers of the respiratory system.

Source: NAACCR, 2016.

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approximately 20% of all laryngeal cancers are associated with HPV infection.¹⁸ Laryngeal cancer rates are 4-5 times higher in males than females. The highest incidence rates are in blacks (6.7 per 100,000), and the lowest are in Asians/Pacific Islanders (1.6 per 100,000) (Table S2).

Incidence and death rates for laryngeal cancer have decreased sharply, by more than 2% per year over the past decade (Figure S4), largely due to declines in smoking prevalence. Nearly half (48%) of laryngeal cancers arise from the vocal cords (glottis). These cancers are often (79%) diagnosed at a local stage because they cause voice changes or hoarseness early in the course of disease.

Cancers that arise in other parts of the larynx typically cause non-specific symptoms, such as a persistent sore throat or cough, and are less likely to be diagnosed early. The overall 5-year relative survival rate for laryngeal cancer is 61%.

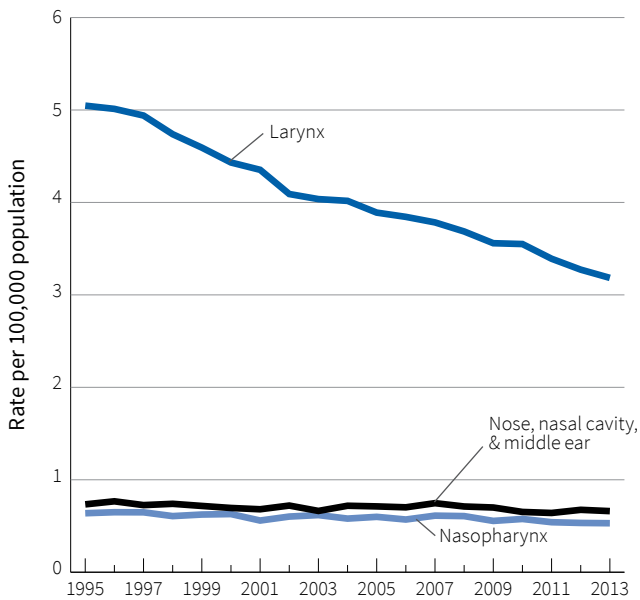
The nasopharynx is the upper part of the throat, behind the nose. Risk factors for nasopharyngeal cancers include Epstein-Barr virus infection, consumption of salted, preserved fish, and a family history of the disease.¹⁹ In the United States, the incidence rate in Asians/Pacific Islanders (3.1 per 100,000) is more than six times higher than that in whites and Hispanics (both 0.5 per 100,000) and about 3.5 times higher than that in blacks (0.9 per 100,000). Similarly, incidence is particularly high among some Asian populations, particularly in southern China and southeastern Asia.¹⁹⁻²¹ Relatively high rates of nasopharyngeal cancer have also been noted in Alaska Natives.²² Over the past decade, nasopharyngeal cancer incidence and death rates declined by 0.9% per year and 1.4% per year, respectively. Most (83%) nasopharyngeal cancers are diagnosed at regional or distant stages (Figure S2, page 32). The overall 5-year relative survival rate is 60% (Figure S3, page 33).

Some cancers of the nose, nasal cavity, and middle ear are associated with workplace exposures, including dusts from wood and leather related to furniture and cabinet making and shoe manufacturing,²³⁻²⁵ while others are linked to HPV infection.²⁶ These cancers occur nearly twice as often in men than women. Since the 1990s, incidence rates have decreased by 0.6% per year (Figure S4) and death rates have decreased by 2.0% per year.

Respiratory system

The most common rare cancers of the respiratory system occur in the larynx, nasopharynx, and nose and nasal cavity. The larynx is the part of the throat between the base of the tongue and the trachea (windpipe); it is also called the voice box because it contains the vocal cords. The major risk factors for laryngeal cancer are tobacco use and alcohol consumption.¹⁶⁻¹⁷ Studies suggest that

Figure S4. Trends in Incidence Rates for Select Rare Cancers of the Respiratory System, Adults 20+, 1995-2013



Source: NAACCR, 2016.

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Overall 5-year relative survival for nose, nasal cavity, and middle ear cancer is 56%. More than half (65%) of these cancers are diagnosed at a regional or distant stage, for which the 5-year survival is 49% and 37%, respectively.

Genitourinary system

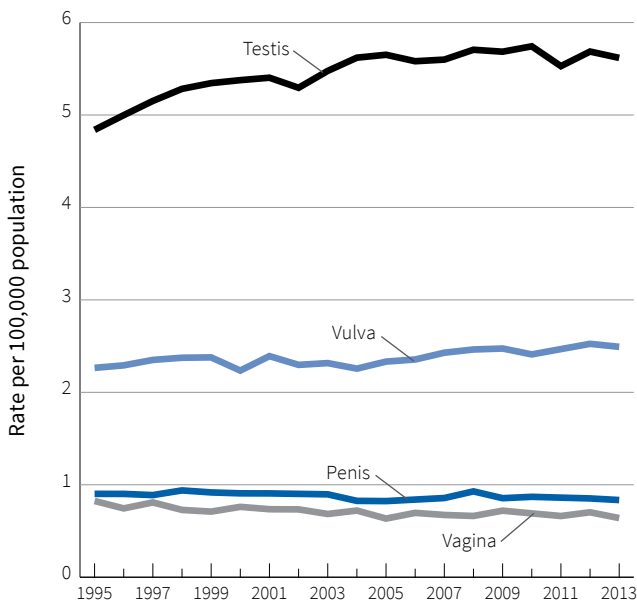
Rare cancers of the genitourinary system include cancers of the vulva, vagina, penis, and testis. The vagina is a 3- to 4-inch tube, sometimes referred to as the birth canal, that extends from the cervix to the vulva (the outer part of female genitals). Similar to cervical cancer, persistent HPV infection and smoking are major risk factors for vaginal and vulvar cancers.^{27,28} A recent analysis estimated that 75% of vaginal cancers and 69% of vulvar cancers diagnosed during 2008-2012 in the US were attributable to HPV infections.⁸ However, in contrast to cervical cancer, for which incidence peaks in women in their 30s and 40s, incidence rates continually increase with age for both vaginal and vulvar cancers. Among the four broad racial/ethnic groups, incidence rates are highest in non-Hispanic white women for vulvar cancer and in black women for vaginal cancer (Table S2). Since

the 1990s, incidence and death rates decreased by about 1% per year for vaginal cancer, and were stable or slightly increasing for vulvar cancer (Figure S5, page 36). Most women with vaginal or vulvar cancers have early symptoms. For vaginal cancer, these include abnormal bleeding, discharge, or pain during intercourse. Vulvar cancer can present as a lump or bump, persistent itching, pain, or soreness. Vulvar cancers are more likely than vaginal cancers to be diagnosed at a localized stage (60% versus 32%), which is reflected in the overall 5-year relative survival rates of 72% versus 47%, respectively.

Similar to female genital cancers, most (63%) penile cancers are associated with HPV infection.^{8,29} Smoking is associated with more than a 4-fold increased risk for penile cancer, while circumcision decreases risk.³⁰ Incidence rates for penile cancers are highest in Hispanic men (1.9 per 100,000), followed by black (1.4 per 100,000), white (1.1 per 100,000), and Asian/Pacific Islander (0.6 per 100,000) men. Incidence rates for penile cancers were relatively stable from 2004-2013, while death rates declined slightly by 0.6% per year (Table S1, page 30). Penile cancer often presents as a change in color or thickening of the skin, or as a growth, sore, or rash. More than half (57%) of penile cancers are diagnosed at a localized stage, for which 5-year relative survival is 81%.

Testicular cancer is the most commonly diagnosed cancer among men between the ages of 15 and 44. Most (97%) testicular cancers are testicular germ cell tumors (TGCT), which arise from cells that normally develop into sperm cells.³ The two main types of TGCT are seminomas and non-seminomas. Seminomas are slow-growing tumors usually diagnosed in men in their late 20s to late 40s. Non-seminomas generally occur in men in their late teens to early 40s and tend to be more aggressive. The main risk factors for testicular cancer are cryptorchidism (undescended testicle), a personal or family history of testicular cancer (particularly a brother), and Northern European ancestry.³¹ Research also suggests that men who are employed as firefighters or airplane mechanics, or who are exposed to organochlorine pesticides, are at increased risk.³¹ Incidence rates are highest in white men (9.1 per 100,000) followed by Hispanic men (5.6 per 100,000), and are much lower in black (2.0 per 100,000) and Asian/

Figure S5. Trends in Incidence Rates for Select Rare Cancers of the Genitourinary System, Adults 20+, 1995-2013



Source: NAACCR, 2016.

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Pacific Islander (2.3 per 100,000) men. Racial variation in the US reflects differences worldwide, with the highest testicular cancer rates in Scandinavian countries and the lowest rates in African and Asian countries.³¹ Testicular cancer incidence rates have increased in the US and in many western countries over the past 40 years.³² In contrast, death rates have slowly declined by 0.4% per year from 1990 to 2014. A lump on the testicle is usually the first sign and often leads to diagnosis at an early stage; approximately 68% of testicular cancers are diagnosed at a localized stage. Prognosis for testicular cancer is generally very good. Overall 5-year relative survival is 95% (Figure S3, page 33). Even cancers diagnosed at a distant stage are often successfully treated, with a 5-year relative survival of 73%.

Other rare cancers

Bone and joint

The two main types of bone and joint cancer in adults are chondrosarcoma (35%), which arises in the cartilage, and

osteosarcoma (22%), which usually arises from the growing end of long bones. Risk factors for bone cancer include previous radiation treatment, especially at a young age and/or with higher doses, and certain inherited conditions (e.g., Li-Fraumeni syndrome, retinoblastoma).³³ Early signs of bone cancer include pain and swelling around the affected bone. Incidence and death rates for bone cancer have declined slightly (0.2% to 0.4% per year) since 1995. Approximately 40% of bone cancers are diagnosed at a localized stage, for which the 5-year relative survival is 85%. The overall 5-year relative survival for adult bone cancer is 66%, but is higher for chondrosarcoma (80%) than osteosarcoma (54%).³⁴

Soft tissue

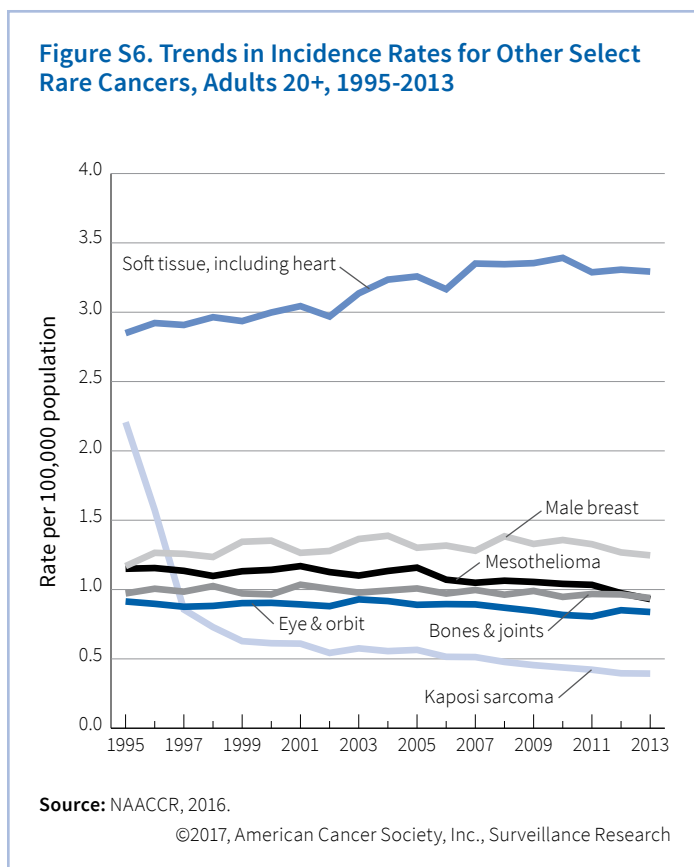
Soft tissue sarcomas are a diverse group of cancers, including those comprised of cells that resemble adipose (fat) tissue (liposarcoma), skeletal muscle (rhabdomyosarcoma), smooth muscle (leiomyosarcoma), and the linings of blood and lymph vessels (angiosarcoma). Soft tissue sarcoma can also affect more than one type of body tissue, or have no clear origin. There are more than 70 different types of soft tissue sarcoma. Most arise in the arms or legs, but they can be found in any part of the body, including the trunk, head and neck, internal organs, and in the area behind the abdominal cavity (retroperitoneum). The rarity and variety of this cancer make it very difficult to study. Little is known about what causes soft tissue sarcomas, but similar to bone cancer, radiation and certain inherited conditions (neurofibromatosis, Gardner syndrome, and Li-Fraumeni syndrome) are associated with increased risk.³⁵ Overall incidence rates for soft tissue sarcomas are highest in blacks and lowest in Asians/Pacific Islanders (Table S2, page 34). Incidence rates for soft tissue cancers increased 1.3% per year from 1995 to 2009, and subsequently leveled off (Figure S6). Death rates increased slightly (0.5% per year) from 2001 to 2014. Soft tissue sarcomas often begin as a painless lump, sometimes facilitating early diagnosis; 58% are diagnosed at a localized stage. The prognosis of soft tissue sarcoma varies widely by subtype. Overall 5-year relative survival is 64%, but increases to 80% when cancers are diagnosed at a local stage.

Eye and orbit

Most cancers of the eye and orbit are ocular melanomas. (Lymphoma can occur in the eye, but these are classified as lymphomas). Similar to melanoma of the skin, the risk of ocular melanoma is highest in whites, particularly those with fair skin and light eyes. However, it is not clear if exposure to sunlight or ultraviolet light increases risk.^{36,37} Incidence rates for eye and orbit cancer have been relatively stable, whereas death rates declined sharply (2.8% per year) from 1990 to 2004, and subsequently leveled off. Symptoms of eye and orbit cancers include changes in vision or in the shape of the eye, which may be discovered during an ophthalmologic exam. Nearly three-quarters of eye and orbit cancers are diagnosed at a localized stage (Figure S2, page 32), for which the 5-year relative survival rate is 85%.

Male breast

Although breast cancer is commonly thought of as a woman's disease, it also occurs in men. Obesity, gynecomastia (swelling of breast tissue caused by a hormone imbalance), diabetes, and Klinefelter syndrome are independent risk factors for male breast cancer.³⁸



Radiation exposure, *BRCA1/2* gene mutations, and a family history of male or female breast cancer are also associated with increased risk.³⁹ The highest rates of male breast cancer are in black (2.7 per 100,000) and white (1.9 per 100,000) men (Table S2, page 34). Male breast cancer rates were stable from 1995 to 2013, while death rates decreased by 1.2% per year since 1993. A lump in the breast is usually the first sign of breast cancer in men. Breast cancers in men are more likely than those in women to be diagnosed at an advanced stage, in part because men are not screened for breast cancer and because of lack of awareness. Breast cancer survival in males and females is similar for each stage at diagnosis. However, because men are more likely to be diagnosed with advanced disease, the overall 5-year survival in men is 84%, compared to 90% in women.

Mesothelioma

Mesothelioma is named for mesothelial cells, which line certain body cavities and from which the cancer arises. Most cases (81%) occur in the pleura (the lining of the lungs and chest cavity) or the peritoneum (the lining of the abdomen) (9%). The main risk factor for mesothelioma is asbestos exposure, particularly in the workplace.⁴⁰ Government safety regulations and new workplace practices have reduced the risk for some workers. Other environmental exposures, including some naturally occurring mineral fibers, are also thought to contribute to the occurrence of mesothelioma, particularly those in the peritoneum.⁴¹ Rates of mesothelioma are four times higher in men than in women, reflecting occupational exposures. Incidence rates are twice as high in non-Hispanic whites (1.5 per 100,000) as in blacks (0.7 per 100,000) (Table S2, page 34). Mesothelioma incidence rates increased until the mid-1990s, remained level for several years, and began to decline in 2005 (Figure S6). From 2005 to 2013, incidence rates remained stable in women, while declining (2.6% per year) in men, reflecting the reduction in workplace exposure to asbestos. Similarly, mesothelioma death rates declined in men (1.5% per year from 1999-2014), but were stable in women. Symptoms of mesothelioma can include shortness of breath, wheezing or hoarseness, a persistent cough, and pain in the chest or lower back. People who have been exposed to asbestos should be familiar with these symptoms and seek care if

they occur. There is usually a delay of 20 to 50 years between exposure to asbestos and a mesothelioma diagnosis. Five-year relative survival for mesothelioma is only 10% because the disease is often diagnosed at an advanced stage and it is difficult to treat.

