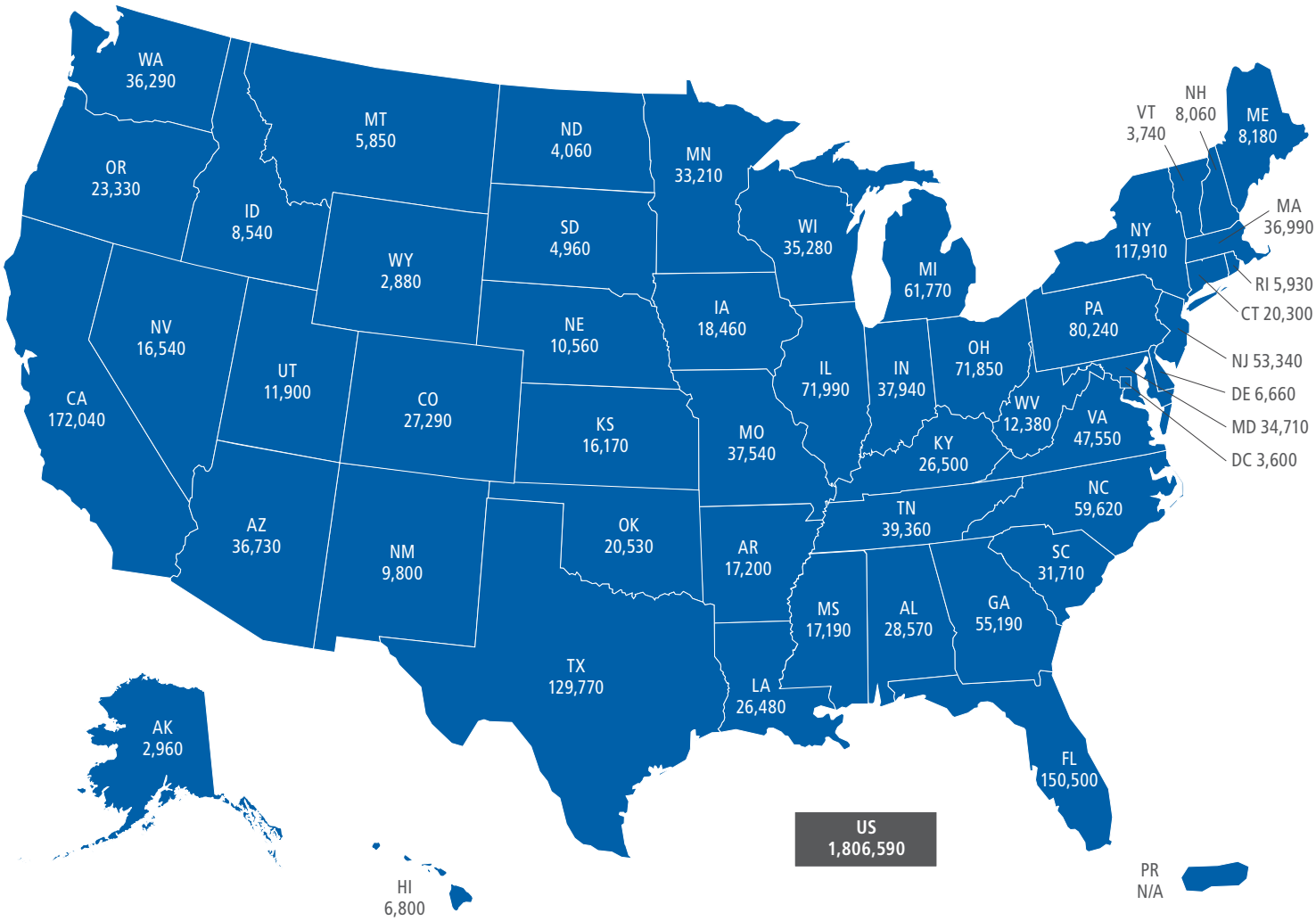
American Cancer Society®

Cancer Facts & Figures 2020



Estimated number of new cancer cases for 2020, 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.

Special Section: Cancer in Adolescents and Young Adults

see page 29

Contents

Basic Cancer Facts 1

Figure 1. Trends in Age-adjusted Cancer Death Rates by Site, Males, US, 1930-2017 2

Figure 2. Trends in Age-adjusted Cancer Death Rates by Site, Females, US, 1930-2017 3

Table 1. Estimated Number of New Cancer Cases and Deaths by Sex, US, 2020 4

Table 2. Estimated Number of New Cases for Selected Cancers by State, US, 2020 5

Table 3. Estimated Number of Deaths for Selected Cancers by State, US, 2020 6

Table 4. Incidence Rates for Selected Cancers by State, US, 2012-2016 7

Table 5. Death Rates for Selected Cancers by State, US, 2013-2017 8

Figure 3. Leading Sites of New Cancer Cases and Deaths – 2020 Estimates 10

Selected Cancers 10

Table 6. Probability (%) of Developing Invasive Cancer during Selected Age Intervals by Sex, US, 2014-2016 14

Table 7. Trends in 5-year Relative Survival Rates (%) by Race, US, 1975-2015 18

Table 8. Five-year Relative Survival Rates (%) by Stage at Diagnosis, US, 2009-2015 21