Kaposi sarcoma (KS)

There are 4 types of Kaposi sarcoma. Classic KS occurs primarily in older people of Mediterranean or Jewish descent; endemic KS occurs in people living in Equatorial Africa, often in those younger than 40; iatrogenic KS, which is associated with immune suppression drug therapy given to transplant recipients; and AIDS-related KS, also called epidemic Kaposi sarcoma. KS is caused by infection with KS-associated herpesvirus, and most cases in the US occur in people with AIDS.⁴² Combined antiretroviral therapy reduces the risk of both AIDS and KS in people infected with HIV. KS rates in the US are nearly 10 times higher in men than women and are higher for blacks and Hispanics than other groups (Table S2, page 34), reflecting sex and racial/ethnic differences in rates of HIV infection.⁴³ Rates for KS peaked in the early 1990s, corresponding to the peak of the AIDS epidemic in the US, and since have been declining rapidly (Figure S6, page 37). From 1998 to 2013, incidence rates declined by 3.4% per year. Skin lesions (which may be purple, red, or brown) are typically the first signs of KS. Lesions can also appear on mucous membranes, such as the linings of the mouth or throat, or in other parts of the body, such as the lungs, stomach, or intestines. People with HIV should be examined regularly by a health care provider experienced with recognizing KS and other HIV-related diseases. People with KS often die from other AIDS-related diseases; 5-year relative survival for KS is 73%.

Conclusion

In this report we have provided an overview of the burden of rare cancers in US adults. Approximately 208,000 rare cancers will be diagnosed in adults in 2017, not to mention those diagnosed with a rare subtype of a more common cancer. In large part because of historically limited attention and investment, much less is known about this diverse group of cancers. In recent years, national and international collaborations have formed to address some of the challenges associated with rare diseases. In Europe, the

RARECARE project was initiated to define the burden of rare cancers, and subsequently transitioned to RARECAREnet to increase awareness, provide information, and improve outcomes for rare cancers. In the US, in 2013, the National Cancer Institute launched the Rare Tumors Initiative, a collaboration of scientists, advocates, and industry experts with the goal of advancing research and treatment for rare cancers. In addition, one of the goals of the 2014 transformation of the National Cancer Institute's clinical trial program (National Clinical Trials Network) is to improve the care of patients with rare and molecularly defined cancers. Continued efforts are needed to diagnose rare cancers earlier and improve survival. Discoveries for rare cancers can further knowledge for all cancers.

References

1. Komatsubara KM, Carvajal RD. The promise and challenges of rare cancer research. *Lancet Oncol.* 2016;17: 136-138.
2. Gatta G, van der Zwan JM, Casali PG, et al. Rare cancers are not so rare: the rare cancer burden in Europe. *Eur J Cancer.* 2011;47: 2493-2511.
3. Surveillance, Epidemiology and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: NAACCR Incidence – CiNA Analytic File, 1995-2013, Custom File With County, North American Association of Central Cancer Registries.
4. Aparicio T, Zaanani A, Svrcek M, et al. Small bowel adenocarcinoma: epidemiology, risk factors, diagnosis and treatment. *Dig Liver Dis.* 2014;46: 97-104.
5. Schottenfeld D, Beebe-Dimmer JL, Vigneaun FD. The epidemiology and pathogenesis of neoplasia in the small intestine. *Ann Epidemiol.* 2009;19: 58-69.
6. Lu Y, Cross AJ, Murphy N, et al. Comparison of abdominal adiposity and overall obesity in relation to risk of small intestinal cancer in a European Prospective Cohort. *Cancer Causes Control.* 2016;27: 919-927.
7. Bennett CM, Coleman HG, Veal PG, Cantwell MM, Lau CC, Murray LJ. Lifestyle factors and small intestine adenocarcinoma risk: A systematic review and meta-analysis. *Cancer Epidemiol.* 2015;39: 265-273.
8. Viens LJ, Henley SJ, Watson M, et al. Human Papillomavirus-Associated Cancers – United States, 2008-2012. *MMWR Morb Mortal Wkly Rep.* 2016;65: 661-666.
9. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2017. *CA Cancer J Clin.* 2017.
10. Robbins HA, Shiels MS, Pfeiffer RM, Engels EA. Epidemiologic contributions to recent cancer trends among HIV-infected people in the United States. *AIDS.* 2014;28: 881-890.
11. Shiels MS, Pfeiffer RM, Chaturvedi AK, Kreimer AR, Engels EA. Impact of the HIV epidemic on the incidence rates of anal cancer in the United States. *J Natl Cancer Inst.* 2012;104: 1591-1598.
12. Tan W, Gao M, Liu N, Zhang G, Xu T, Cui W. Body Mass Index and Risk of Gallbladder Cancer: Systematic Review and Meta-Analysis of Observational Studies. *Nutrients.* 2015;7: 8321-8334.
13. Wistuba II, Gazdar AF. Gallbladder cancer: lessons from a rare tumour. *Nat Rev Cancer.* 2004;4: 695-706.

14. Bhaskaran K, Douglas I, Forbes H, dos-Santos-Silva I, Leon DA, Smeeth L. Body-mass index and risk of 22 specific cancers: a population-based cohort study of 5.24 million UK adults. *Lancet*. 2014;384: 755-765.
15. Henley SJ, Weir HK, Jim MA, Watson M, Richardson LC. Gallbladder Cancer Incidence and Mortality, United States 1999-2011. *Cancer Epidemiol Biomarkers Prev*. 2015;24: 1319-1326.
16. Hashibe M, Brennan P, Chuang SC, et al. Interaction between tobacco and alcohol use and the risk of head and neck cancer: pooled analysis in the International Head and Neck Cancer Epidemiology Consortium. *Cancer Epidemiol Biomarkers Prev*. 2009;18: 541-550.
17. Siegel RL, Jacobs EJ, Newton CC, et al. Deaths due to cigarette smoking for 12 smoking-related cancers in the United States. *JAMA Intern Med*. 2015;175: 1574-1576.
18. Hernandez BY, Goodman MT, Lynch CF, et al. Human papillomavirus prevalence in invasive laryngeal cancer in the United States. *PLoS One*. 2014;9: e115931.
19. Chang ET, Adami HO. The enigmatic epidemiology of nasopharyngeal carcinoma. *Cancer Epidemiol Biomarkers Prev*. 2006;15: 1765-1777.
20. Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. *CA Cancer J Clin*. 2015;65: 87-108.
21. Parkin DM. The global health burden of infection-associated cancers in the year 2002. *Int J Cancer*. 2006;118: 3030-3044.
22. Kelly JJ, Lanier AP, Schade T, Brantley J, Starkey BM. Cancer disparities among Alaska native people, 1970-2011. *Prev Chronic Dis*. 2014;11: E221.
23. Binazzi A, Ferrante P, Marinaccio A. Occupational exposure and sinonasal cancer: a systematic review and meta-analysis. *BMC Cancer*. 2015;15: 49.
24. Straif K, Benbrahim-Tallaa L, Baan R, et al. A review of human carcinogens—Part C: metals, arsenic, dusts, and fibres. *Lancet Oncol*. 2009;10: 453-454.
25. d'Errico A, Pasian S, Baratti A, et al. A case-control study on occupational risk factors for sino-nasal cancer. *Occup Environ Med*. 2009;66: 448-455.
26. Bishop JA, Guo TW, Smith DF, et al. Human papillomavirus-related carcinomas of the sinonasal tract. *Am J Surg Pathol*. 2013;37: 185-192.
27. Daling JR, Madeleine MM, Schwartz SM, et al. A population-based study of squamous cell vaginal cancer: HPV and cofactors. *Gynecol Oncol*. 2002;84: 263-270.
28. Madeleine MM, Daling JR, Carter JJ, et al. Cofactors with human papillomavirus in a population-based study of vulvar cancer. *J Natl Cancer Inst*. 1997;89: 1516-1523.
29. Hernandez BY, Goodman MT, Unger ER, et al. Human papillomavirus genotype prevalence in invasive penile cancers from a registry-based United States population. *Front Oncol*. 2014;4: 9.
30. Daling JR, Madeleine MM, Johnson LG, et al. Penile cancer: importance of circumcision, human papillomavirus and smoking in situ and invasive disease. *Int J Cancer*. 2005;116: 606-616.
31. McGlynn KA, Trabert B. Adolescent and adult risk factors for testicular cancer. *Nat Rev Urol*. 2012;9: 339-349.
32. Manecksha RP, Fitzpatrick JM. Epidemiology of testicular cancer. *BJU Int*. 2009;104: 1329-1333.
33. Miller RW, Boice JD, Curtis RE. Bone cancer. In: Schottenfeld D, Fraumeni JF, editors. *Cancer Epidemiology and Prevention, Third Edition*. New York, NY: Oxford University Press, 2006:946-958.
34. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence – SEER 18 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2015 Sub (1973-2013 varying) – Linked To County Attributes – Total U.S., 1969-2014 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2016, based on the November 2015 submission.
35. Burningham Z, Hashibe M, Spector L, Schiffman JD. The epidemiology of sarcoma. *Clin Sarcoma Res*. 2012;2: 14.
36. Weis E, Shah CP, Lajous M, Shields JA, Shields CL. The association between host susceptibility factors and uveal melanoma: a meta-analysis. *Arch Ophthalmol*. 2006;124: 54-60.
37. Shah CP, Weis E, Lajous M, Shields JA, Shields CL. Intermittent and chronic ultraviolet light exposure and uveal melanoma: a meta-analysis. *Ophthalmology*. 2005;112: 1599-1607.
38. Brinton LA, Cook MB, McCormack V, et al. Anthropometric and hormonal risk factors for male breast cancer: male breast cancer pooling project results. *J Natl Cancer Inst*. 2014;106: djt465.
39. Ruddy KJ, Winer EP. Male breast cancer: risk factors, biology, diagnosis, treatment, and survivorship. *Ann Oncol*. 2013;24: 1434-1443.
40. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Asbestos (chrysotile, amosite, crocidolite, tremolite, actinolite and anthophyllite). *A review of human carcinogens Part C: Arsenic, metals, fibres and dusts*. Lyon, France: International Agency for Research on Cancer, 2012.
41. Baumann F, Carbone M. Environmental risk of mesothelioma in the United States: An emerging concern-epidemiological issues. *J Toxicol Environ Health B Crit Rev*. 2016;19: 231-249.
42. Ablashi DV, Chatlynne LG, Whitman JE, Jr., Cesarman E. Spectrum of Kaposi's sarcoma-associated herpesvirus, or human herpesvirus 8, diseases. *Clin Microbiol Rev*. 2002;15: 439-464.
43. Hall HI, Song R, Rhodes P, et al. Estimation of HIV incidence in the United States. *JAMA*. 2008;300: 520-529.

Tobacco Use

Smoking remains the world's most preventable cause of death. Since the first US Surgeon General's report on smoking and health in 1964, smoking has caused more than 21 million premature deaths in the US alone. Each year, cigarette smoking results in an estimated 480,000 premature deaths, including 42,000 from secondhand smoke exposure.¹ Tobacco use also imposes substantial economic costs on society.² In 2012, smoking accounted for \$176 billion in health care-related costs in the US.¹

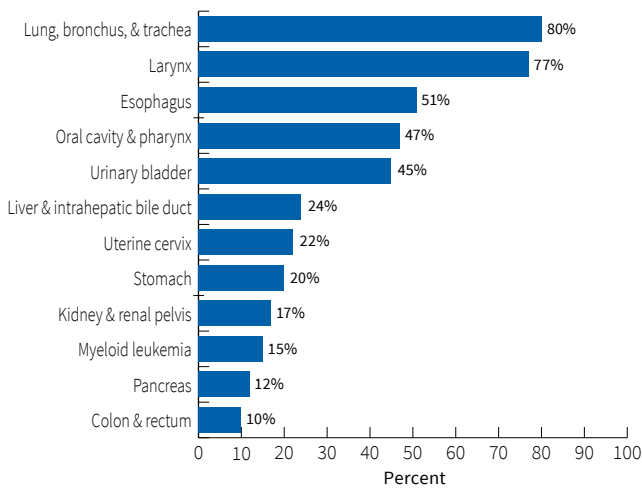
While there have been declines in cigarette smoking, use of other tobacco products, such as hookah (waterpipe) smoking and e-cigarettes, has increased, particularly among youth. For example, sales of pipe tobacco increased more than tenfold from 2008 (3.2 million pounds) to 2012 (36.5 million pounds).³ To address these trends and protect consumers, the Federal Drug Administration recently expanded its regulatory authority to include all tobacco products, including e-cigarettes, cigars, hookah and pipe tobacco, nicotine gels, and those not yet on the market. (See fda.gov/TobaccoProducts/default.htm for more information.)

Cigarette Smoking

Cigarette smoking increases the risk of cancers of the oral cavity and pharynx, larynx, lung, esophagus, pancreas, uterine cervix, kidney, bladder, stomach, colorectum, and liver, as well as acute myeloid leukemia (Figure 4).¹ In addition, the International Agency for Research on Cancer has concluded that there is some evidence that tobacco smoking causes female breast cancer, and the Surgeon General concluded that smoking increases the risk of advanced-stage prostate cancer.^{1,4} Excluding secondhand smoke, cigarette smoking is estimated to cause 32% of all cancer deaths in the US.⁵ However, in many Southern states, smoking causes as much as 40% of all cancer deaths in men.⁶

- The prevalence of current cigarette smoking among adults 18 years of age and older has declined by more than half, from 42% in 1965 to 15% in 2015, although reductions vary across population subgroups.^{7,8}
- Approximately 36.5 million adults (18 years of age and older) were current smokers in 2015,⁷ about 4.9 million fewer than in 2004.⁹
- Between 2004 and 2015, the proportion of daily smokers reporting light or intermittent smoking (fewer than 10 cigarettes per day) increased from 17% to 25%, whereas heavy smoking (30 or more cigarettes per day) declined from 13% to 7%.^{7,9}
- Although uptake of smoking began earlier in men than in women, the gender gap, particularly among non-Hispanic whites, has narrowed. As of 2015, there was a 1 percentage point difference in smoking prevalence between white men (18%) and women (17%), a 6 percentage point difference between Hispanic men (13%) and women (7%), a 7 percentage point difference between non-Hispanic black men (21%) and women (14%), and a 9 percentage point difference between Asian men (12%) and women (3%).⁷
- Smoking is most common, and has declined more slowly, among those with the least education. In 2015, smoking prevalence was 26% among adults 25 years of age and older with less than a high school diploma and 4% among those with graduate degrees. Adults with a GED (General Educational Development), or high school equivalency credential, are the most likely to smoke (34%).⁷
- Among US states in 2015, the prevalence of adult smoking ranged from 9% in Utah to 26% in West Virginia and Kentucky.¹⁰
- Current cigarette smoking among US high school students (at least once in the past 30 days) decreased from 29% in 1999 to 9% in 2015.^{11,12}
- In contrast to declines in cigarette smoking among teens, current use of hookahs in this age group has increased dramatically, from 4% in 2011 to 7% in 2015, and is now as common as smoking.¹¹

Figure 4. Proportion of Cancer Deaths Attributable to Cigarette Smoking in Adults 35 Years and Older, US, 2011



Adapted from Siegel RL, Jacobs EJ, Newton CC, et al. *JAMA Intern Med.* 2015 Sep;175(9):1574-6.

Cigar Smoking

Cigar smoking causes many of the same diseases as cigarette smoking. Regular cigar smoking is associated with an increased risk of cancers of the lung, oral cavity, larynx, and esophagus, and cigar smokers have 4 to 10 times the risk of dying from these cancers compared to never smokers.^{13,14,15} The three main types of cigars in the US are large cigars, cigarillos, and small cigars, which resemble cigarettes, but are taxed differently. Lower tax rates on cigars have caused some cost-conscious smokers to switch from cigarettes to cigars.¹⁶

- While cigarette consumption declined by nearly 40% from 2000 to 2015, cigar consumption increased by 92%.¹⁷
- According to the 2015 National Health Interview Survey, 3% of adults (6% of men and 1% of women) reported smoking cigars every day or some days.⁷
- Cigar use was highest among non-Hispanic blacks (5%).⁷
- In 2015, 9% of US high school students had smoked cigars at least once in the past 30 days, down from 15% in 1999.^{11,12}

Secondhand Smoke

There is no safe level of exposure to secondhand smoke (SHS), or environmental tobacco smoke, which contains more than 7,000 chemicals, at least 69 of which cause cancer.¹⁸ Nonsmokers who are exposed to SHS are at increased risk of lung diseases (including cancer), coronary artery disease, heart attacks, coughing, wheezing, chest tightness, and reduced lung function.¹⁹⁻²² Laws that prohibit smoking in public places and create smoke-free environments are the most effective approach to prevent exposure to and harm from SHS. In addition, there is strong evidence that smoke-free policies decrease the prevalence of both adult and youth smoking.^{21,23} Momentum to regulate public smoking began to increase in 1990, and smoke-free laws have become increasingly common and comprehensive over time.

- Each year, about 7,000 nonsmoking adults die of lung cancer as a result of breathing SHS.¹
- Nationwide, SHS exposure among nonsmokers declined from 84% in 1988-1994²⁴ to 25% in 2011-2012,²⁵ likely reflecting widespread implementation of smoke-free laws and reduction in smoking prevalence. However, this progress differs by subgroup, and poor individuals remain substantially more likely to be exposed than those who are more affluent.
- In the US, as of July 1, 2016, 822 municipalities and 25 states, the District of Columbia, Puerto Rico, and the US Virgin Islands have comprehensive laws in place requiring all non-hospitality workplaces, restaurants, and bars to be smoke-free.²⁶
- Currently, 49% of the US population is covered by comprehensive smoke-free laws that do not permit smoking in workplaces, restaurants, and bars.²⁶

E-cigarettes

Electronic nicotine delivery systems (ENDS), or e-cigarettes, are battery-operated devices introduced in the US market around 2007 that allow the user to inhale aerosol produced from cartridges or tanks filled with a liquid typically containing nicotine, propylene glycol and/or vegetable glycerin, other chemicals, and sometimes flavoring. Some studies have shown lower

levels of toxic chemicals in aerosol from e-cigarette products than in smoke from combustible cigarettes,²⁷ and e-cigarettes are promoted as a less harmful alternative to traditional cigarettes and a way to bypass smoke-free laws. However, the long-term health risks of using these products, or being exposed to them secondhand, are unknown and likely vary depending on the specific e-cigarette product and how it is used.

E-cigarette use has skyrocketed in the US and Europe,^{28,29} and there is growing concern that it will normalize cigarette smoking and lead to the use of other tobacco products with known health risks. Indeed, studies show that adolescent e-cigarette users are two to four times more likely than nonusers to initiate combustible (cigarette, cigar, or hookah) tobacco use.^{30,31} These products may also discourage smokers who want to quit from using evidence-based cessation therapies.

- In 2015, 4% of adults reported current (every day or some days) e-cigarette use.⁷
- The prevalence of adults who have ever tried e-cigarettes tripled from 3% in 2010 to 14% in 2015.^{7,29}
- Among high school students, e-cigarette use (at least once in the past 30 days) increased from 2% in 2011 to 16% in 2015, surpassing cigarette smoking.¹¹
- E-cigarette use among teens is more common in non-Hispanic whites (17%) and Hispanics (16%) than in blacks (9%).¹¹

Smokeless Tobacco Products

Smokeless tobacco products include moist snuff, chewing tobacco, snus (a “spitless,” moist powder tobacco pouch), dissolvable nicotine products, and a variety of other tobacco-containing products that are not smoked. These products cause oral, esophageal, and pancreatic cancers; precancerous lesions of the mouth; gum recession; bone loss around the teeth; and tooth staining.³² They can also lead to nicotine addiction. Switching from smoking to using smokeless tobacco products has been shown to result in a higher risk of tobacco-related death than completely stopping the use of all tobacco products.³³

Recently, the smokeless market in high-income countries, including the US, has been consolidated from smaller tobacco companies into the control of tobacco multinational corporations. In the US, sales of smokeless tobacco products are growing at a more rapid pace than those of cigarettes. As part of their marketing strategy, the industry is actively promoting these products both for use in settings where smoking is prohibited and as a way to quit smoking. However, there is no evidence to date that these products are as effective as proven cessation therapies for quitting. When smokeless tobacco was aggressively marketed in the US in the 1970s and 1980s, use of these products increased among adolescent males, but not among older smokers trying to quit. Using any smokeless tobacco product is not a safe substitute for quitting.

- Sales of moist snuff have increased by 52% from 68.6 million pounds in 2002 to 104.4 million pounds in 2012.³
- According to the 2015 National Health Interview Survey (NHIS), 2% of adults 18 years of age and older (5% of men and <1% of women) currently (every day or some days) used smokeless tobacco products.⁷
- In 2015, whites were more likely to use smokeless tobacco than non-Hispanic blacks, or Hispanics.⁷
- Current adult smokeless tobacco use varied from 1.6% in California to 9.3% in West Virginia in 2015.¹⁰
- According to the 2015 National Youth Tobacco Survey, 10% of high school boys and 2% of girls used smokeless tobacco in the past 30 days.¹¹

Smoking Cessation

Smokers who quit, regardless of age, increase their longevity, with those who quit before middle age generally experiencing a lifespan similar to never smokers.³⁴ Smoking cessation reduces the risk of lung and other cancers caused by smoking. In addition, cancer survivors who quit smoking have better health outcomes than those who do not.¹

- According to the 2015 NHIS, 59% (52.8 million) of the 89.3 million Americans who ever smoked at least 100 cigarettes are now former smokers.⁷
- In 2015, 49% of current smokers attempted to quit for at least one day in the past year.⁷
- Although effective cessation treatments can double or triple a smoker's chances of long-term abstinence, only 32% of people who try to quit used counseling or medication. Use of smoking cessation aids is particularly low among less educated smokers.³⁵
- Less educated smokers are also less likely to succeed in quitting than smokers with an undergraduate or graduate degree.³⁶
- In 2015, of the 11% of high school students who were current cigarette smokers, 45% had tried to quit during the 12 months preceding the survey, down from 57% in 2001.³⁷

Reducing Tobacco Use and Exposure

There are federal, state, and local initiatives aimed at reducing tobacco exposure. While states have been at the forefront of tobacco control efforts, the importance of the federal government's role was emphasized in a 2007 Institute of Medicine Report.³⁸ Federal initiatives in tobacco control hold promise for reducing tobacco use, and include regulation of tobacco products, national legislation ensuring coverage of some clinical cessation services, and tax increases. The Family Smoking Prevention and Tobacco Control Act of 2009 granted the US Food and Drug Administration (FDA) the authority to regulate the manufacturing, selling, and marketing of tobacco products. Key provisions that have already gone into effect include the prohibition of misleading descriptors, such as light, low, and mild, on tobacco product labels and fruit and candy cigarette flavorings. Provisions in the 2010 Affordable Care Act ensure at least minimum coverage of evidence-based cessation treatments, including pharmacotherapy and cessation counseling, to previously uninsured tobacco users, pregnant Medicaid recipients, and eligible Medicare recipients. Furthermore, cost-sharing for evidence-based cessation treatments was eliminated for new or renewed private health plans and Medicare recipients.

In 2000, the US Surgeon General outlined the goals and components of comprehensive statewide tobacco control programs.³⁹ These programs seek to prevent the initiation of tobacco use among youth, promote quitting at all ages, eliminate nonsmokers' exposure to SHS, and identify and eliminate the disparities related to tobacco use and its effects among different population groups. The Centers for Disease Control and Prevention (CDC) recommends funding levels for comprehensive tobacco use prevention and cessation programs for all 50 states and the District of Columbia. In fiscal year 2017, states averaged 15% of CDC-recommended funding levels for tobacco control programs, ranging from < 1% in Connecticut and New Jersey to 93% in Alaska and 101% in North Dakota.⁴⁰ States that have previously invested in comprehensive tobacco control programs, such as California, Massachusetts, and Florida, have reduced smoking rates and saved millions of dollars in tobacco-related health care costs.³⁹ Some states have gone beyond established policies. Hawaii was the first state to enact legislation increasing the purchase age for tobacco products from 18 to 21 years of age as of January 2016. California recently went beyond raising the smoking age by also prohibiting e-cigarette use (vaping) in many public places and banning the marketing of e-cigarettes to children. Similar legislation is pending in several other states. For more information about tobacco control, visit cancer.org/statistics to view the most recent edition of *Cancer Prevention & Early Detection Facts & Figures*.

Conclusion

Substantial progress has been made in reducing the disease burden from tobacco over the 53 years since the first report of the Surgeon General's Advisory Committee on Smoking and Health in 1964. Smoking prevalence has been reduced by more than half and millions of premature deaths have been averted. Nevertheless, more needs to be done to further reduce the health and economic burden of tobacco. Numerous studies confirm that a comprehensive approach to tobacco control, including higher taxes, 100% smoke-free environments, coverage for tobacco dependence treatment, plain cigarette packaging, and vigorous tobacco counteradvertising, can be successful in reducing deaths, disease, and economic disruption from tobacco use.

References

1. US Department of Health and Human Services. *The Health Consequences of Smoking-50 Years of Progress. A Report from the Surgeon General*. Atlanta, GA; USA: Department of Health and Human Services. Center for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion;2014.
2. Centers for Disease Control and Prevention. Smoking-attributable mortality, years of potential life lost, and productivity losses – United States, 2000-2004. *MMWR Morb Mortal Wkly Rep*. 2008;57(45):1226-1228.
3. Agaku IT, Alpert HR. Trends in annual sales and current use of cigarettes, cigars, roll-your-own tobacco, pipes, and smokeless tobacco among US adults, 2002-2012. *Tob Control*. Jul 2016;25(4):451-457.
4. Secretan B, Straif K, Baan R, et al. A review of human carcinogens–Part E: tobacco, areca nut, alcohol, coal smoke, and salted fish. *Lancet Oncol*. 2009 10:1033-1034.
5. Jacobs EJ, Newton CC, Carter BD, et al. What proportion of cancer deaths in the contemporary United States is attributable to cigarette smoking? *Ann Epidemiol*. Mar 2015;25(3):179-182 e171.
6. Lortet-Tieulent J, Goding Sauer A, Siegel RL, Miller KD, Islami F, Fedewa SA, Jacobs EJ, Jemal A. State-level cancer mortality attributable to cigarette smoking in the United States. *JAMA Intern Med*. 2016;176(12):1-8. Online October 24, 2016.
7. National Center for Health Statistics. National Health Interview Survey, 2015. Public-use data file and documentation. 2015; http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm. Accessed July 16, 2016.
8. National Center for Health Statistics. *Health, United States, 2015: With a Special Feature on Racial and Ethnic Disparities*. Hyattsville, MD. 2015.
9. National Center for Health Statistics. National Health Interview Survey, 2004. Public-use data file and documentation. 2004; http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm. Accessed Aug 15, 2005.
10. Center for Disease Control and Prevention. Behavioral Risk Factor Surveillance System Survey Data and Documentation. 2015; http://www.cdc.gov/brfss/data_documentation/index.htm.
11. Singh T, Arrazola RA, Corey CG, et al. Tobacco Use Among Middle and High School Students – United States, 2011-2015. *MMWR Morb Mortal Wkly Rep*. 2016;65(14):361-367.
12. Centers for Disease Control and Prevention. Youth tobacco surveillance–United States, 1998-1999. *MMWR CDC Surveill Summ*. 2000;49(10):1-94.
13. Baker F, Ainsworth SR, Dye JT, et al. Health risks associated with cigar smoking. *JAMA*. Aug 9 2000;284(6):735-740.
14. Shanks TG, Burns DM. Disease consequences of cigar smoking. *National Cancer Institute, Smoking and Tobacco Control, Monograph 9: Cigars- Health Effects and Trends*. Washington, DC: National Institutes of Health; 1998.
15. Shapiro JA, Jacobs EJ, Thun MJ. Cigar smoking in men and risk of death from tobacco-related cancers. *J Natl Cancer Inst*. Feb 16 2000;92(4):333-337.
16. Gammon DG, Loomis BR, Dench DL, King BA, Fulmer EB, Rogers T. Effect of price changes in little cigars and cigarettes on little cigar sales: USA, Q4 2011-Q4 2013. *Tob Control*. Sep 10 2015.
17. Boonn A, Campaign for Tobacco-Free Kids. The Rise of Cigars and Cigar-Smoking Harms. 2016. Accessed August 11, 2016. tobaccofreekids.org/research/factsheets/pdf/0333.pdf.
18. US Department of Health and Human Services. *How Tobacco Causes Disease – The Biology and Behavioral Basis for Smoking-Attributable Disease*. Rockville, MD: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health;2010.
19. International Agency for Research on Cancer. *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 83: Tobacco smoke and Involuntary Smoking*. Lyon, France: IARC;2004.
20. US Department of Health and Human Services. *The Health Consequences of Involuntary Exposure to Tobacco Smoke. A Report from the Surgeon General*. Washington, DC: US Department of Health and Human Services, Centers for Disease Control and Prevention and Health Promotion, Office of Smoking and Health;2006.
21. Institute of Medicine. *Secondhand Smoke Exposure and Cardiovascular Effects: Making Sense of the Evidence*. Washington, DC: IOM;2009.
22. Centers for Disease Control and Prevention. Vital Signs: Nonsmokers' Exposure to Secondhand Smoke – United States, 1999-2008. *MMWR Morb Mortal Wkly Rep*. 2010;59(35):1141-1146.
23. International Agency for Research on Cancer. *IARC Handbooks of Cancer Prevention. Volume 13: Evaluating the Effectiveness of Smoke-free Policies*. Lyon, France: IARC Press; 2009.
24. Centers for Disease Control and Prevention. Disparities in secondhand smoke exposure – United States, 1988-1994 and 1999-2004. *MMWR Morb Mortal Wkly Rep*. Jul 11 2008;57(27):744-747.
25. Homa DM, Neff LJ, King BA, et al. Vital signs: disparities in nonsmokers' exposure to secondhand smoke – United States, 1999-2012. *MMWR Morb Mortal Wkly Rep*. Feb 6 2015;64(4):103-108.
26. American Cancer Society Cancer Action Network. *How Do You Measure Up? A Progress Report on State Legislative Activity to Reduce Cancer Incidence and Mortality*. August 2015 2016.
27. Goniewicz ML, Knysak J, Gawron M, et al. Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. *Tob Control*. Mar 2014;23(2):133-139.
28. Filippidis FT, Laverty AA, Gerovasili V, Vardavas CI. Two-year trends and predictors of e-cigarette use in 27 European Union member states. *Tob Control*. May 24 2016.
29. King BA, Patel R, Nguyen KH, Dube SR. Trends in awareness and use of electronic cigarettes among US adults, 2010-2013. *Nicotine Tob Res*. Feb 2015;17(2):219-227.
30. Leventhal AM, Strong DR, Kirkpatrick MG, et al. Association of Electronic Cigarette Use With Initiation of Combustible Tobacco Product Smoking in Early Adolescence. *JAMA*. Aug 18 2015;314(7):700-707.
31. Cardenas VM, Evans VL, Balamurugan A, Faramawi MF, Delongchamp RR, Wheeler JG. Use of electronic nicotine delivery systems and recent initiation of smoking among US youth. *Int J Public Health*. Mar 2016;61(2):237-241.
32. Boffetta P, Hecht S, Gray N, Gupta P, Straif K. Smokeless tobacco and cancer. *Lancet Oncol*. 2008;9(7):667-675.
33. Henley SJ, Connell CJ, Richter P, et al. Tobacco-related disease mortality among men who switched from cigarettes to spit tobacco. *Tob Control*. Feb 2007;16(1):22-28.

34. Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observation on male British doctors. *BMJ*. 2004;328:1519-1527.

35. Centers for Disease Control and Prevention. Quitting smoking among adults – United States, 2001-2010. *MMWR Morb Mortal Wkly Rep*. Nov 11 2011;60(44):1513-1519.

36. Zhuang YL, Gamst AC, Cummins SE, Wolfson T, Zhu SH. Comparison of smoking cessation between education groups: findings from 2 US National Surveys over 2 decades. *Am J Public Health*. Feb 2015;105(2):373-379.

37. Centers for Disease Control and Prevention (CDC). 1991-2015 High School Youth Risk Behavior Survey Data. Available at <http://nccd.cdc.gov/youthonline/>. Accessed on September 9, 2016.

38. Institute of Medicine. *Ending the Tobacco Problem: A Blueprint for the Nation*. Washington, D.C.2007.

39. US Department of Health and Human Services. *Reducing Tobacco Use: A Report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health;2000.

40. Campaign for Tobacco-Free Kids. Broken Promises to Our Children. 2016. Available at www.tobaccofreekids.org/research/factsheets.

Nutrition & Physical Activity

The World Cancer Research Fund estimates that about 20% of cancers that occur in the US are due to the combined effects of excess alcohol consumption, poor nutrition, physical inactivity, and excess weight, and thus could be prevented.¹ Thus, for the 85% of adults who don't smoke, maintaining a healthy body weight, being physically active on a regular basis, eating a healthy diet, and limiting alcohol consumption are the most important ways to reduce cancer risk. In fact, studies estimate that adults who most closely follow these healthy lifestyle recommendations are 10%-20% less likely to be diagnosed with cancer and 20%-30% less likely to die from the disease.² The American Cancer Society's nutrition and physical activity guidelines emphasize the importance of weight control, physical activity, healthy dietary patterns, and limited, if any, alcohol consumption in reducing cancer risk and helping people stay well. Unfortunately, the majority of Americans are not meeting these recommendations.³ The Society's guidelines also include recommendations for community action because of the substantial influence of physical and social environments on individual food and activity choices.

The following recommendations reflect the best nutrition and physical activity evidence available to help Americans reduce their risk of cancer and promote overall health. See *Cancer Prevention & Early Detection Facts & Figures* at cancer.org/statistics for more detailed information on how nutrition, physical activity, and body weight affect cancer risk.

Recommendations for Individual Choices

Achieve and maintain a healthy weight throughout life.

- Be as lean as possible throughout life without being underweight.
- Avoid excess weight gain at all ages. For those who are currently overweight or obese, losing even a small amount of weight has health benefits and is a good place to start.
- Engage in regular physical activity and limit consumption of high-calorie foods and beverages as key strategies for maintaining a healthy weight.