Special Section: Cancer in Adolescents and Young Adults 29

Table S1. Estimated Cancer Cases and Deaths in AYAs by Age, US, 2020 29

Figure S1. Case Distribution (%) of Leading Cancer Types in AYAs, US, 2012-2016 29

Figure S2. Leading Sites of New Cancer Cases in AYAs, Both Sexes Combined – 2020 Estimates 30

Figure S3. Trends in AYA Cancer Incidence and Mortality Rates for All Cancers Combined by Age and Sex, US, 1975-2017 31

Figure S4. AYA Cancer Incidence and Mortality Rates by Sex and Race/Ethnicity, US, 2012-2017 32

Figure S5. Kaposi Sarcoma and Non-Hodgkin Lymphoma Incidence Rates in Comparison to All Other Cancers Combined among Young Adult Men, US, 1975-2016 32

Figure S6. Trends in AYA Cancer Incidence Rates by Site and Age, US, 1995-2016 33

Figure S7. Trends in AYA Cancer Mortality Rates by Site and Sex, US, 1975-2017 34

Table S2. Cancer Incidence (2012-2016), Mortality (2013-2017), and 5-year Relative Survival (2009-2015) Rates in AYAs by Age, US 35

Figure S8. Five-year Cause-specific Survival by Race/Ethnicity for Selected Cancers in AYAs, US, 2009-2015 36

Figure S9. Stage Distribution for Selected Cancers in AYAs, US, 2012-2016 37

Figure S10. Observed-to-expected (O/E) Ratios for Subsequent Cancers by Primary Site, Ages 15-39, US, 1975-2016 40

Tobacco Use 44

Figure 4. Proportion of Cancer Deaths Attributable to Cigarette Smoking in Adults 30 Years and Older, US, 2014 44

Excess Body Weight, Alcohol, Diet, & Physical Activity 49

Cancer Disparities 52

Table 9. Incidence and Mortality Rates for Selected Cancers by Race and Ethnicity, US, 2012-2017 54

The Global Cancer Burden 55

The American Cancer Society 58

Sources of Statistics 67

American Cancer Society Recommendations for the Early Detection of Cancer in Average-risk Asymptomatic People 70

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.

Suggested citation: American Cancer Society. *Cancer Facts & Figures 2020.* Atlanta: American Cancer Society; 2020.

Global Headquarters: American Cancer Society Inc.
250 Williams Street, NW, Atlanta, GA 30303-1002
404-320-3333

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 causes of cancer are not completely understood, numerous factors are known to increase the disease's occurrence, including many that are modifiable (e.g., tobacco use and excess body weight) and others that are not (e.g., inherited genetic mutations). These risk factors may act simultaneously or in sequence to initiate and/or promote cancer growth.

Can Cancer Be Prevented?

A substantial proportion of cancers could be prevented, including all cancers caused by tobacco use and other unhealthy behaviors. According to a recent study by American Cancer Society researchers, at least 42% of newly diagnosed cancers in the US – about 750,000 cases in 2020 – are potentially avoidable, including the 19% of all cancers that are caused by smoking and the 18% caused by a combination of excess body weight, alcohol consumption, poor nutrition, and physical inactivity. Certain cancers caused by infectious agents, such as human papillomavirus (HPV), hepatitis B virus (HBV), hepatitis C virus (HCV), and *Helicobacter pylori* (*H. pylori*), could be prevented through behavioral changes or vaccination to avoid the infection, 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 detecting precancerous lesions that can be removed. It can also detect some cancers early, when treatment is more often successful. Screening is known to reduce mortality for cancers of the breast, colon, rectum, cervix, lung (among current or former heavy smokers), and probably prostate. In addition, being aware of changes in the body, such as the breast, skin, mouth, eyes, or genitalia, and bringing these to the attention of a health care professional, may also result in the early detection of cancer. For complete cancer screening guidelines, see page 70.

How Many People Alive Today Have Ever Had Cancer?

More than 16.9 million Americans with a history of cancer were alive on January 1, 2019, most of whom were diagnosed many years ago and have no current evidence of cancer.

How Many New Cases and Deaths Are Expected to Occur in 2020?

More than 1.8 million new cancer cases are expected to be diagnosed in 2020 (Table 1). 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 types of skin cancer are not required to be reported to cancer registries. Table 2 provides estimated new cancer cases in 2020 by state.

About 606,520 Americans are expected to die of cancer in 2020 (Table 1), which translates to about 1,660 deaths per day. Cancer is the second most common cause of death in the US, exceeded only by heart disease. Table 3 provides estimated cancer deaths by state in 2020.

How Much Progress Has Been Made against Cancer?

Cancer death rates are the best measure of progress against the disease because they are less affected by detection practices than cancer incidence (new diagnoses) and survival rates. The overall age-adjusted cancer death rate rose during most of the 20th century, peaking in 1991 at 215 cancer deaths per 100,000 people, mainly because of the smoking epidemic. As of 2017, the rate had dropped to 152 per 100,000 (a decline of 29%) because of reductions in smoking, as well as improvements in early detection and treatment. This decline translates into more than 2.9 million fewer cancer deaths from 1991 to 2017, progress that has been driven by steady declines in death rates for the four most common cancer types – lung, colorectal, breast, and prostate (Figure 1 and Figure 2).

Do Cancer Incidence and Death Rates Vary by State?