A recent review conducted by scientists on behalf of the International Agency for Research on Cancer found that there is sufficient evidence to conclude that being overweight or obese increases the risk of developing 13 cancers: uterine corpus, esophagus (adenocarcinoma), liver, stomach (gastric cardia), kidney (renal cell), brain (meningioma), multiple myeloma, pancreas, colorectum, gallbladder, ovary, breast (postmenopausal), and thyroid.⁴ There is also limited evidence that excess body fatness is associated with an increased risk of non-Hodgkin lymphoma (diffuse large B-cell lymphoma), male breast cancer, and fatal prostate cancer. Accumulating evidence suggests that obesity also increases the risk of cancer recurrence and decreases survival for several cancers.^{5,6}

Some studies have shown that intentional weight loss is associated with decreased cancer risk among women, but the evidence is less clear for men.⁷

The prevalence of obesity among US adults 20-74 years of age has more than doubled, from 15% during 1976-1980 to 38% during 2013-2014.^{8,9} More women are currently obese than men, 40% versus 35%, with the highest rates among Hispanic women (47%) and non-Hispanic black women (57%). Obesity rates in women continue to rise, while they appear to have stabilized in recent years in men.⁹

Obesity among children and adolescents has risen in parallel to that among adults across race, ethnicity, and gender. In 2011-2014, 17% of American children 2 to 19 years of age were obese, including 20% of blacks, 22% of Hispanics, 15% of non-Hispanic whites, and 9% of Asians.¹⁰ The proportion of children with unhealthy body weight increases with age, with obesity prevalence of 9% in ages 2-5 years; 18% in ages 6-11 years; and 21% in ages 12-19 years in 2013-2014. Obesity among children and adolescents appears to have plateaued over the past decade, particularly among ages 2-11 years, with moderate declines reported among children 2 to 5 years of age.¹⁰ Efforts to establish healthy body weight are especially important during childhood because excess weight in youth tends to continue throughout life.

The high prevalence of obesity in children and adolescents may impact the future cancer burden because of longer cumulative exposure to excess body fat.¹¹ More than likely, the obesity epidemic is already impacting cancer rates. For example, rising uterine corpus cancer incidence rates probably partly reflect the increasing prevalence of obesity.¹² Additionally, some researchers have speculated that longstanding increases in life expectancy in the US may level off or even decline within the first half of this century as a result of the obesity epidemic. Indeed, a slowing in the decline in death rates for obesity-related diseases was recently reported.¹³

Adopt a physically active lifestyle.

- Adults should engage in at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity activity each week, or an equivalent combination, preferably spread throughout the week.
- Children and adolescents should engage in at least 1 hour of moderate- or vigorous-intensity activity each day, with vigorous-intensity activity at least three days each week.
- Limit sedentary behavior such as sitting, lying down, and watching television and other forms of screen-based entertainment.
- Doing any intentional physical activity above usual activities can have many health benefits.

Living a physically active lifestyle helps reduce the risk of a variety of cancer types, as well as heart disease, diabetes, and many other diseases. Scientific evidence indicates that leisure-time physical activity reduces the risk of 13 cancers, including lung, liver, kidney, colorectal, and esophageal (adenocarcinoma).¹⁴ Physical activity also indirectly reduces the risk of developing obesity-related cancers because of its role in helping to maintain a healthy weight. High levels of moderate-intensity activity (60-75 minutes per day) have even been shown to offset the increased risk of death associated with prolonged sitting, which has become increasingly common in the workplace.¹⁵ Being active is thought to reduce cancer risk largely by improving energy metabolism and reducing circulating concentrations of estrogen, insulin, and insulin-like growth factors. Physical activity also improves the quality of life of cancer patients and has been associated with reduced cancer recurrence and overall mortality.

Despite the wide variety of health benefits from being active, in 2015 30% of adults reported no leisure-time activity, and only 50% met recommended levels of aerobic activity.¹⁶ Similarly, only 27% of high school students met recommendations in 2015.¹⁷ However, recent data released by the CDC indicate that trends may be slightly improving. The proportion of adults meeting recommended aerobic and muscle-strengthening guidelines increased from 14% in 1998 to 22% in 2015, although this has stayed flat in recent years.¹⁶

Consume a healthy diet, with an emphasis on plant foods.

- Choose foods and beverages in amounts that help achieve and maintain a healthy weight.
- Limit consumption of red and processed meat.
- Eat at least 2½ cups of vegetables and fruits each day.
- Choose whole grains instead of refined-grain products.

There is strong scientific evidence that healthy dietary patterns, in combination with regular physical activity, are needed to maintain a healthy body weight and to reduce cancer risk. Studies have shown that individuals who eat more processed and red meat, potatoes, refined grains, and sugar-sweetened beverages and foods are at a higher risk of developing or dying from a variety of cancers. In fact, processed meat consumption was recently classified as a human carcinogen, and red meat consumption as a probable carcinogen, by the International Agency for Research on Cancer based on the evidence of their association with increased colorectal cancer risk.¹⁸ Adhering to a diet that contains a variety of fruits and vegetables, whole grains, and fish or poultry and fewer red and processed meats is associated with reduced cancer risk. A recent review of the evidence found that people who have the healthiest diet have an 11% to 24% lower risk of cancer death than those with the least healthy diet.¹⁹ Despite the known benefits of a healthy diet, Americans are not following recommendations; according to the US Department of Agriculture, the majority of Americans would need to substantially lower their intake of added sugars, added fats, refined grains, and sodium, and increase their consumption of fruits, vegetables, whole grains, and low-fat dairy products in order to meet the US Departments of Health and Human Services and Agriculture's 2015-2020 Dietary Guidelines for Americans (health.gov/dietaryguidelines/2015/guidelines/).

The scientific study of nutrition and cancer is challenging, largely because eating patterns are complex and difficult to assess.²⁰ While the evaluation of dietary patterns instead of individual food items is a promising new strategy for better understanding the relationship between diet and cancer, many important questions

remain unanswered. For example, it is not presently clear how single nutrients, combinations of nutrients, and over-nutrition at particular stages of life influence cancer risk. Until more is known, the best advice is to consume a mostly plant-based diet that limits red and processed meats and emphasizes a variety of vegetables, fruits, and whole grains. A special emphasis should be placed on controlling total caloric intake to help achieve and maintain a healthy weight.

If you drink alcoholic beverages, limit consumption.

People who drink alcohol should limit their intake to no more than two drinks per day for men and one drink per day for women. Alcohol consumption is a risk factor for cancers of the mouth, pharynx, larynx, esophagus, liver, colorectum, and female breast,¹ and heavy drinking (3 to 4 drinks daily) may also increase risk of stomach and pancreatic cancer.²¹ Cancer risk increases with alcohol volume, and even a few drinks per week may be associated with a slightly increased risk of female breast cancer.²² Alcohol consumption combined with tobacco use increases the risk of cancers of the mouth, larynx, and esophagus far more than either drinking or smoking alone.²³

The American Cancer Society Recommendations for Community Action

Many Americans encounter substantial barriers to consuming a healthy diet and engaging in regular physical activity. Among those barriers that have collectively contributed to increased obesity are: limited access to affordable, healthy foods; increased portion sizes, especially of restaurant meals; marketing and advertising of foods and beverages high in calories, fat, and added sugar, particularly to kids; schools and worksites that are not conducive to good health; community design that hinders physical activity and promotes sedentary behavior; and economic and time constraints.

The Society's nutrition and physical activity guidelines include Recommendations for Community Action because of the tremendous influence that the surrounding environment has on individual food and

activity choices. Acknowledging that reversing obesity trends will require extensive policy and environmental changes, the Society calls for public, private, and community organizations to create social and physical environments that support the adoption and maintenance of healthy eating and physical activity behaviors to help people stay well.

Achieving these recommendations requires multiple strategies and bold action, ranging from the implementation of community and workplace health promotion programs to policies that affect community planning, transportation, school-based physical activity, and food services. The tobacco control experience has shown that policy and environmental changes at the national, state, and local levels are critical to achieving changes in individual behavior. Measures such as smoke-free laws and increases in cigarette excise taxes have been highly effective in deterring tobacco use. To avert an epidemic of obesity-related disease, similar purposeful changes in public policy and in the community environment are required to help individuals make smart food and physical activity choices and maintain a healthy body weight.

References

1. World Cancer Research Fund and American Institute for Cancer Research. Continuous Update Project Available from URL: <http://www.wcrf.org/int/research-we-fund/continuous-update-project-cup>.
2. Kohler LN, Garcia DO, Harris RB, Oren E, Roe DJ, Jacobs ET. Adherence to Diet and Physical Activity Cancer Prevention Guidelines and Cancer Outcomes: A Systematic Review. *Cancer Epidemiol Biomarkers Prev*. 2016;25: 1018-1028.
3. Kushi LH, Doyle C, McCullough M, et al. American Cancer Society Guidelines on Nutrition and Physical Activity for cancer prevention: reducing the risk of cancer with healthy food choices and physical activity. *CA Cancer J Clin*. 2012;62(1): 30-67.
4. Lauby-Secretan B, Scoccianti C, Loomis D, et al. Body Fatness and Cancer – Viewpoint of the IARC Working Group. *N Engl J Med*. 2016;375: 794-798.
5. Campbell PT, Newton CC, Dehal AN, Jacobs EJ, Patel AV, Gapstur SM. Impact of body mass index on survival after colorectal cancer diagnosis: the Cancer Prevention Study-II Nutrition Cohort. *J Clin Oncol*. 2012;30: 42-52.
6. Cao Y, Ma J. Body mass index, prostate cancer-specific mortality, and biochemical recurrence: a systematic review and meta-analysis. *Cancer Prev Res (Phila)*. 2011;4: 486-501.
7. Birks S, Peeters A, Backholer K, O'Brien P, Brown W. A systematic review of the impact of weight loss on cancer incidence and mortality. *Obes Rev*. 2012;13: 868-891.
8. Fryar CD, Carroll MD, Ogden CL. Prevalence of Overweight, Obesity, and Extreme Obesity Among Adults: United States, 1960-1962 through 2011-2012. National Center for Health Statistics. September 2014. Available from URL: http://www.cdc.gov/nchs/data/hestat/obesity_adult_11_12/obesity_adult_11_12.pdf.
9. Flegal KM, Kruszon-Moran D, Carroll MD, Fryar CD, Ogden CL. Trends in Obesity Among Adults in the United States, 2005 to 2014. *JAMA*. 2016;315: 2284-2291.
10. Ogden CL, Carroll MD, Lawman HG, et al. Trends in Obesity Prevalence Among Children and Adolescents in the United States, 1988-1994 Through 2013-2014. *JAMA*. 2016;315: 2292-2299.
11. Lee JM, Pili S, Gebremariam A, et al. Getting heavier, younger: trajectories of obesity over the life course. *Int J Obes (Lond)*. 2010;34: 614-623.
12. Polednak AP. Estimating the number of U.S. incident cancers attributable to obesity and the impact on temporal trends in incidence rates for obesity-related cancers. *Cancer Detect Prev*. 2008;32: 190-199.
13. Ma J, Ward EM, Siegel RL, Jemal A. Temporal Trends in Mortality in the United States, 1969-2013. *JAMA*. 2015;314: 1731-1739.
14. Moore SC, Lee IM, Weiderpass E, et al. Association of Leisure-Time Physical Activity With Risk of 26 Types of Cancer in 1.44 Million Adults. *JAMA Intern Med*. 2016;176: 816-825.
15. Ekelund U, Steene-Johannessen J, Brown WJ, et al. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *Lancet*. 2016.
16. National Center for Health Statistics. National Health Interview Survey, 2015. Public-use data file and documentation. Available from URL: http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm [accessed July 16, 2016].
17. Kann L, McManus T, Harris WA, et al. Youth Risk Behavior Surveillance – United States, 2015. *MMWR Surveill Summ*. 2016;65: 1-174.
18. Bouvard V, Loomis D, Guyton KZ, et al. Carcinogenicity of consumption of red and processed meat. *Lancet Oncol*. 2015;16: 1599-1600.
19. Liese AD, Krebs-Smith SM, Subar AF, et al. The Dietary Patterns Methods Project: synthesis of findings across cohorts and relevance to dietary guidance. *J Nutr*. 2015;145: 393-402.
20. Mayne ST, Playdon MC, Rock CL. Diet, nutrition, and cancer: past, present and future. *Nat Rev Clin Oncol*. 2016;13: 504-515.
21. Bagnardi V, Rota M, Botteri E, et al. Alcohol consumption and site-specific cancer risk: a comprehensive dose-response meta-analysis. *Br J Cancer*. 2015;112: 580-593.
22. Chen WY, Rosner B, Hankinson SE, Colditz GA, Willett WC. Moderate alcohol consumption during adult life, drinking patterns, and breast cancer risk. *JAMA*. 2011;306: 1884-1890.
23. World Cancer Research Fund/American Institute for Cancer Research. *The Associations Between Food, Nutrition and Physical Activity and the Prevention of Cancer: A Global Perspective*. Washington, DC: World Cancer Research Fund/American Institute for Cancer Research 2007.

Cancer Disparities

Eliminating disparities in the cancer burden among different segments of the US population, defined in terms of socioeconomic status (income, education, insurance status, etc.), race/ethnicity, geographic location, sex, and sexual orientation, is an overarching goal of the American Cancer Society. The causes of health disparities within each of these groups are complex and include interrelated social, economic, cultural, environmental, and health system factors. However, disparities predominantly arise from inequities in work, wealth, education, housing, and overall standard of living, as well as social barriers to high-quality cancer prevention, early detection, and treatment services.

Socioeconomic Status

People with lower socioeconomic status (SES) have higher cancer death rates than those with higher SES, regardless of demographic factors such as race/ethnicity. For example, cancer mortality rates among both black and non-Hispanic white men with 12 or fewer years of education are almost 3 times higher than those of college graduates for all cancers combined. One reason for this disparity is generally higher cancer incidence rates, in part because this group is more likely to engage in behaviors that increase cancer risk. For example, both smoking and obesity prevalence are higher in people with lower SES, partly because marketing strategies by tobacco companies and fast food chains that target these populations. Moreover, environmental and/or community factors often limit opportunities for physical activity and access to fresh fruits and vegetables. A higher prevalence of cancer-causing infections, workplace exposures, and other environmental exposures also contributes to higher incidence rates.

A second reason for higher cancer death rates in lower SES groups is lower cancer survival rates because the disease is often detected at an advanced stage and because people in these groups are less likely to receive standard treatment. Barriers to preventive care, early detection, and optimal treatment include inadequate health insurance; financial, structural, and personal barriers to health care; and low

health literacy rates. Progress in reducing cancer death rates has also been slower in people with lower SES because of delays in the dissemination of preventive measures and improvements in early detection and treatment in this underserved population.

Racial and Ethnic Minorities

Racial and ethnic disparities in the cancer burden largely reflect obstacles to receiving health care services related to cancer prevention, early detection, and high-quality treatment, with poverty as the largest contributing factor. According to the US Census Bureau, in 2015, 24% of blacks and 21% of Hispanics/Latinos lived below the poverty line, compared to 9% of non-Hispanic whites. Moreover, 11% of blacks and 16% of Hispanics/Latinos were uninsured, compared to 7% of non-Hispanic whites.

Discrimination also contributes to cancer disparities. Racial and ethnic minorities tend to receive lower-quality health care than non-Hispanic whites even when insurance status, age, severity of disease, and health status are comparable. Social inequalities, including communication barriers and provider/patient assumptions, can affect interactions between patients and physicians and contribute to miscommunication and/or delivery of substandard care.

In addition to poverty and social discrimination, cancer occurrence is also influenced by cultural and/or inherited factors. For example, Hispanics and Asians have lower rates of lung cancer than non-Hispanic whites because they have historically been less likely to smoke (Table 9, page 50). Conversely, because these populations include a large number of recent immigrants, they have higher rates of cancers related to infectious agents (e.g., stomach) because of a higher prevalence of infection in their native countries. Genetic factors may also explain some differences in cancer incidence, such as the higher frequency of mutations in the breast cancer susceptibility genes *BRCA1* and *BRCA2* among women of Ashkenazi Jewish descent. However, it is important to note that genetic differences associated with race or ethnicity make only a minor contribution to the disparate cancer burden between populations.

Table 9. Incidence Rates* for Selected Cancers by Race and Ethnicity, US, 2009-2013

	Non-Hispanic white	Non-Hispanic black	Asian and Pacific Islander	American Indian and Alaska Native†	Hispanic/Latino
All sites					
Male	519.3	577.3	310.2	426.7	398.1
Female	436.0	408.5	287.1	387.3	329.6
Breast (female)	128.3	125.1	89.3	98.1	91.7
Colon & rectum					
Male	46.1	58.3	37.8	51.4	42.8
Female	35.2	42.7	27.8	41.2	29.8
Kidney & renal pelvis					
Male	21.9	24.4	10.8	29.9	20.7
Female	11.3	13.0	4.8	17.6	11.9
Liver & intrahepatic bile duct					
Male	9.7	16.9	20.4	18.5	19.4
Female	3.3	5.0	7.6	8.9	7.5
Lung & bronchus					
Male	77.7	90.8	46.6	71.3	42.2
Female	58.2	51.0	28.3	56.2	25.6
Prostate	114.8	198.4	63.5	85.1	104.9
Stomach					
Male	7.8	14.7	14.4	11.2	13.1
Female	3.5	7.9	8.4	6.5	7.8
Uterine cervix	7.0	9.8	6.1	9.7	9.9

Hispanic origin is not mutually exclusive from Asian/Pacific Islander or American Indian/Alaska Native. *Rates are per 100,000 population and age adjusted to the 2000 US standard population. †Data based on Indian Health Service Contract Health Service Delivery Areas and exclude data from Kansas.

Source: North American Association of Central Cancer Registries, 2016.

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Following is a brief overview of the cancer burden for the four major racial and ethnic minority groups in the US. It is important to note that although cancer data in the US are primarily reported in terms of these broad categories, these populations are very heterogeneous, with substantial variation in the cancer burden within each group. In addition, cancer information for several racial and ethnic groups, especially American Indians and Alaska Natives (AIANs), is known to be incomplete due to misclassification on medical and death records. Although efforts are being made to collect more accurate information, rates presented for AIANs in particular likely do not represent the true cancer burden in this population.

Non-Hispanic Black: Non-Hispanic black (henceforth black) males have the highest overall cancer incidence (577.3 per 100,000) and death (253.4) rates of the major racial/ethnic groups, 11% and 24% higher, respectively, than non-Hispanic whites (519.3 and 204.0) (Table 9 and Table 10). Cancer death rates in black males are twice those in Asian and Pacific Islanders (122.7), who have the lowest rates. In particular, prostate cancer death rates in

blacks are more than double those of any other group. Black females have 14% higher cancer death rates than non-Hispanic white females despite 6% lower incidence rates. See *Cancer Facts & Figures for African Americans*, available online at cancer.org/statistics, for more information.

Hispanic/Latino: Cancer patterns in US Hispanics generally reflect those in immigrant countries of origin, but become more similar to non-Hispanic white Americans across generations due to acculturation. As an aggregate group, Hispanics have lower rates for the most common cancers in the US (female breast, colorectum, lung, and prostate), but among the highest rates for cancers associated with infectious agents. For example, Hispanics have cervical cancer incidence rates that are about 40% higher than those in non-Hispanic whites, and liver and stomach cancer incidence rates that are about double (Table 9). See *Cancer Facts & Figures for Hispanics/Latinos*, available online at cancer.org/statistics, for more information.

Table 10. Death Rates* for Selected Cancers by Race and Ethnicity, US, 2010-2014

	Non-Hispanic white	Non-Hispanic black	Asian and Pacific Islander	American Indian and Alaska Native†	Hispanic/Latino
All sites					
Male	204.0	253.4	122.7	183.6	142.5
Female	145.5	165.9	88.8	129.1	97.7
Breast (female)	21.1	30.0	11.3	14.1	14.4
Colon & rectum					
Male	17.3	25.9	12.4	19.5	15.0
Female	12.3	16.9	8.8	14.0	9.2
Kidney & renal pelvis					
Male	5.8	5.7	2.7	8.9	4.9
Female	2.5	2.5	1.1	4.2	2.3
Liver & intrahepatic bile duct					
Male	8.0	13.3	14.3	14.9	13.1
Female	3.3	4.6	6.1	6.8	5.8
Lung & bronchus					
Male	58.3	69.8	31.7	46.2	27.3
Female	39.8	35.5	18.0	30.8	13.4
Prostate	18.7	42.8	8.8	19.4	16.5
Stomach					
Male	3.4	8.7	7.1	7.5	6.9
Female	1.7	4.2	4.3	3.8	4.1
Uterine cervix	2.1	3.9	1.7	2.8	2.6

Hispanic origin is not mutually exclusive from Asian/Pacific Islander or American Indian/Alaska Native. *Rates are per 100,000 population and age adjusted to the 2000 US standard population. †Data based on Indian Health Service Contract Health Service Delivery Areas.

Source: National Center for Health Statistics, Centers for Disease Control and Prevention, 2016.

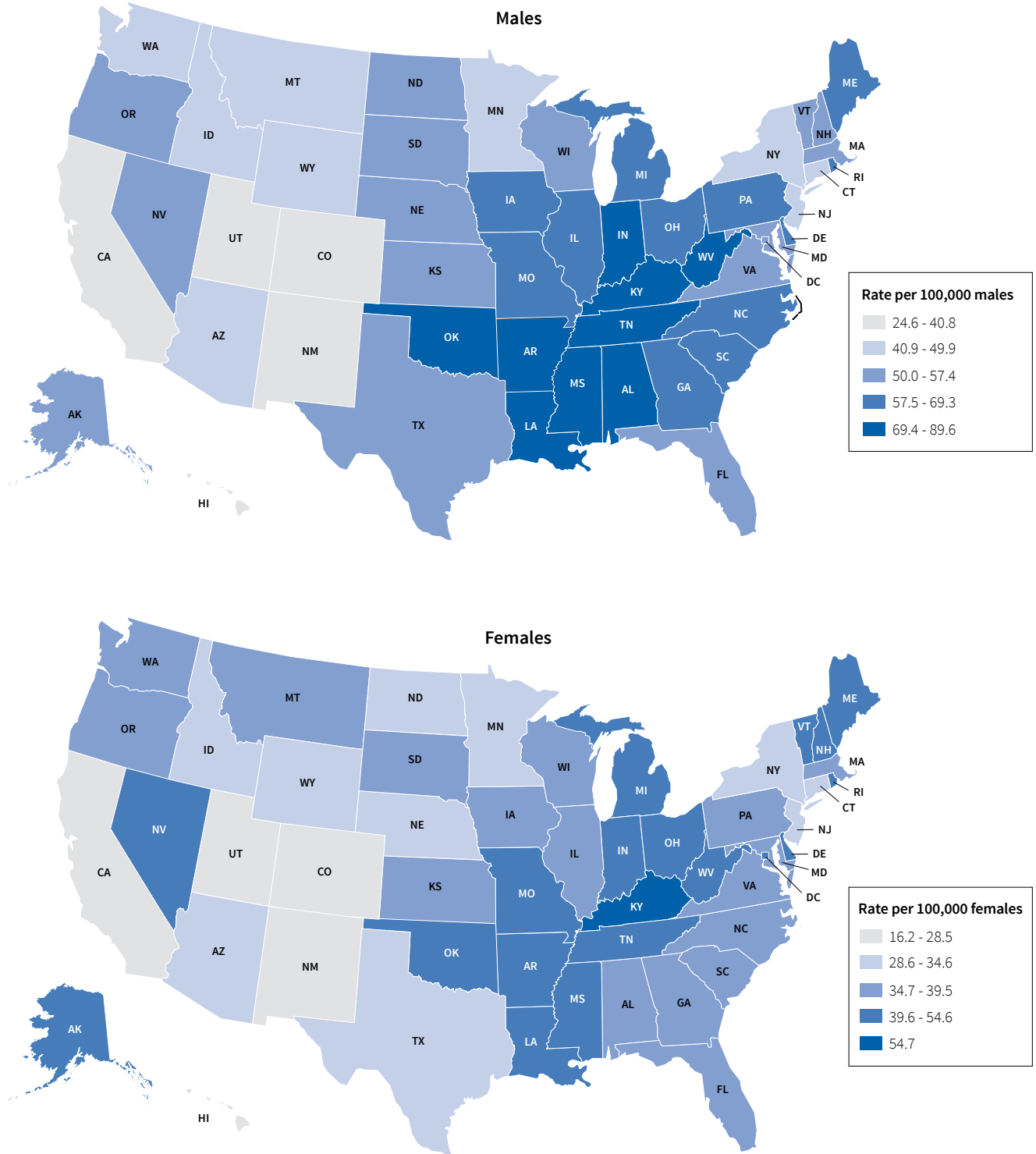
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Asian and Pacific Islander (API): APIs are an extremely diverse population in terms of geographic origin, language, acculturation, and socioeconomic status. This heterogeneity is reflected in the striking variation in cancer incidence rates, which ranges in men, for example, from 217 (per 100,000) in Asian Indians/Pakistanis to 527 in Samoans. Unfortunately, most cancer data are currently only available for this group in aggregate, masking these differences. As a group, APIs have the lowest overall cancer incidence and death rates, but among the highest liver and stomach cancer rates, about double those among non-Hispanic whites (Table 9). Like Hispanics overall, lung cancer rates in APIs as a group are about half those in non-Hispanic whites because of historically low smoking rates. However, some Hispanic and API subgroups with higher smoking rates, such as Cubans and Native Hawaiians, have lung cancer rates approaching those of non-Hispanic whites. See the *Cancer Facts & Figures 2016* Special Section on Cancer in Asian Americans, Native Hawaiians, and Pacific Islanders, available online at cancer.org/statistics, for more information.

American Indian and Alaska Native (AIAN): AIANs have the highest kidney cancer incidence and death rates of any racial or ethnic population – 3 times higher than those among APIs, who have the lowest rates (Table 9 and Table 10). However, like other broad racial and ethnic groups, cancer rates vary greatly within the AIAN population because of differences in behaviors that influence disease risk. For example, kidney cancer death rates are twofold higher among AIAN men living in the Northern and Southern Plains than in those living in the East and Pacific Coast regions, likely because of differences in the prevalence of smoking, obesity, and hypertension. Variations in smoking patterns are also reflected in lung cancer rates among AIAN men, which are about 50% higher than whites among persons living in the Northern Plains or Alaska, but less than half those in whites among persons living in the Southwest.

For information about American Cancer Society advocacy efforts dedicated to reducing the cancer burden among minority and medically underserved populations, see “Advocacy” on page 66.

Figure 5. Geographic Patterns in Lung Cancer Death Rates* by State, US, 2010-2014



*Rates adjusted to the 2000 US standard population.

Source: US Mortality Data, National Center for Health Statistics, Centers for Disease Control and Prevention, 2016.

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Geographic Variability

Cancer incidence and mortality rates in the US vary by geographic area (Table 4, page 7 and Table 5, page 8), reflecting differences in behaviors, such as smoking, as well as socioeconomic factors related to population demographics, environmental exposures, and cancer screening prevalence. Lung cancer has the most striking variation by state, with death rates more than threefold higher in Kentucky (90 and 55 per 100,000 in males and females, respectively) than in Utah (25 and 16

per 100,000 in males and females, respectively) (Figure 5). These differences reflect the substantial historic variation in smoking prevalence across states, which continues today. For example, smoking prevalence in adults in 2015 ranged from 9% in Utah to 26% in Kentucky and West Virginia. Some of this difference reflects state tobacco control policies. There is little state variation in the occurrence of cancers that are less influenced by behavior and/or early detection tests, such as non-Hodgkin lymphoma (Table 4, page 7).

The Global Cancer Burden

The ultimate mission of the American Cancer Society is to eliminate cancer as a major health problem. Because cancer knows no boundaries, this mission extends around the world. Cancer is an enormous global health burden, touching every region and socioeconomic group. Today, cancer accounts for about 1 in every 7 deaths worldwide – more than HIV/AIDS, tuberculosis, and malaria combined. In 2012, there were an estimated 14.1 million cases of cancer diagnosed around the world and 8.2 million cancer deaths. More than 60% of cancer deaths occur in low- and middle-income countries (LMICs), many of which lack the medical resources and health systems to support the disease burden.

Moreover, the global cancer burden is growing at an alarming pace; in 2030 alone, about 21.6 million new cancer cases and 13.0 million cancer deaths are expected to occur, simply due to the growth and aging of the population. The future burden may be further increased by the adoption of unhealthy behaviors and lifestyles associated with rapid income growth (e.g., smoking, poor diet, and physical inactivity), and changes in reproductive patterns (e.g., fewer children, later age at first childbirth) in LMICs. Tobacco use is a major contributor to the global burden of cancer as the number of smokers worldwide continues to grow.

Worldwide Tobacco Use

Tobacco-related diseases are the most preventable cause of death worldwide, responsible for approximately half of all deaths among long-term tobacco users.

- Tobacco use is responsible for almost 6 million deaths annually, 80% of which are in LMICs; by 2030, this number is expected to increase to 8 million.
- Between 2002 and 2030, tobacco-attributable deaths are expected to decrease from 1.6 million to 1.5 million in high-income countries, while doubling in LMICs (from 3.4 million to 6.8 million).
- The tobacco industry has been aggressively pursuing legal challenges to tobacco control interventions around the globe, including claims that it will increase illicit trade and threaten the livelihoods of tobacco farmers, neither of which is supported by evidence.

The first global public health treaty under the auspices of the World Health Organization, the Framework Convention on Tobacco Control (FCTC) was unanimously adopted by the World Health Assembly in 2003, and subsequently entered into force as a legally binding accord for all ratifying states in 2005. The purpose of the treaty is to fight the devastating health, environmental, and economic effects of tobacco on a global scale by requiring parties to adopt a comprehensive range of tobacco control

measures. It features specific provisions to control both the global supply of and demand for tobacco, including the regulation of tobacco product contents, packaging, labeling, advertising, promotion, sponsorship, taxation, illicit trade, youth access, exposure to secondhand tobacco smoke, and environmental and agricultural impacts. Parties to the treaty are expected to strengthen national legislation, enact effective domestic tobacco control policies, and cooperate internationally to reduce global tobacco consumption. A number of major tobacco-producing nations, including Argentina, Indonesia, Malawi, and the United States, are among the few nations that have not yet ratified the treaty.

- As of November 2016, 180 out of 196 eligible parties have ratified or acceded to the treaty, representing approximately 89% of the world's population.
- About one-third of the world's population was covered by at least one comprehensive tobacco control measure in 2014, up from about 15% in 2008.
- The WHO estimates that 18% of the world's population lives in smoke-free environments.
- Although tobacco excise tax increases are among the most cost-effective tobacco control strategies, only 10% of the world population is covered by comprehensive tobacco tax policy.

The Role of the American Cancer Society

With more than a century of experience in cancer control, the American Cancer Society is uniquely positioned to help save lives from cancer and tobacco globally by assisting and empowering the world's cancer societies and anti-tobacco advocates. The Society's Global Cancer Control and Intramural Research departments are raising awareness about the growing global cancer burden and promoting evidence-based cancer and tobacco control programs. The Society strives to reduce the global burden of cancer by helping prevent the disease, saving lives, diminishing suffering, catalyzing local responses, and shaping the global policy agenda. Our efforts focus on LMICs.

Make cancer control a political and public health priority. Noncommunicable diseases (NCDs) such as cancer, heart disease, and diabetes account for about 70% of the world's deaths. Although 67% of these deaths occur in LMICs, less than 3% of private and public health funding is allocated to prevent and control NCDs in these areas. The Society helps make cancer and other NCDs a global public health priority by collaborating with key partners, including the NCD Alliance, the Union for International Cancer Control, the World Health Organization (WHO), the International Agency for Research on Cancer, the NCD Roundtable, and the Taskforce on Women and Non-Communicable Diseases. In 2011, world leaders gathered at a special United Nations High-level Meeting and adopted a Political Declaration that elevated cancer and other NCDs on the global health and development agenda and included key commitments to address these diseases. In 2012, the WHO approved a resolution calling for a 25% reduction in premature deaths from NCDs by 2025 (also known as 25 by 25). At a United Nations summit in 2015, government leaders formally recognized NCDs as a major challenge to sustainable development for the first time, committing to develop national responses to NCDs as part of the Sustainable Development Goals, including strengthening the implementation of the FCTC and improving access to vaccines and medicines for cancer and other NCDs.

Develop cancer control capacity globally. Many governments in LMICs are ill-prepared to adequately address the increasing burden of cancer. In many cases, civil society actors (nongovernmental organizations, institutions, and individuals) are also not yet fully engaged in cancer control efforts. The Society's Global Capacity Development program is intended to strengthen the civil society response to cancer and tobacco control in focus countries around the world. This program provides intensive and culturally appropriate technical assistance to targeted organizations in LMICs that includes the basic elements of organizational capacity development, such as governance, financial management, fundraising, program design and management, and evaluation.

Tobacco control. The Society's Global Cancer Control department and the Economic and Health Policy Research (EHPR) group are working to end the worldwide tobacco epidemic through research and programs. In 2016, the two teams launched a global tobacco taxation initiative that promotes the Sustainable Development Goal of a 30% reduction in smoking prevalence by 2025. This program actively seeks to specifically engage cancer organizations, most of which have not been involved in this area, particularly in LMICs. The initiative not only engages new actors, but also provides capacity building and technical assistance to interested organizations and governments. Further, because issues around illicit trade have been so tied to tobacco taxation, the initiative takes advantage of the EHPR's knowledge and experience in this area to help governments navigate the challenges around implementing tobacco taxation successfully and countering the industry's opposition.