Table 4 and Table 5 provide average annual incidence (new diagnoses) and death rates for selected cancer types by state. Lung cancer rates vary the most by state, reflecting historical differences in smoking prevalence that continue today.

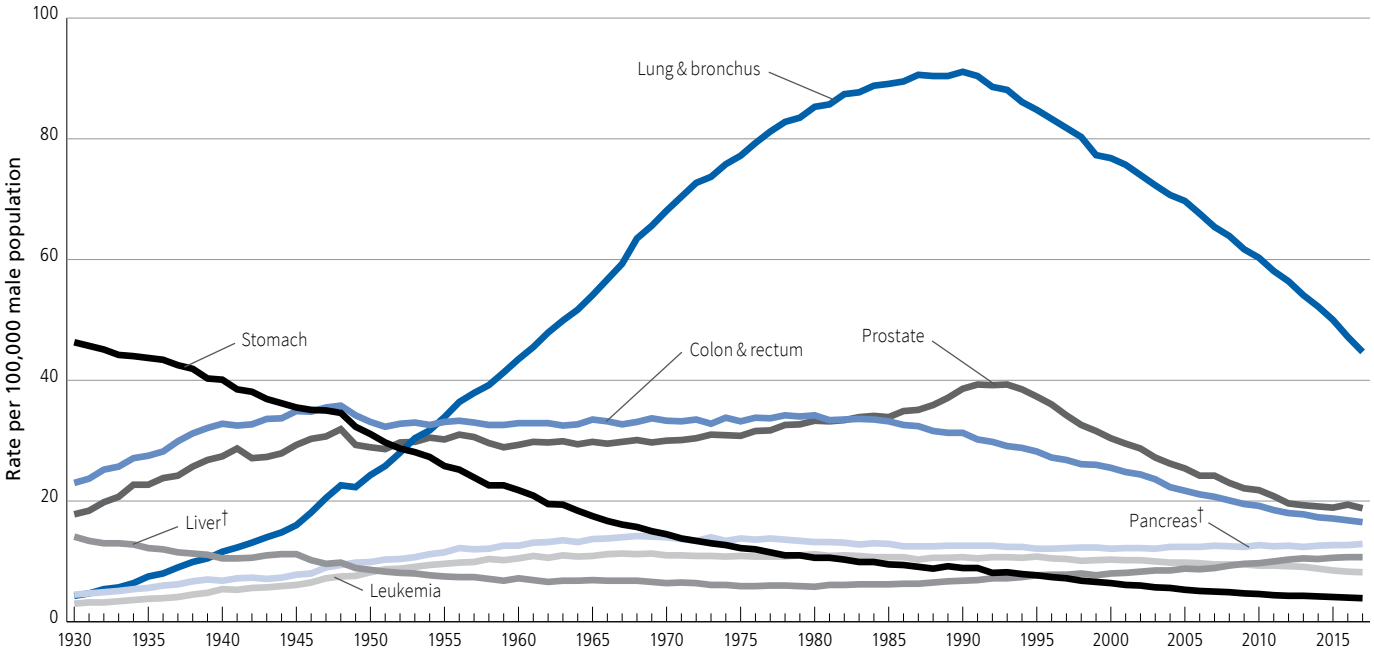
Who Is at Risk of Developing Cancer?

Cancer usually develops in older people; 80% of all cancers in the United States are diagnosed in people 55 years of age or older. Certain behaviors also increase risk, such as smoking, having excess body weight, and drinking alcohol. In the US, an estimated 40 out of 100 men and 39 out of 100 women will develop cancer during their lifetime (Table 6). These estimates are based on cancer occurrence in the general population and may differ for individuals because of exposures (e.g., smoking), family history, and/or genetic susceptibility.

For many types of cancer, risk is higher with a family history of the disease. This is thought to result primarily from the inheritance of genetic variations that confer low or moderate risk and/or similar exposures to lifestyle/environmental risk factors among family members. Inheritance of genetic alterations that confer a very high risk occurs much more rarely.

Relative risk is the strength of the relationship between exposure to a given risk factor and cancer. It is measured by comparing the rate of cancer in a group of people with a certain exposure or trait to the rate in a group of people without this characteristic. For example, men and women who smoke are about 25 times more likely to develop lung cancer than nonsmokers, so the relative risk of lung cancer among smokers is 25. Most relative risks are not this large. For example, the relative risk of breast cancer among women who have a mother, sister, or daughter with a history of breast cancer is about 2.

Figure 1. Trends in Age-adjusted Cancer Death Rates* by Site, Males, US, 1930-2017



*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, and colon and rectum are affected by these coding changes.

Source: US Mortality Volumes 1930 to 1959, US Mortality Data 1960 to 2017, National Center for Health Statistics, Centers for Disease Control and Prevention.