Make effective pain treatment available to all in need. Untreated moderate to severe pain, which is experienced by about 80% of people with advanced cancer, is commonly experienced by cancer patients in resource-limited settings. Improved access to essential pain medicines – arguably the easiest and least expensive need to meet – would do the most to relieve suffering and may also extend survival. The Society leads projects in Nigeria, Ethiopia, Kenya, Uganda, and Swaziland to improve access to essential pain medicines. In Nigeria, the Society collaborated with the government to make morphine available for the first time in several years. By setting up a local production system in 27 teaching hospitals, the price paid by the patients was lowered by 80% to 90%. The Society continues to support the national morphine production facility in Uganda, which has been operating since 2010, and is supporting Kenya to replicate this successful initiative in the national

hospital in Nairobi. The Society is also training health workers in more than 25 teaching and referral hospitals across the 5 countries through the Pain-Free Hospital Initiative, a 1-year hospital-wide quality improvement initiative designed to change clinical practice by integrating effective, high-quality pain treatment into hospital-based services.

Increase awareness about the global cancer burden. The Society continues to work with global collaborators to increase awareness about the growing cancer and tobacco burdens and their disproportionate impact on LMICs. For example, the Society partnered with the International Agency for Research on Cancer (IARC) and the Union for International Cancer Control (UICC) to produce *The Cancer Atlas, Second Edition* and its interactive website (canceratlas.cancer.org). The *Atlas*, which highlights the complex nature of the global cancer landscape while pointing to strategies governments can use to reduce their cancer burden, is currently available in French, Spanish, Russian, Chinese, Hindi, Turkish, and Portuguese with more translations to come. Similarly, *The Tobacco Atlas, Fifth Edition* (tobaccoatlas.org), which is a collaboration with the World Lung Foundation, is the most comprehensive resource on the evolving, worldwide tobacco epidemic. The Society's Intramural Research department also publishes *Global Cancer Facts & Figures* (cancer.org/statistics), along with an accompanying statistics article in *CA: A Cancer Journal for Clinicians*, which provides up-to-date data on cancer incidence, mortality, and survival worldwide. In addition to print publications, the Society website, cancer.org, provides cancer information to millions of individuals throughout the world. In 2015, 43% of visits to the website came from outside the US. Information is currently available in English, Spanish, Chinese, Bengali, Hindi, Korean, Urdu, and Vietnamese.

The American Cancer Society

The American Cancer Society was founded in 1913 as the American Society for the Control of Cancer by 15 prominent physicians and business leaders in New York City. The organization's aim was to bring cancer into the mainstream of public disclosure through education campaigns, working to inform both health practitioners and the public about the disease. The Society now works with 2 million volunteers to help create a world free from the pain and suffering of cancer. Although our message and methods have changed over the past 100-plus years, our goal remains the same: save lives. Thanks in part to our contributions, more than 2.1 million cancer deaths have been averted in the US in the past two decades.

How the American Cancer Society Is Organized

The American Cancer Society, Inc., is a 501(c)(3) nonprofit corporation. The organization is governed by one Board of Directors, composed entirely of volunteers from the medical and lay communities. The Board is responsible for setting policy, establishing long-term goals, monitoring general operations, and approving organizational outcomes and the allocation of resources.

The Society has a global headquarters in Atlanta, Georgia, 6 geographic Regions and local offices in those regions. The headquarters is responsible for overall strategic planning; corporate support services such as human resources, financial management, IT, etc.; development and implementation of global and nationwide endeavors such as our groundbreaking research program, our global program, and our 24-hour call center; and providing technical support and materials for Regions and local offices for local delivery.

Our Regions and local offices are organized to engage communities in helping to save lives from cancer, delivering potentially lifesaving programs and services and raising money at the local level. Offices are

strategically located around the country in an effort to maximize the impact of our efforts, and to be as efficient as possible with the money donated to the Society to help create a world free from the pain and suffering of cancer.

The Society also works closely with our advocacy affiliate, the American Cancer Society Cancer Action NetworkSM (ACS CAN). As the nation's leading cancer advocacy organization, ACS CAN is working every day to make cancer issues a national priority. Headquartered in Washington, DC, but including staff and volunteers in all 50 states, ACS CAN uses applied policy analysis, direct lobbying, grassroots action, and media advocacy to ensure elected officials nationwide pass and effectively implement laws that help save lives from cancer.

Volunteers

The Society relies on the strength of millions of dedicated volunteers. Supported by professional staff, these volunteers drive every part of our mission. They raise funds to support innovative research, provide cancer patients rides to and from treatments, and give one-on-one support to those facing a cancer diagnosis – and that's just the beginning.

How the American Cancer Society Saves Lives

As an organization of 2 million strong, the American Cancer Society is committed to a world free from the pain and suffering of cancer.

Prevention and Early Detection

The American Cancer Society is doing everything in our power to prevent cancer. We promote healthy lifestyles by issuing cancer guidelines for prevention and early detection, helping people avoid tobacco, and reducing barriers to healthy eating and exercise.

Prevention

The **Quit For Life**[®] Program is the nation's leading tobacco cessation program, offered by 27 states and more than 700 employers and health plans throughout the US. A collaboration between the American Cancer Society

and Optum, the program is built on the organizations' more than 35 years of combined experience in tobacco cessation. The Quit For Life Program employs an evidence-based combination of physical, psychological, and behavioral strategies to enable participants to take responsibility for and overcome their addiction to tobacco. A critical mix of medication support, phone-based cognitive behavioral coaching, text messaging, web-based learning, and support tools produces a higher-than-average quit rate.

More than 5 million new cases of skin cancer will be diagnosed in the US this year. That's why the American Cancer Society and other members of the National Council on Skin Cancer Prevention have designated the Friday before Memorial Day as Don't Fry Day. The Society promotes skin cancer prevention and awareness educational messages in support of Don't Fry Day and year-round.

The Society also offers many products to employers and other systems to help their employees reduce their cancer risk, too. These include:

- **80% by 2018 Employer Challenge Guide** – The Society is part of the National Colorectal Cancer Roundtable initiative to eliminate colorectal cancer as a major health problem and have 80% of adults 50 and older screened by 2018. The Society's *80% by 2018 Employer Challenge Guide* provides companies with the tools and resources companies need to reach the 2018 goal.
- The **Workplace Health Assessment** program, which surveys a company's health and wellness practices to provide recommended strategies for increasing effectiveness of current programs, developing target initiatives to meet employees' needs, and strengthening the culture of health for the organization. Targeted behaviors include organizational readiness, tobacco control, cancer screening, healthy eating, physical activity, and cancer care.
- The **Freshstart**[®] group-based tobacco cessation program, which is designed to help employees plan a successful quit attempt by providing essential information, skills for coping with cravings, and social support
- The **Content Subscription Service**, an electronic toolkit subscription offered by the Society to employers that supports the health and wellness needs of employees with information about cancer prevention and early detection, as well as support services and resources for those facing the disease
- **Healthy Living**, a monthly electronic newsletter produced by the American Cancer Society that teaches the importance of making healthy lifestyle choices. The e-newsletter focuses on exercising, eating better, and maintaining a healthy weight. *Healthy Living* is available in both English and Spanish, and the content has been edited by the Society's scientific staff to ensure that the most up-to-date and accurate information is being provided.
- The 10-week **Active For Life**SM online program, which uses evidence-based practices like individual goal-setting, social support, and frequent logging of activity to help employees become more physically active on a regular basis
- **Tobacco Policy Planner**, an online assessment of company policies, benefits, and programs related to tobacco control. Following the completion of the survey, the company receives a detailed report that includes information needed to help create new – or enhance existing – workplace tobacco policies, programs, and benefits. The resource can assist employers in creating a safe, tobacco-free environment that enhances employee well-being.
- **Nutrition and Physical Activity Planner**, an online assessment of company policies, benefits, and programs related to eating better and being more physically active. Following the completion of the survey, the company receives a detailed report that includes information needed to help create new – or enhance existing – workplace policies, programs, and benefits.
- The **Meeting Well** guidebook, which offers companies healthy food ideas and suggestions for physical activity that energize meeting participants and demonstrate how easy it can be to live a healthier lifestyle every day

For the majority of Americans who do not smoke, the most important ways to reduce cancer risk are to maintain a healthy weight, be physically active on a regular basis, and eat a mostly plant-based diet, consisting of a variety of vegetables and fruit, whole grains, and limited amounts of red and processed meats. The Society publishes guidelines on nutrition and physical activity for cancer prevention in order to review the accumulating scientific evidence on diet and cancer; to synthesize this evidence into clear, informative recommendations for the general public; to promote healthy individual behaviors and environments that support healthy eating and physical activity; and, ultimately, to reduce cancer risk. Those guidelines form the foundation for the Society's communication, worksite, school, and community strategies designed to encourage and support people in making healthy lifestyle behavior choices.

Early Detection

Finding cancer at its earliest, most treatable stage gives patients the greatest chance of survival. To help the public and health care providers make informed decisions about cancer screening, the American Cancer Society publishes a variety of early detection guidelines. Those guidelines are assessed regularly to ensure that recommendations are based on the most current scientific evidence.

The Society currently provides screening guidelines for cancers of the breast, cervix, colorectum, endometrium, lung, and prostate, as well as general recommendations for a cancer-related component of a periodic checkup to examine the thyroid, oral cavity, skin, lymph nodes, testicles, and ovaries.

Throughout our history, the Society has implemented a number of aggressive awareness campaigns targeting the public and health care professionals. Campaigns to increase usage of Pap testing and mammography have contributed to a 70% decrease in cervical cancer death rates since 1969 and a 38% decline in breast cancer death rates between 1989 and 2014. Building on previous and ongoing colorectal cancer prevention and early detection efforts, the Society joined the National Colorectal Cancer Roundtable in its 80% by 2018 initiative in 2013. The bold

goal of this campaign is to increase the rate of regular colorectal cancer screening among adults 50 and older to 80% by 2018, with an emphasis on economically disadvantaged individuals, who are least likely to be tested. The Society also continues to encourage the early detection of breast cancer through public awareness and other efforts targeting poor and underserved communities.

Treatment

For the nearly 1.7 million cancer patients diagnosed this year and more than 15.5 million US cancer survivors, the American Cancer Society is there every step of the way. Whether it's providing emotional support, the latest cancer information, or a home away from home when treatment is far away, we're here when you need us.

Information, 24 Hours a Day, 7 Days a Week

The American Cancer Society is available 24 hours a day, 7 days a week online at cancer.org and by calling 1-800-227-2345. Callers are connected with a cancer information specialist who can help them locate a hospital, understand cancer and treatment options, learn what to expect and how to plan, address insurance concerns, find financial resources, find a local support group, and more. The Society can also help people who speak languages other than English or Spanish find the assistance they need, offering services in more than 200 languages.

Information on every aspect of the cancer experience, from prevention to survivorship, is also available through cancer.org, the Society's website. The site contains in-depth information on every major cancer type, as well as on treatments, side effects, caregiving, and coping.

The Society also publishes a wide variety of brochures and books that cover a multitude of topics, from patient education, quality of life, and caregiving issues to healthy living. Visit cancer.org/bookstore for a complete list of Society books that are available to order. Call 1-800-227-2345 or visit cancer.org for brochures.

The Society publishes three peer-reviewed journals for health care providers and researchers: *Cancer*, *Cancer Cytopathology*, and *CA: A Cancer Journal for Clinicians*.

Visit acsjournals.com to learn about the journals and their content.

Day-to-day Help and Support

The American Cancer Society can help cancer patients and their families find the resources they need to make decisions about the day-to-day challenges that can come from a cancer diagnosis, such as transportation to and from treatment, financial and insurance needs, and lodging when treatment is needed away from home, as well as ongoing needs for survivors and caregivers. The Society also connects people with others who have been through similar experiences to offer one-on-one support.

Survivorship: American Cancer Society survivorship work aims to help people living with and beyond cancer from diagnosis through long-term survivorship to the end of life. Efforts focus on helping survivors understand and access treatment; manage their ongoing physical, psychosocial, and functional problems; and engage in healthy behaviors to optimize their wellness. Our post-treatment survivorship care guidelines are designed to promote survivor healthiness and quality of life by facilitating the delivery of high-quality, comprehensive, coordinated clinical follow-up care. The Society's survivorship research efforts focus on understanding the impact of cancer on multiple facets of survivors' lives and on developing and testing interventions to help survivors actively engage in their health care and improve their health and well-being through and beyond treatment.

Support for caregivers: Approximately 7% of the US population is made up of family caregivers of a loved one with cancer. We are committed to supporting cancer caregivers and focus on meeting their information, education, and support needs. Approximately 4% of the US population is surviving cancer, meaning the ratio of family caregivers to cancer survivors is nearly double, supporting the notion that cancer is not isolated only to the individual diagnosed but rather impacts an entire family unit and network of close friends.

Help navigating the health care system: Learning how to navigate the cancer journey and the health care system can be overwhelming for anyone, but it is

particularly difficult for those who are medically underserved, those who experience language or health literacy barriers, and those with limited resources. The American Cancer Society Patient Navigator Program reaches those most in need. The largest oncology-focused patient navigator program in the country, it has specially trained patient navigators at more than 120 sites across the nation. Patient navigators can help: find transportation to and from cancer-related appointments; assist with medical financial issues, including insurance navigation; identify community resources; and provide information on a patient's cancer diagnosis and treatment process. In 2015, more than 50,000 people relied on the Patient Navigator Program to help them through their diagnosis and treatment. The Society collaborates with a variety of organizations, including the National Cancer Institute's Center to Reduce Cancer Health Disparities, the Center for Medicare and Medicaid Services, numerous cancer treatment centers, and others to implement and evaluate this program.

Transportation to treatment: The American Cancer Society Road To Recovery® program provides free rides to cancer patients who otherwise would have difficulty getting to their medical appointments. Trained volunteer drivers donate their time and the use of their personal vehicles to help patients get to the treatments they need. In 2015, the American Cancer Society provided more than 188,000 rides to cancer patients. Other transportation programs are also available in certain areas. Call us at 1-800-227-2345 for more information.

Lodging during treatment: The American Cancer Society Hope Lodge® program provides a free home away from home for cancer patients and their caregivers. More than just a roof over their heads, it's a nurturing community where patients can share stories and offer each other emotional support. In 2015, the 32 Hope Lodge locations provided more than 267,000 nights of free lodging to more than 21,000 patients and caregivers – saving them \$36 million in hotel expenses. Through our Hotel Partners Program, the Society also partners with local hotels across the country to provide free or discounted lodging to patients and their caregivers in communities without a Hope Lodge facility.

Breast cancer support: Through the American Cancer Society Reach To Recovery® program, breast cancer patients are paired with trained volunteers who have had similar diagnoses and treatment plans to provide more personal, one-on-one support. In 2015, the program assisted more than 8,300 patients.

Hair-loss and mastectomy products: Some women wear wigs, hats, breast forms, and special bras to help cope with the effects of a mastectomy and hair loss. The American Cancer Society “*tlc*” *Tender Loving Care*® publication offers affordable hair loss and mastectomy products, as well as advice on how to use those products. The “*tlc*”™ products and catalogs may be ordered online at tlcdirect.org or by calling 1-800-850-9445. All proceeds from product sales go back into the Society’s survivorship programs and services.

Help with appearance-related side effects of treatment: The Look Good Feel Better® program is a collaboration of the American Cancer Society, the Personal Care Products Council Foundation, and the Professional Beauty Association that helps women feel more like themselves by teaching hands-on beauty techniques. The free program engages certified, licensed beauty professionals trained as Look Good Feel Better volunteers to teach simple techniques on skin care, makeup, and nail care, and give practical tips on hair loss, wigs, and head coverings to help deal with challenges after treatment. Information and materials are also available for men and teens. To learn more, visit the Look Good Feel Better website at lookgoodfeelbetter.org or call 1-800-395-LOOK (1-800-395-5665).

Finding hope and inspiration: The American Cancer Society Cancer Survivors Network® provides a safe online connection where cancer patients can find others with similar experiences and interests. At csn.cancer.org, members can join chat rooms and build their own support network from among the members.

Research

Research is at the heart of the American Cancer Society’s mission. For 70 years, we have been finding answers that help save lives – from changes in lifestyle to new

approaches in therapies to improving cancer patients’ quality of life. No single private, nongovernmental organization in the US has invested more to find the causes and cures of cancer than the Society. We relentlessly pursue the answers that help us understand how to prevent, detect, and treat all cancer types. We combine the world’s best and brightest researchers with the world’s largest, oldest, and most effective community-based organization to put answers into action.

The Society’s comprehensive research program consists of extramural grants, as well as intramural programs in epidemiology, surveillance and health services research, behavioral research, economic and health policy research, and statistics and evaluation. Intramural research programs are led by the Society’s own staff scientists.

Extramural Research

The American Cancer Society Extramural Research program currently supports research and training in a wide range of cancer-related disciplines at more than 200 institutions. As of August 1, 2016, the Society is funding 748 research and training grants totaling nearly \$407 million. Grant applications are solicited through a nationwide competition and are subjected to a rigorous external peer-review process, ensuring that only the most promising research is funded. The Society primarily funds investigators early in their research careers, thus giving the best and the brightest a chance to explore cutting-edge ideas at a time when they might not find funding elsewhere. The Extramural Research department is comprised of six programs that span areas of cancer research from the most basic to public policy.

Molecular Genetics and Biochemistry of Cancer: This research program focuses on the genes involved in cancer and how alterations in those genes (mutations, deletions, and amplifications) play a role in the cancer process. Also of interest is the examination of molecules involved in cancer (proteins, nucleic acids, lipids, and carbohydrates) and how alterations in those molecules affect the disease. The program highlights potential targets for new cancer treatments.

Cancer Cell Biology and Metastasis: The primary goal of this program is to provide an understanding of the nature of cancer cells so they can be more effectively detected and eliminated. Emphases include understanding the fundamental controls of both normal cells and cancer cells, with a focus on how cells regulate when to grow, when to divide, and when to die; how and when to develop from one cell type into another; how cells relate to the local environment and to other cells; and how cells regulate when and how to move from one site to another. To reach the program goals, a wide variety of cell and tumor types are used so that all aspects of cell biology can be examined.

Preclinical and Translational Cancer Research: This research program focuses on the interface between laboratory investigations and human testing. The scope of the program includes investigations of the role of infectious diseases in cancer, the synthesis and discovery of cancer drugs, the creation and use of cancer animal models, and the role of individual or groups of genes in different types of cancer.

Clinical Cancer Research, Nutrition, and Immunology: This program focuses on investigations including basic, preclinical, clinical, and epidemiological studies. Areas of interest include new modalities for cancer prevention, diagnosis, and treatment. In addition, the program seeks to improve understanding of cancer-related inflammatory responses and the use of the immune system for cancer prevention and therapy. The program also focuses on increased understanding of the effects of nutrition and the environment on cancer prevention, initiation, progression, and treatment.

Cancer Control and Prevention Research: This research program focuses on the study of behaviors (of individuals, health care professionals, or health care systems) and how interventions to change these behaviors or systems can reduce cancer risk, help detect cancer early, better inform treatment decisions, or improve the quality of life of patients and families. Special emphasis is placed on reducing disparities in disadvantaged groups.

Health Professional Training in Cancer Control: The goals of this program are to encourage highly qualified individuals to enter careers in cancer prevention and control practice and to accelerate the application of research findings in this area. Toward that end, this program provides grants in support of nurses, physicians, and social workers to pursue training in cancer prevention and control programs that meet high standards for excellence.

In addition to funding across the continuum of cancer research and training, from basic science to clinical and quality-of-life research, the Society also focuses on needs that are unmet by other funding organizations. For instance, for 10 years, the Society supported a targeted research program to address the causes of higher cancer mortality in the poor and medically underserved. To date, 47 Nobel Prize winners have received grant support from the Society, most of them early in their careers, a number unmatched in the nonprofit sector and proof that the organization's approach to funding young researchers truly helps launch high-quality scientific careers.

Intramural Research

In 1946, under the direction of E. Cuyler Hammond, ScD, a small group of researchers was created at the American Cancer Society. Since that time, the Society's Intramural Research program has grown into 5 programs that conduct and publish high-quality research to advance the understanding of cancer and evaluate Society programs to ensure that they are effective and reaching the cancer patients that are most in need.

Epidemiology: The Epidemiology Research program seeks to reduce the cancer burden by conducting large, nationwide prospective studies that advance our understanding of cancer etiology and survival to inform cancer prevention and control programs, policies, and guidelines. To accomplish this work, in 1952 Hammond pioneered the idea of working with the extensive network of Society volunteers nationwide to enroll and follow large cohorts to provide insights into the causes of cancer. The first cohort, known as the Hammond-Horn Study, was conducted from 1952 through 1955 and provided the first US prospective evidence to confirm the

association between cigarette smoking and death from lung cancer, cardiovascular disease, and other conditions in men. The success of this early study established the foundation on which the Society invested in a series of large prospective studies – the Cancer Prevention Studies – and in the creation and growth of the Epidemiology Research program. Indeed, with help from more than 150,000 Society volunteers to enroll and collect information from more than 2.2 million US men and women, findings from the Hammond- Horn Study, Cancer Prevention Study-I (CPS-I, 1959-1972), and CPS-II (1982-ongoing) have played a major role in cancer prevention initiatives at the Society, as well as in other national and international efforts. For example:

- The Hammond-Horn Study, which linked smoking to lung cancer and higher overall death rates, contributed to the Surgeon General’s landmark 1964 conclusion that smoking causes lung cancer and helped drive a decline in adult smoking rates to less than 20% today. American Cancer Society epidemiologic studies continue to document the ongoing health impact of smoking. In 2014, the Surgeon General used our results to show that more than 480,000 Americans die each year from smoking cigarettes.
- CPS-I provided the first epidemiologic evidence that obesity increases risk of premature death, and subsequent studies from CPS-II helped to establish the link between obesity and death from breast, colorectal, and other cancers.
- In the early 1990s, CPS-II was the first prospective study to find a link between regular aspirin use and lower risk of colorectal cancer, a finding confirmed by many later studies. These results opened the door to ongoing studies in the US and internationally to find out if aspirin might lower the risk of other cancers and to better understand the overall risks and benefits of aspirin use.
- Our studies showing that high red and processed meat and alcohol intake, low physical activity, and longer sitting time increase the risk of cancer or mortality have contributed to the scientific evidence used to develop the Society’s Guidelines on Nutrition and Physical Activity for Cancer Prevention.

Moreover, findings from CPS-II were used to demonstrate the lifesaving potential of a lifestyle consistent with our guidelines.

- Findings from CPS-II contributed substantially to the scientific evidence associating increasing levels of specific types of air pollution with higher deaths rates from cardiovascular disease and lung cancer. These studies are cited prominently by both the Environmental Protection Agency and World Health Organization in policies and recommendations for US and worldwide air pollution limits.
- CPS-II data and biospecimens have been included in the identification or validation of nearly every confirmed breast, prostate, and pancreatic cancer genetic susceptibility variant known to date. This work has led to a better understanding of the heritable component of these cancers.

While landmark findings from the CPS-II cohort have informed multiple areas of public health policy and clinical practice, this cohort is aging and a new cohort is essential to continue exploring the effects of changing exposures and to provide greater opportunity to integrate biological and genetic factors into studies of other cancer risk factors. Therefore, following on the long history of partnering with Society volunteers and supporters, CPS-3 was established. From 2006 through 2013, more than 304,000 men and women, ages 30 to 65, were enrolled in CPS-3, and nearly all provided a blood sample at the time of enrollment. The blood specimens and questionnaire data collected from CPS-3 participants will be a valuable resource for research on cancer risk factors and premature mortality in the United States in the 21st century

Surveillance and Health Services Research: The Surveillance and Health Services Research (SHSR) program analyzes and disseminates data on cancer occurrence, risk factors, prevention, early detection, treatment, and outcomes to strengthen the scientific basis for and promote cancer control nationally and globally. Researchers in the SHSR program produce *Cancer Facts & Figures*, published annually since 1951, and the accompanying Cancer Statistics article,

published in *CA: A Cancer Journal for Clinicians* (cancerjournal.com) since 1967. These publications are the most widely cited sources for cancer statistics and are available on the Society's website at cancer.org/statistics and in hard copy from Society Division offices. In 2016, an interactive website called the Cancer Statistics Center (cancerstatisticscenter.cancer.org) was launched to provide consumers with a comprehensive, dynamic, and mobile-friendly way to access cancer statistics.

In addition, SHSR staff produces seven supplemental *Cancer Facts & Figures* reports with accompanying Cancer Statistics articles. Some of these publications focus on a specific cancer site (e.g., breast) or subpopulation (e.g., Hispanics), while *Cancer Prevention & Early Detection Facts & Figures* provides information on cancer risk factors and screening, along with Society recommendations, policy initiatives, and examples of evidence-based cancer control programs. Information on the worldwide cancer burden is disseminated in *Global Cancer Facts & Figures*, as well as *The Cancer Atlas* (canceratlas.cancer.org), which are collaborations with the International Agency for Research on Cancer (IARC) and the Union for International Cancer Control (UICC).

Surveillance epidemiologists also conduct and publish high-quality epidemiologic research to help advance the understanding of cancer. Since 1998, Society epidemiologists have collaborated with the National Cancer Institute, the Centers for Disease Control and Prevention, the National Center for Health Statistics, and the North American Association of Central Cancer Registries to produce the Annual Report to the Nation on the Status of Cancer, a highly cited, peer-reviewed journal article that reports current information related to cancer rates and trends in the US. Other research topics include exploring socioeconomic, racial, and geographic disparities in cancer risk factors, screening, and occurrence; describing global cancer trends; generating scientific evidence to support Society priority areas for cancer prevention, control, and advocacy; and demonstrating the association between public health interventions, such as tobacco control, and cancer incidence and mortality. Recent surveillance studies have reported declines in early stage prostate cancer incidence rates following the US Preventive Services Task Force

recommendations against routine PSA testing; state disparities in the number of cancer deaths caused by smoking; and incidence and survival rates in the US for numerous leukemia and lymphoma subtypes.

Health Services Research (HSR) activities began in the late 1990s, with a primary objective of performing high-quality, high-impact research to evaluate disparities in cancer treatment and outcomes in support of the Society's mission to reduce health care inequalities. Researchers in the HSR program use secondary data sources such as the National Cancer Data Base (NCDB), a hospital-based cancer registry jointly sponsored by the American Cancer Society and the American College of Surgeons. The NCDB has been key to the program's research on the impact of insurance status on cancer diagnosis, treatment, and outcomes, as well as for broader cancer treatment patterns. Other data sources include the SEER-Medicare database, a linkage of population-based cancer registry data with Medicare claims data, and the Medical Expenditure Panel Survey Data linked with National Health Interview Survey Data. Findings from HSR researchers have been instrumental in the Society's and the American Cancer Society Cancer Action Network's (ACS CAN) support of the Affordable Care Act (ACA) and its effect on public health. Recent studies include the association between the ACA expansion of coverage for dependents younger than age 26 and earlier stage at diagnosis among patients ages 19 to 25 for screening-detectable cancers and state disparities in lung cancer treatment.

Economic and Health Policy Research: An earlier version of the Economic and Health Policy Research (EHPR) program was created in 2006 to support collaborative tobacco control efforts involving the Society and numerous international organizations and academic institutions such as the WHO Tobacco Free Initiative, the Centers for Disease Control and Prevention (CDC), the Campaign for Tobacco-Free Kids, Johns Hopkins University, and the University of Illinois-Chicago, among others. The program focused on economic and policy research in tobacco control and research capacity building for the collection and analysis of economic data to provide the evidence base for tobacco control, particularly in LMICs. This was an

important investment by the Society because economic factors contribute greatly to the global tobacco epidemic, and economic solutions – such as tobacco taxation and better health-related trade and investment policies – are also among the most effective and most cost-effective policy interventions. Major donors in global health, such as the Bloomberg Philanthropies, the Bill & Melinda Gates Foundation, and the US National Institutes of Health, have supported these efforts through additional funding.

Due to the high demand for the type of economic and policy analysis generated by the program, the Society's leadership made a strategic decision in early 2013 to expand the program to the areas of nutrition and physical activity. Accordingly, the team now applies its expertise to a better understanding of the economic and policy aspects of most major cancer risk factors (e.g., tobacco use, poor nutrition, physical inactivity, alcohol misuse, etc.), as well as a number of other cancer-related challenges, including patient access to potentially lifesaving medicines and the direct and indirect costs of cancer and its treatment. The dissemination of this research comes in multiple forms, including publications in high-impact, peer-reviewed scientific journals; the release of public scientific reports; and local, national, and international capacity-building programs with governments, international governmental organizations, and civil society.

The flagship service publication of the EHPR program is *The Tobacco Atlas*, which is produced in collaboration with the Society's Global Cancer Control department and Vital Strategies. *The Tobacco Atlas, Fifth Edition* and its corresponding website, tobaccoatlas.org, were released at the 16th World Conference on Tobacco or Health in March 2015 in Abu Dhabi, United Arab Emirates, and are or will be available in five other languages – French, Spanish, Portuguese, Chinese, and Arabic. The EHPR has several other important tobacco control focus areas. First, the team is a leading voice on tobacco taxation, affordability of tobacco products, and issues around illicit trade in these goods. Second, the team is one of the principal research institutions examining the economics of tobacco farming globally. Using rigorous empirical research, the Society has been working with partners

including the World Bank, the University of Zambia, and the University of Malawi to counter the tobacco industry's false narrative that tobacco control hurts the economic livelihoods of tobacco farmers. Finally, the EHPR is actively involved in helping governments to navigate their tobacco control laws and regulations to ensure that they are not violating commitments to the international economic treaties to which they belong.

Behavioral Research Center: The American Cancer Society was one of the first organizations to recognize the importance of behavioral and psychosocial factors in the prevention and control of cancer and to fund extramural research in this area. In 1995, the Society established the Behavioral Research Center (BRC) within the Intramural Research department. The BRC co-hosts the Biennial Cancer Survivorship Research Conference along with partners from the National Cancer Institute, the Centers for Disease Control and Prevention, and the LIVESTRONG Foundation. Held every other year since 2002, this meeting serves as a forum for researchers, clinicians, cancer survivors, advocates, program planners, policy makers, and public health experts to learn about current and emerging cancer survivorship innovation in a rapidly changing landscape. The BRC's own work focuses on cancer survivorship, quality of life, tobacco control, healthy lifestyle (e.g., physical activity, nutrition, and weight management), and health disparities. Ongoing projects include:

- Studies of the quality of life of cancer survivors, which include the American Cancer Society Study of Cancer Survivors-I (SCS-I), a nationwide longitudinal study of a cohort of more than 6,000 cancer survivors that explores the physical and psychosocial adjustment to cancer and identifies factors affecting quality of life. Results from this research have informed the Society's informational materials and support programs for cancer patients, survivors, and their loved ones.
- A National Quality of Life Survey for Caregivers, which includes a nationwide longitudinal study of a cohort of more than 1,600 cancer caregivers that explores the impact of the family's involvement in cancer care on the quality of life of the cancer survivor and the caregiver

- Studies of symptoms associated with cancer and its treatment such as pain, fatigue, and depression. Symptoms are often underreported and undertreated but, ideally, are clinically assessed using patient-reported outcomes (PROs). We are investigating the use of PROs in the clinical setting, to monitor quality, and to measure population health with the goal of informing efforts to improve symptom control, quality of life, functioning, and treatment adherence among cancer patients and survivors.
- Studies to identify and prioritize gaps in information and resources for 1,200 breast, colorectal, and prostate cancer survivors as they transition from active treatment to the community care setting
- A randomized controlled trial (Moving Forward Together 3) to test the delivery and sustainability of a telephone-based physical activity intervention implemented via the Society's Reach To Recovery breast cancer support program, conducted in collaboration with researchers at The University of South Carolina with funding support from the National Cancer Institute
- Studies investigating how social, psychological, and other factors impact smokers' motivation and ability to quit in order to improve existing Society programs for smoking cessation (e.g., the Freshstart and the Great American Smokeout® programs) or to develop new technology-based interventions for smokers who seek cessation assistance
- Development and evaluation of Springboard Beyond Cancer, an online self-management program for cancer survivors, with the Society's Cancer Control department and the National Cancer Institute. The online tool is designed to make it easy for those who are both in treatment and post-treatment to access essential information to help them manage ongoing cancer-related symptoms, deal with stress, change healthy behaviors, communicate better with their health care team, and seek support from friends and family.

Statistics and Evaluation Center: The mission of the Statistics and Evaluation Center (SEC) is to deliver valid, reliable, and timely information to Society leadership and

staff for evidence-based decision making that ensures the Society continues to provide effective, high-quality programs. The SEC has 3 main responsibilities: 1) to provide leadership on evaluations of Society mission and income delivery programs, including study, survey and sample design, data analysis, and, report preparation; 2) to provide operational support for surveys and other data collection related to anyone using the Society's services; and 3) to support Society programs and activities through information, analysis, and knowledge integration. SEC staff expertise draws from statistical, evaluation, and geospatial sciences, with extensive experience in survey/sample study design and project management.

SEC staff work closely with researchers in Intramural Research and across the Society to improve program efficiency and impact through targeted data collection and analysis. Evidence generated through published research, through the Society's own data capture, and evaluations are used to create impactful cancer prevention and patient support programs and target those programs in geographical areas of most need. Focus groups, structured interviews, semi-structured interviews, and online surveys are all used in the design and implementation of process and outcome evaluations of Society programs, pilot studies, and initiatives. The SEC is a full participant in the Society's community-based cancer prevention initiatives. In particular, the SEC provides support to the Society's leadership of national roundtables on HPV vaccination as a cancer preventive and on increasing colorectal cancer screening. Evaluation, educational, and operational support has also been provided for a CDC-funded initiative aimed at increasing HPV vaccination rates among adolescents as a means of preventing future cancer.

The SEC collaborates with staff in the Behavioral Research Center and the Society's Cancer Control department in ongoing evaluations of all Society survivorship and quality-of-life programs, in the development of guidelines to support quality-of-life improvements in cancer survivors who have completed their cancer treatments, and in developing and evaluating fundraising activities in support of these programs. The SEC continues its collaboration with the

Society's Global Cancer Control department in assessing lodging and transportation needs of cancer patients in East Africa. The SEC is working with the Society's Talent Development program to evaluate its emerging leadership training program and ongoing diversity and inclusion initiatives.