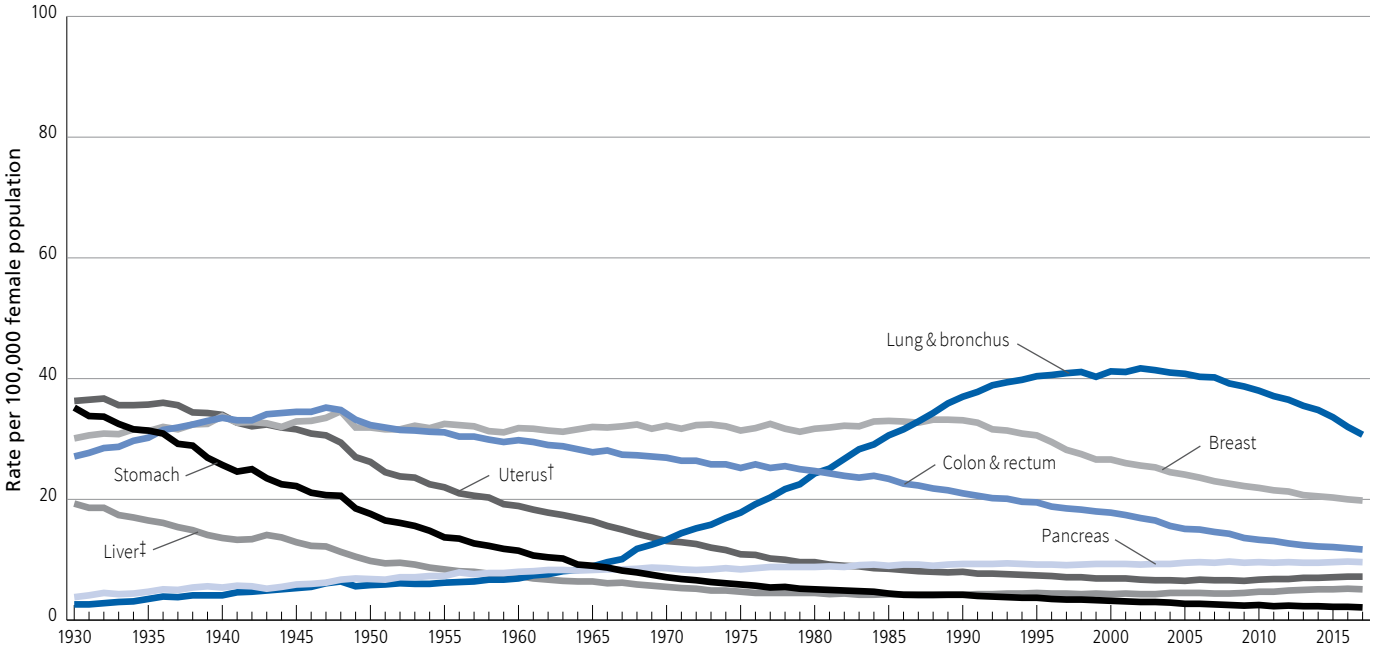
What Percentage of People Survive Cancer?

The 5-year relative survival rate for all cancers combined has increased substantially since the early 1960s, from 39% to 70% among whites and from 27% to 64% among blacks. Improvements in survival (Table 7) reflect advances in treatment, as well as earlier diagnosis for some cancers. Survival varies greatly by cancer type, as well as stage and age at diagnosis (Table 8).

Relative survival is the proportion of people who are alive for a designated time (usually 5 years) after a cancer diagnosis divided by the proportion of people of similar age, race, etc. expected to be alive in the absence of cancer based on normal life expectancy. Relative survival 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 death can occur beyond 5 years after diagnosis. For information about how survival rates were calculated for this report, see Sources of Statistics on page 67.

Although relative survival rates provide some indication about the average experience of cancer patients, they should be interpreted with caution for several reasons. 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 at least several years in the past. Second, they do not account for many factors that influence individual survival, such as access to treatment, other illnesses, and biological or behavioral differences. Third, improvements in survival rates over time do not always indicate progress against cancer. For example, increases in average survival rates occur when screening results in the detection of cancers that would never have caused harm if left undetected (overdiagnosis).

Figure 2. Trends in Age-adjusted Cancer Death Rates* by Site, Females, US, 1930-2017



*Per 100,000, age adjusted to the 2000 US standard population. Rates exclude deaths in Puerto Rico and other US territories. †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 cancers of the liver, lung and bronchus, colon and rectum, and uterus are affected by these coding changes.

Source: US Mortality Volumes 1930 to 1959, US Mortality Data 1960 to 2017, National Center for Health Statistics, Centers for Disease Control and Prevention.