The SEC continues to grow its Geospatial services, providing the Society with integrated GIS analysis, research reports, and visualization products that inform decision making at all levels of the organization. The SEC collaborates with the Surveillance and Health Services Research program to provide the Society's mission and advocacy programs with research on the geographical distribution of cancer, locations of cancer patient needs, and, associated barriers to care. In 2016, the SEC and the SHSR together published estimated mortality rates for selected cancer for each US congressional district and provided ACS CAN staff with a web-based tool to quickly access the hundreds of maps that resulted from this project.

Advocacy

Saving lives from cancer is as much a matter of public policy as scientific discovery. Lawmakers play a critical role in determining how much progress we make as a country to save lives – whether it's advocating for quality, affordable health care for all Americans, increasing funding for cancer research and programs, improving quality of life for patients and their families, or enacting laws and policies that help communities prevent cancer and promote good health. The American Cancer Society Cancer Action Network (ACS CAN), the Society's nonprofit, nonpartisan advocacy affiliate, works with federal, state and local policy makers to achieve these goals.

Created in 2001, ACS CAN is the force behind a powerful grassroots movement uniting and empowering cancer patients, survivors, caregivers, and their families to save lives from cancer. As the nation's leading voice advocating for public policies that are helping to defeat cancer, ACS CAN works to encourage elected officials and candidates to make cancer a top national priority. In recent years, ACS CAN has successfully worked to pass and implement

laws at the federal, state, and local levels that assure cancer patients access to adequate and affordable health insurance coverage; increase funding for groundbreaking cancer research; improve access to prevention and early detection measures, treatment, and follow-up care; and improve quality of life for cancer patients.

Some of ACS CAN's recent advocacy accomplishments on behalf of cancer patients are outlined in the following sections.

Access to Care

ACS CAN successfully advocated for the enactment of key patient protections in the Affordable Care Act (ACA) that eliminated insurance coverage exclusions, prevented pre-existing condition exclusions, eliminated caps on annual and lifetime coverage benefits, and removed copays for key cancer preventive services and early detection screenings like mammography and colonoscopy. The law also requires coverage of routine care for participants in clinical trials, and created a new dedicated Prevention and Public Health Fund, providing billions of dollars each year for national and community-based prevention efforts. Finally, the ACA affords states the opportunity to expand eligibility for state Medicaid programs, allowing millions of low-income individuals and families to gain access to comprehensive and affordable health care coverage.

The organization continues to monitor implementation of this important law to ensure:

- Continued expansion of Medicaid in all 50 states in the face of a 2012 Supreme Court ruling that made the expansion a state-by-state option, while also closely monitoring states that take an alternative approach to providing this coverage to low-income residents through federal approval for demonstration projects
- Passage of legislation to ensure cost-sharing for chemotherapy and other vital treatment options is affordable to patients
- Full public access to health plan information for consumers shopping for health insurance coverage

- Full federal funding for community health centers, which provide community-oriented primary care in areas that are underserved or do not have access to other health care services
- Access to preventive services without cost sharing
- Continuation of the Prevention and Public Health Fund

Funding Research

ACS CAN is a leader in the effort to ensure full funding for the nation's public cancer research institutions, including the National Institutes of Health and its National Cancer Institute. Each year, nearly \$5 billion in grant funding for cancer research is distributed to investigators working in cancer centers, universities, and labs in every state of the country. Federal budget pressures threaten this funding every year, and ACS CAN views this driver of the research pipeline to be of prime importance in the search for cures, and fights not only to protect this funding, but also to expand it.

Prevention and Early Detection

ACS CAN is supporting policies that focus on the prevention and early detection of cancer by:

- Leading the advocacy partnership that pushed the 2009 enactment of the Family Smoking Act giving the US Food and Drug Administration authority, for the first time, to regulate the production and marketing of tobacco products. ACS CAN is now working to expedite full implementation of the law, including the regulation of new and emerging products.
- Leading efforts to pass comprehensive smoke-free laws, including 25 states, the District of Columbia, Puerto Rico, the US Virgin Islands, and countless local jurisdictions requiring all workplaces, restaurants, and bars to be smoke-free. California closed gaps in its smoke-free law in 2016, bringing the percentage of the US population covered by comprehensive laws to nearly 60%.
- Working to increase the price of tobacco products through increases in federal and state taxes on all tobacco products and defending against tax rollbacks.

The average state tax rate for cigarettes rose to \$1.65 per pack (as of August 2015), largely due to a \$1.00 increase in Pennsylvania's cigarette tax.

- Working to increase and protect state funding for tobacco control programs
- Continuing its role as an intervener in the long-pending tobacco industry appeal of the federal government's lawsuit against the industry, in which specific manufacturers found to be in violation of the Racketeer Influenced and Corrupt Organizations statute for engaging in decades of fraudulent practices aimed at addicting generations of smokers to their deadly products
- Advocating for coverage of cancer screenings and other recommended preventive services without financial barriers in private insurance, Medicare, and Medicaid
- Advocating for full funding for the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) which provides low-income, uninsured, and medically underserved women access to cancer screenings, diagnostic, patient navigation and treatment services
- Urging policy makers to invest federal and state funds in colorectal cancer control programs that ensure promotion and coverage of screening for the uninsured and underinsured through use of evidence-based interventions
- Supporting federal legislation to eliminate a glitch in the law that imposes substantial patient out-of-pocket costs on Medicare beneficiaries who have a polyp removed during colonoscopy
- Supporting efforts to help increase human papillomavirus (HPV) vaccination uptake
- Continuing to support implementation of the Healthy, Hunger-Free Kids Act of 2010, important legislation to reauthorize the federal child nutrition programs and strengthen school nutrition, and advocate to maintain science-based standards for school meals and snacks as part of the child nutrition programs reauthorization

- Advocating for state and local requirements to increase the quality and quantity of physical education and physical activity in K-12 schools and hold schools accountable for increasing students' physical activity and fitness
- Supporting the federal government's development of the 2018 edition of the Physical Activity Guidelines for Americans, which provides evidence-based recommendations for physical activity to improve health
- Supporting the implementation of menu labeling in restaurants and other food retail establishments and of the updated Nutrition Facts label that appears on most packaged foods and beverages
- Urging federal regulation of indoor tanning devices and working with states to pass legislation prohibiting minors from accessing indoor tanning devices

Quality of Life

- ACS CAN supports balanced pain policies at the federal and state levels that ensure continued patient and survivor access to the pain relief medications that they need to live and work independently and have good quality of life.
- ACS CAN supports the enactment of legislation to assure cancer patients' full access to palliative care services, along with curative treatment, from the point of diagnosis through treatment and survivorship or

end of life as the case may be. Palliative care for pain and symptoms of treatment has been shown to improve patient, survivor, and family quality of life; in some cases it can improve survival; and it can lower health care costs as better care reduces patient trips to the emergency room, hospital admissions and readmissions, as well as days in the ICU. The legislation provides for increased training and professional development in palliative care, a nationwide public and provider education campaign to disseminate information about the benefits of palliative care, and additional research on pain and symptom management with the intent of improving patient care. The organization is making sure the voice of the cancer community is heard in the halls of government and is empowering communities everywhere to help save lives from cancer.

Central to ACS CAN's success is the sophisticated and effective volunteer structure. Across the country, volunteers in every congressional district work closely with ACS CAN to organize and execute advocacy campaigns. Together, these committed volunteers recruit and support other volunteers dedicated to the most critical components of successful advocacy campaigns: grassroots mobilization, media outreach, fundraising, and integrating advocacy into the Society's Relay For Life®, Making Strides Against Breast Cancer®, Colleges Against Cancer® and Coaches vs. Cancer® signature programs and events.

Sources of Statistics

Estimated new cancer cases in 2017. The number of new cancer cases diagnosed in the US in 2017 is estimated using a spatiotemporal model based on incidence data from 49 states and the District of Columbia (DC) for the years 1999-2013 that met the North American Association of Central Cancer Registries' (NAACCR) high-quality data standard. NAACCR is an umbrella organization that sets standards, collects, and disseminates incidence data from cancer registries in the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) program and the Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR). The case projection method considers geographic variations in sociodemographic and lifestyle factors, medical settings, and cancer screening behaviors as predictors of incidence, and also accounts for expected delays in case reporting. (For more information on this method, see "A" in Additional information on page 70.)

The number of new cases of female breast carcinoma in situ and melanoma in situ diagnosed in the US in 2017 is estimated by 1) approximating the actual number of cases in the 10 most recent data years (2004-2013) by applying average annual age-specific incidence rates (based on 46 states and DC) to population estimates; 2) calculating the average annual percent change (AAPC) in cases over this time period; and 3) using the AAPC to project the number of cases four years ahead. In situ estimates are not adjusted for reporting delays.

Incidence rates. Incidence rates are defined as the number of people who are diagnosed with cancer divided by the number of people who are at risk for the disease in the population during a given time period, usually one year. Annual incidence rates in this publication are presented per 100,000 people and are age adjusted to the 2000 US standard population to allow comparisons across populations with different age distributions. Age-adjusted rates should only be compared to rates that are adjusted to the same population standard. State-, race-, and ethnicity-specific incidence rates were previously published in NAACCR's publication *Cancer*

Incidence in North America, 2009-2013. (See "B" in Additional information on page 70 for full reference.)

Trends in cancer incidence rates provided in the text of this publication are based on delay-adjusted incidence rates from the nine oldest SEER registries. Delay-adjustment accounts for delays and error corrections that occur in the reporting of cancer cases, which is substantial for some sites, particularly those less often diagnosed in a hospital, such as leukemia. Delay-adjustment is not available for some cancer types. Trends were originally published in the *SEER Cancer Statistics Review (CSR) 1975-2013.* (See "C" in Additional information on page 70 for full reference.)

Estimated cancer deaths in 2017. The number of cancer deaths in the US in 2017 was estimated by fitting the number of cancer deaths from 2000 to 2014 to a statistical model and then using the most recent trend (APC) to forecast the number in 2017. Data on the number of deaths were obtained from the National Center for Health Statistics (NCHS) at the Centers for Disease Control and Prevention. (For more information on this method, see "D" in Additional information on page 70.)

Mortality rates. Mortality rates, or death rates, are defined as the number of people who die from cancer divided by the number of people at risk in the population during a given time period, usually one year. Annual mortality rates in this publication are based on cancer death counts compiled by the NCHS and presented per 100,000 people and are age adjusted to the 2000 US standard population. Trends in cancer mortality rates provided in the text are based on mortality data from 1975 to 2014.

Important note about estimated cancer cases and deaths for the current year. While these estimates provide a reasonably accurate portrayal of the current cancer burden in the absence of actual data, they should be interpreted with caution because they are model-based projections that may vary from year to year for reasons other than changes in cancer occurrence. In addition, they are not informative for tracking cancer trends. Trends in cancer occurrence are analyzed using

age-adjusted incidence rates reported by population-based cancer registries and mortality rates reported by the NCHS.

Survival. This report describes survival in terms of 5-year relative survival rates, which are adjusted for normal life expectancy by comparing survival among cancer patients to survival in people of the same age, race, and sex who were not diagnosed with cancer. Many of the survival rates presented in this publication were previously published in the *CSR 1975-2013*. Trends in 5-year survival are based on data from the nine oldest SEER registries, which go back to 1975, whereas contemporary 5-year survival rates are based on data from all 18 SEER registries, which provide greater population coverage. In addition to 5-year relative survival rates, 10- and 15-year survival rates are presented for selected cancers. These rates were generated using the NCI's SEER 18 database and SEER*Stat software version 8.3.2. (See "E" in Additional information for full reference.)

Probability of developing cancer. Probabilities of developing cancer were calculated using DevCan (Probability of Developing Cancer) software version 6.7.4, developed by the NCI. (See "F" in Additional information for full reference.) These probabilities reflect the average experience of people in the US and do not take into

account individual behaviors and risk factors. For example, the estimate of 1 man in 14 developing lung cancer in a lifetime underestimates the risk for smokers and overestimates the risk for nonsmokers.

Additional information. More information on the methods used to generate the statistics for this report can be found in the following publications:

- A. Zhu L, Pickle LW, Naishadham D, et al. Predicting US and state-level cancer counts for the current calendar year: part II – evaluation of spatio-temporal projection methods for incidence. *Cancer* 2012;118(4): 1100-9.
- B. Copeland G, Lake A, Firth R, et al. (eds). *Cancer in North America: 2009-2013. Volume Two: Registry-specific Cancer Incidence in the United States and Canada*. Springfield, IL: North American Association of Central Cancer Registries, Inc. June 2016. Available at naaccr.org/DataandPublications/CINAPubs.aspx.
- C. Howlander N, Noone AM, Krapcho M, et al. (eds). *SEER Cancer Statistics Review, 1975-2013*. National Cancer Institute. Bethesda, MD, 2016. Available at seer.cancer.gov.
- D. Chen HS, Portier K, Ghosh K, et al. Predicting US and State-level counts for the current calendar year: part I – evaluation of temporal projection methods for mortality. *Cancer* 2012;118(4):1091-9.
- E. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence – SEER 18 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2015 Sub (1973-2013 varying) – Linked To County Attributes – Total U.S., 1969-2014 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2016, based on the November 2015 submission.
- F. DevCan: Probability of Developing or Dying of Cancer Software, Version 6.7.4; Statistical Research and Applications Branch, National Cancer Institute, 2016. <http://srab.cancer.gov/devcan>

American Cancer Society Recommendations for the Early Detection of Cancer in Average-risk Asymptomatic People*

Cancer Site	Population	Test or Procedure	Recommendation
Breast	Women, ages 40-54	Mammography	Women should undergo regular screening mammography starting at age 45. Women ages 45 to 54 should be screened annually. Women should have the opportunity to begin annual screening between the ages of 40 and 44.
	Women, ages 55+		Transition to biennial screening, or have the opportunity to continue annual screening. Continue screening as long as overall health is good and life expectancy is 10+ years.
Cervix	Women, ages 21-29	Pap test	Screening should be done every 3 years with conventional or liquid-based Pap tests.
	Women, ages 30-65	Pap test & HPV DNA test	Screening should be done every 5 years with both the HPV test and the Pap test (preferred), or every 3 years with the Pap test alone (acceptable).
	Women, ages 66+	Pap test & HPV DNA test	Women ages 66+ who have had ≥ 3 consecutive negative Pap tests or ≥ 2 consecutive negative HPV and Pap tests within the past 10 years, with the most recent test occurring in the past 5 years should stop cervical cancer screening.
	Women who have had a total hysterectomy		Stop cervical cancer screening.
Colorectal[†]	Men and women, ages 50+	Guaiac-based fecal occult blood test (gFOBT) with at least 50% sensitivity or fecal immunochemical test (FIT) with at least 50% sensitivity, OR	Annual testing of spontaneously passed stool specimens. Single stool testing during a clinician office visit is not recommended, nor are “throw in the toilet bowl” tests. In comparison with guaiac-based tests for the detection of occult blood, immunochemical tests are more patient-friendly and are likely to be equal or better in sensitivity and specificity. There is no justification for repeating FOBT in response to an initial positive finding.
		Stool DNA test, OR	Every 3 years
		Flexible sigmoidoscopy (FSIG), OR	Every 5 years alone, or consideration can be given to combining FSIG performed every 5 years with a highly sensitive gFOBT or FIT performed annually.
		Double-contrast barium enema, OR	Every 5 years
		Colonoscopy, OR	Every 10 years
CT Colonography	Every 5 years		
Endometrial	Women at menopause		Women should be informed about risks and symptoms of endometrial cancer and encouraged to report unexpected bleeding to a physician.
Lung	Current or former smokers ages 55-74 in good health with 30+ pack-year history	Low-dose helical CT (LDCT)	Clinicians with access to high-volume, high-quality lung cancer screening and treatment centers should initiate a discussion about annual lung cancer screening with apparently healthy patients ages 55-74 who have at least a 30 pack-year smoking history, and who currently smoke or have quit within the past 15 years. A process of informed and shared decision making with a clinician related to the potential benefits, limitations, and harms associated with screening for lung cancer with LDCT should occur before any decision is made to initiate lung cancer screening. Smoking cessation counseling remains a high priority for clinical attention in discussions with current smokers, who should be informed of their continuing risk of lung cancer. Screening should not be viewed as an alternative to smoking cessation
Prostate	Men, ages 50+	Prostate-specific antigen test with or without digital rectal examination	Men who have at least a 10-year life expectancy should have an opportunity to make an informed decision with their health care provider about whether to be screened for prostate cancer, after receiving information about the potential benefits, risks, and uncertainties associated with prostate cancer screening. Prostate cancer screening should not occur without an informed decision-making process.

CT-Computed tomography. *All individuals should become familiar with the potential benefits, limitations, and harms associated with cancer screening. †All positive tests (other than colonoscopy) should be followed up with colonoscopy.

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