Table 1. Estimated Number* of New Cancer Cases and Deaths by Sex, US, 2020

	Estimated New Cases			Estimated Deaths		
	Both sexes	**Male**	**Female**	**Both sexes**	**Male**	**Female**
All sites	1,806,590	893,660	912,930	606,520	321,160	285,360
Oral cavity & pharynx	53,260	38,380	14,880	10,750	7,760	2,990
Tongue	17,660	12,960	4,700	2,830	1,980	850
Mouth	14,320	8,430	5,890	2,660	1,690	970
Pharynx	17,950	14,630	3,320	3,640	2,820	820
Other oral cavity	3,330	2,360	970	1,620	1,270	350
Digestive system	333,680	187,620	146,060	167,790	97,560	70,230
Esophagus	18,440	14,350	4,090	16,170	13,100	3,070
Stomach	27,600	16,980	10,620	11,010	6,650	4,360
Small intestine	11,110	6,000	5,110	1,700	940	760
Colon†	104,610	52,340	52,270	53,200	28,630	24,570
Rectum	43,340	25,960	17,380			
Anus, anal canal, & anorectum	8,590	2,690	5,900	1,350	540	810
Liver & intrahepatic bile duct	42,810	30,170	12,640	30,160	20,020	10,140
Gallbladder & other biliary	11,980	5,600	6,380	4,090	1,700	2,390
Pancreas	57,600	30,400	27,200	47,050	24,640	22,410
Other digestive organs	7,600	3,130	4,470	3,060	1,340	1,720
Respiratory system	247,270	130,340	116,930	140,730	76,370	64,360
Larynx	12,370	9,820	2,550	3,750	3,000	750
Lung & bronchus	228,820	116,300	112,520	135,720	72,500	63,220
Other respiratory organs	6,080	4,220	1,860	1,260	870	390
Bones & joints	3,600	2,120	1,480	1,720	1,000	720
Soft tissue (including heart)	13,130	7,470	5,660	5,350	2,870	2,480
Skin (excluding basal & squamous)	108,420	65,350	43,070	11,480	8,030	3,450
Melanoma of the skin	100,350	60,190	40,160	6,850	4,610	2,240
Other nonepithelial skin	8,070	5,160	2,910	4,630	3,420	1,210
Breast	279,100	2,620	276,480	42,690	520	42,170
Genital system	317,260	203,740	113,520	67,830	34,210	33,620
Uterine cervix	13,800		13,800	4,290		4,290
Uterine corpus	65,620		65,620	12,590		12,590
Ovary	21,750		21,750	13,940		13,940
Vulva	6,120		6,120	1,350		1,350
Vagina & other genital, female	6,230		6,230	1,450		1,450
Prostate	191,930	191,930		33,330	33,330	
Testis	9,610	9,610		440	440	
Penis & other genital, male	2,200	2,200		440	440	
Urinary system	159,120	110,230	48,890	33,820	23,540	10,280
Urinary bladder	81,400	62,100	19,300	17,980	13,050	4,930
Kidney & renal pelvis	73,750	45,520	28,230	14,830	9,860	4,970
Ureter & other urinary organs	3,970	2,610	1,360	1,010	630	380
Eye & orbit	3,400	1,890	1,510	390	210	180
Brain & other nervous system	23,890	13,590	10,300	18,020	10,190	7,830
Endocrine system	55,670	14,160	41,510	3,260	1,600	1,660
Thyroid	52,890	12,720	40,170	2,180	1,040	1,140
Other endocrine	2,780	1,440	1,340	1,080	560	520
Lymphoma	85,720	47,070	38,650	20,910	12,030	8,880
Hodgkin lymphoma	8,480	4,690	3,790	970	570	400
Non-Hodgkin lymphoma	77,240	42,380	34,860	19,940	11,460	8,480
Myeloma	32,270	17,530	14,740	12,830	7,190	5,640
Leukemia	60,530	35,470	25,060	23,100	13,420	9,680
Acute lymphocytic leukemia	6,150	3,470	2,680	1,520	860	660
Chronic lymphocytic leukemia	21,040	12,930	8,110	4,060	2,330	1,730
Acute myeloid leukemia	19,940	11,090	8,850	11,180	6,470	4,710
Chronic myeloid leukemia	8,450	4,970	3,480	1,130	670	460
Other leukemia‡	4,950	3,010	1,940	5,210	3,090	2,120
Other & unspecified primary sites‡	30,270	16,080	14,190	45,850	24,660	21,190

*Rounded to the nearest 10; cases exclude basal cell and squamous cell skin cancer and in situ carcinoma except urinary bladder. About 48,530 cases of female breast ductal carcinoma in situ and 95,710 cases of melanoma in situ will be diagnosed in 2020. †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 2002-2016 incidence data reported by the North American Association of Central Cancer Registries (NAACCR). Estimated deaths are based on 2003-2017 US mortality data, National Center for Health Statistics, Centers for Disease Control and Prevention.

Table 2. Estimated Number* of New Cases for Selected Cancers by State, US, 2020

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	28,570	4,120	240	2,460	780	810	4,230	1,550	1,000	3,530	1,090
Alaska	2,960	510	†	320	120	90	400	120	120	340	160
Arizona	36,730	5,630	260	3,010	1,240	990	4,200	2,380	1,500	3,830	1,810
Arkansas	17,200	2,430	140	1,540	500	630	2,760	800	650	1,860	760
California	172,040	30,650	1,630	15,530	7,030	6,060	18,040	10,980	8,200	20,160	7,780
Colorado	27,290	4,530	190	2,040	920	910	2,550	1,920	1,150	3,140	1,250
Connecticut	20,300	3,590	130	1,520	910	400	2,650	1,110	930	2,320	1,080
Delaware	6,660	960	†	470	220	230	890	420	260	770	320
Dist. of Columbia	3,600	510	†	250	120	110	300	90	130	370	80
Florida	150,500	19,900	1,130	11,310	4,460	3,370	18,150	8,750	7,170	13,950	6,780
Georgia	55,190	8,340	440	4,660	1,710	1,550	7,240	3,190	2,280	6,840	2,110
Hawaii	6,800	1,300	60	730	330	230	870	520	290	700	300
Idaho	8,540	1,340	60	730	310	340	990	740	390	1,160	470
Illinois	71,990	11,020	540	6,240	2,850	2,400	9,210	3,700	2,920	8,000	3,310
Indiana	37,940	5,410	270	3,410	1,430	1,290	5,700	2,370	1,590	3,570	1,720
Iowa	18,460	2,710	110	1,600	700	840	2,440	1,150	800	1,920	870
Kansas	16,170	2,390	110	1,320	560	620	2,020	890	650	1,730	640
Kentucky	26,500	3,800	200	2,440	870	920	4,890	1,330	1,040	2,440	1,130
Louisiana	26,480	3,910	260	2,370	690	930	3,700	1,030	1,110	2,970	1,050
Maine	8,180	1,370	50	670	390	160	1,430	520	390	800	520
Maryland	34,710	5,500	250	2,570	1,300	820	3,930	1,780	1,330	4,410	1,360
Massachusetts	36,990	6,690	220	2,650	1,630	580	5,150	2,190	1,670	3,890	1,970
Michigan	61,770	8,800	360	4,620	2,380	2,060	8,140	3,290	2,450	6,820	2,890
Minnesota	33,210	4,670	140	2,320	1,200	1,600	3,580	1,750	1,350	2,880	1,460
Mississippi	17,190	2,390	160	1,730	450	500	2,510	620	570	2,050	630
Missouri	37,540	5,360	270	3,090	1,290	1,370	5,540	1,820	1,410	3,540	1,580
Montana	5,850	960	†	500	220	250	770	450	250	680	330
Nebraska	10,560	1,580	70	940	390	480	1,270	610	450	980	470
Nevada	16,540	2,310	130	1,480	480	520	1,850	840	650	1,780	780
New Hampshire	8,060	1,350	†	590	370	180	1,220	530	370	910	510
New Jersey	53,340	8,260	440	4,250	2,240	2,100	6,100	2,770	2,340	6,010	2,640
New Mexico	9,800	1,570	80	890	370	340	1,040	610	410	920	410
New York	117,910	17,540	930	8,910	4,840	4,600	13,370	4,980	5,120	11,470	5,590
North Carolina	59,620	9,340	430	4,540	2,030	1,640	8,470	3,680	2,480	7,200	2,510
North Dakota	4,060	590	†	360	140	190	460	230	170	400	200
Ohio	71,850	10,350	440	5,910	2,790	2,280	10,110	4,100	2,820	7,030	3,190
Oklahoma	20,530	3,130	170	1,870	620	860	3,200	940	860	2,130	920
Oregon	23,330	3,880	160	1,740	910	740	2,930	1,730	1,000	2,470	1,150
Pennsylvania	80,240	12,180	530	6,520	3,390	3,050	10,710	4,410	3,480	8,300	4,350
Rhode Island	5,930	1,020	†	430	260	100	920	340	270	650	320
South Carolina	31,710	4,790	230	2,550	970	1,220	4,460	1,900	1,300	3,390	1,270
South Dakota	4,960	720	†	430	170	230	590	270	200	520	240
Tennessee	39,360	5,760	330	3,540	1,220	1,280	6,300	2,110	1,580	3,990	1,700
Texas	129,770	19,590	1,410	11,430	4,120	5,260	14,830	4,530	5,650	12,110	4,590
Utah	11,900	1,780	80	840	450	500	730	1,230	550	1,380	460
Vermont	3,740	630	†	270	170	90	570	270	170	330	210
Virginia	47,550	7,410	320	3,530	1,660	1,370	5,960	2,920	1,940	6,200	2,010
Washington	36,290	6,690	250	2,970	1,480	1,430	4,790	2,800	1,740	4,040	1,930
West Virginia	12,380	1,680	80	1,040	440	480	2,030	680	500	1,110	620
Wisconsin	35,280	5,120	200	2,540	1,410	1,420	4,290	2,190	1,460	3,560	1,740
Wyoming	2,880	430	†	260	100	110	320	220	120	400	150
United States	**1,806,590**	**276,480**	**13,800**	**147,950**	**65,620**	**60,530**	**228,820**	**100,350**	**77,240**	**191,930**	**81,400**

*Rounded to the nearest 10. Excludes basal and squamous cell skin cancers and in situ carcinomas except urinary bladder. Estimates for Puerto Rico are unavailable.
†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 (cancerstatisticscenter.cancer.org).

Table 3. Estimated Number* of Deaths for Selected Cancers by State, US, 2020

State	All sites	Brain/ nervous system	Female breast	Colon & rectum	Leukemia	Liver‡	Lung & bronchus	Non-Hodgkin lymphoma	Ovary	Pancreas	Prostate
Alabama	10,530	340	690	960	370	520	2,790	290	230	790	520
Alaska	1,090	†	70	120	†	50	190	†	†	90	60
Arizona	12,580	400	900	1,120	520	680	2,590	410	310	1,070	760
Arkansas	6,730	190	410	610	240	290	1,890	190	140	450	280
California	60,660	1,980	4,620	5,480	2,400	3,880	10,210	2,140	1,590	4,840	3,890
Colorado	8,220	290	640	700	330	410	1,450	260	210	620	590
Connecticut	6,390	210	430	460	260	310	1,370	230	160	520	480
Delaware	2,130	60	150	160	90	120	510	80	50	190	90
Dist. of Columbia	1,020	†	100	100	†	80	180	†	†	90	70
Florida	45,300	1,290	3,040	3,930	1,800	2,200	10,580	1,500	1,000	3,570	2,800
Georgia	17,990	540	1,380	1,730	600	760	4,210	530	400	1,300	990
Hawaii	2,540	60	160	240	90	180	520	90	†	240	130
Idaho	3,100	100	230	260	110	160	590	120	90	260	210
Illinois	24,220	670	1,720	2,160	900	1,080	5,710	750	560	1,780	1,560
Indiana	13,630	370	880	1,170	510	550	3,570	450	290	990	640
Iowa	6,440	190	380	560	250	260	1,530	240	150	500	340
Kansas	5,520	170	350	500	240	250	1,300	180	120	410	290
Kentucky	10,540	290	630	870	370	440	2,910	330	180	670	430
Louisiana	9,300	240	640	880	320	580	2,330	280	160	750	450
Maine	3,350	100	180	240	120	120	870	110	70	240	180
Maryland	10,790	300	850	920	410	580	2,310	340	260	870	580
Massachusetts	12,430	410	780	910	480	640	2,810	390	310	1,020	660
Michigan	21,000	600	1,380	1,700	770	890	5,220	720	480	1,720	1,030
Minnesota	10,040	330	630	790	430	420	2,210	390	210	820	590
Mississippi	6,700	180	460	670	220	320	1,740	160	120	520	360
Missouri	13,010	340	850	1,090	480	570	3,250	390	250	940	570
Montana	2,140	70	140	190	70	100	460	70	50	160	150
Nebraska	3,520	120	240	320	150	120	800	120	80	280	190
Nevada	5,460	210	400	590	200	240	1,230	170	150	400	310
New Hampshire	2,830	90	170	290	110	120	700	90	70	200	150
New Jersey	15,710	480	1,230	1,440	620	700	3,230	560	390	1,340	810
New Mexico	3,730	110	280	360	120	250	670	120	110	280	230
New York	34,710	960	2,430	2,950	1,370	1,610	6,510	1,230	870	2,890	1,850
North Carolina	20,410	570	1,440	1,640	710	850	5,020	610	430	1,500	1,010
North Dakota	1,260	†	80	110	60	†	280	50	†	100	70
Ohio	25,380	700	1,710	2,170	930	1,090	6,460	850	550	1,930	1,200
Oklahoma	8,430	230	560	800	330	410	2,180	270	190	570	430
Oregon	8,280	260	550	660	310	480	1,750	270	240	680	500
Pennsylvania	27,860	780	1,910	2,440	1,070	1,270	6,460	950	640	2,270	1,390
Rhode Island	2,120	60	120	160	80	110	540	70	†	170	110
South Carolina	10,780	310	750	910	390	520	2,610	320	210	830	590
South Dakota	1,690	60	110	170	70	70	400	60	†	130	90
Tennessee	14,780	380	950	1,260	530	730	3,990	460	310	1,010	660
Texas	41,810	1,260	3,060	4,070	1,620	2,740	8,420	1,350	930	3,130	2,310
Utah	3,350	140	290	300	170	160	430	130	110	280	240
Vermont	1,450	60	70	130	50	50	350	50	†	110	70
Virginia	15,220	450	1,140	1,400	540	730	3,450	490	370	1,180	800
Washington	13,020	440	900	1,050	490	720	2,740	450	330	1,000	750
West Virginia	4,750	120	290	440	180	200	1,300	150	90	310	190
Wisconsin	11,610	380	720	920	470	450	2,690	400	250	950	660
Wyoming	960	†	60	80	50	60	190	†	†	70	50
United States	**606,520**	**18,020**	**42,170**	**53,200**	**23,100**	**30,160**	**135,720**	**19,940**	**13,940**	**47,050**	**33,330**

*Rounded to the 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. Estimates are not available for Puerto Rico.

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 (cancerstatisticscenter.cancer.org).

Table 4. Incidence Rates* for Selected Cancers by State, US, 2012-2016

	All sites		Breast	Colon & rectum		Lung & bronchus		Non-Hodgkin lymphoma		Prostate	Urinary bladder	
State	**Male**	**Female**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Male**	**Female**
Alabama	520.6	402.7	122.1	50.9	38.3	87.3	50.5	19.5	13.6	119.5	32.8	7.4
Alaska	426.1	406.0	121.9	43.4	40.4	64.1	48.8	21.0	13.3	81.1	33.1	9.3
Arizona	407.7	373.4	114.5	38.0	28.7	53.1	44.0	18.2	13.1	77.2	31.9	7.9
Arkansas	532.9	419.3	117.5	50.8	37.8	97.8	62.6	21.8	15.0	111.4	34.8	7.7
California	435.0	386.4	121.0	40.4	31.3	47.4	38.1	22.4	15.2	93.9	29.8	7.0
Colorado	425.1	387.7	125.3	37.1	30.2	45.6	40.4	20.8	14.1	94.9	32.4	8.0
Connecticut	506.6	452.1	140.1	41.7	32.3	65.6	55.8	26.1	17.3	108.4	45.1	11.8
Delaware	552.3	460.6	136.1	43.1	32.9	78.9	62.6	24.9	17.6	128.7	43.2	9.9
Dist. of Columbia†‡	505.2	437.0	140.9	49.0	38.3	62.7	49.6	23.1	12.7	137.8	22.3	8.2
Florida	495.8	418.9	117.5	42.0	32.0	68.3	51.3	26.9	19.2	94.7	33.1	8.2
Georgia	533.1	420.2	125.8	49.2	35.9	81.2	51.3	22.4	14.9	122.3	32.7	7.8
Hawaii	434.5	405.3	137.5	48.1	35.5	57.2	36.4	20.2	13.5	84.9	23.9	5.6
Idaho	469.7	419.5	124.2	39.3	32.2	55.6	46.3	22.7	16.2	105.7	36.6	8.6
Illinois	506.8	441.4	131.9	50.4	37.2	75.3	57.0	23.5	16.3	109.5	37.0	9.4
Indiana	500.5	429.5	121.9	48.5	37.9	88.2	61.3	22.8	15.7	91.8	37.9	9.1
Iowa	521.0	444.9	124.2	50.2	39.3	75.0	54.0	26.0	17.6	104.7	37.7	8.8
Kansas†	499.1	429.8	126.4	45.5	34.9	61.0	57.0	23.9	17.0	108.2	37.4	9.0
Kentucky	578.4	482.4	126.3	57.6	42.4	111.3	77.8	25.1	16.7	104.9	38.5	10.0
Louisiana	559.6	422.8	124.2	54.3	39.2	84.8	54.2	23.6	16.1	131.8	32.5	7.6
Maine	504.4	458.7	125.7	41.8	33.6	83.3	66.3	24.1	17.2	87.5	45.8	11.6
Maryland	490.9	424.4	131.5	40.7	33.0	63.7	51.1	20.8	14.8	122.1	36.9	9.2
Massachusetts	470.8	439.5	137.7	39.8	31.6	66.1	59.0	21.8	15.2	99.3	37.7	10.4
Michigan	488.9	423.4	123.8	42.4	33.3	73.2	57.2	23.9	16.5	107.9	38.6	9.8
Minnesota	500.4	440	130.6	42.4	34.3	61.8	51.8	26.2	17.7	106.6	37	9.2
Mississippi	546.6	411.7	117.8	57.1	40.9	99.5	57.4	20.2	14.4	126.6	31.2	7.0
Missouri	492.1	431.0	129.2	47.9	35.5	85.3	63.5	22.7	15.6	92.8	34.7	8.4
Montana	486.7	429.0	124.0	43.7	32.9	55.6	54.8	22.0	16.3	113.0	36.4	10.4
Nebraska	495.0	422.5	124.6	49.2	37.5	67.5	50.4	23.8	16.2	111.2	34.7	8.7
Nevada†	408.8	382.0	111.1	42.1	32.1	57.6	53.4	17.5	12.9	84.8	32.6	9.4
New Hampshire	511.0	466.9	144.6	42.3	33.2	68.3	62.2	25.5	17.6	108.5	46.5	12.0
New Jersey	529.1	455.3	134.2	47.2	36.3	62.2	52.0	26.1	18.0	129.6	40.7	10.5
New Mexico	390.1	365.7	111.6	37.7	29.0	45.5	34.9	17.4	13.9	80.1	25.6	6.6
New York	531.6	452.4	130.7	45.0	34.0	67.0	53.2	26.2	17.9	125.0	40.3	10.3
North Carolina	521.3	428.3	132.3	42.8	32.5	84.9	56.7	21.4	14.5	115.9	35.0	8.6
North Dakota	495.4	424.9	127.3	52.3	37.6	65.7	51.1	20.6	16.7	115.7	36.6	8.1
Ohio	500.7	437.5	127.4	47.6	36.5	81.1	59.1	23.3	15.7	103.0	38.6	9.5
Oklahoma	497.8	422.2	121.1	48.8	36.9	83.4	58.0	21.5	15.4	95.2	34.5	7.6
Oregon	452.2	416.3	125.2	38.6	30.8	59.7	50.9	22.1	15.7	90.5	36.5	9.0
Pennsylvania	527.3	462.4	131.9	48.4	36.4	74.8	56.2	25.4	18.0	105.1	42.4	10.7
Rhode Island	500.8	468.5	138.1	38.9	31.5	78.0	65.7	26.1	17.8	97.8	44.4	12.2
South Carolina	515.4	415.9	129.2	44.6	33.6	81.8	52.9	20.4	14.1	115.4	33.7	8.4
South Dakota	493.2	431.1	131.3	47.1	37.3	67.9	52.9	23.4	15.7	111.7	34.1	9.3
Tennessee	519.9	422.1	122.6	46.3	35.6	93.1	61.5	21.7	14.2	110.4	34.5	8.4
Texas	450.9	378.2	111.9	44.9	31.6	63.4	43.1	21.0	14.5	92.4	26.9	6.1
Utah	440.2	375.5	114.8	33.4	26.5	31.5	23.1	22.4	15.0	113.1	29.3	5.8
Vermont	472.1	442.3	131.9	37.3	33.2	68.8	57.2	25.4	17.3	84.3	37.9	10.7
Virginia	447.6	401.0	128.3	40.0	32.1	69.0	50.6	20.6	14.1	98.3	30.7	7.9
Washington	479.7	433.6	135.1	39.6	32.2	61.3	51.7	24.4	16.2	100.6	37.7	9.1
West Virginia	511.9	452.8	117.5	51.9	41.3	95.2	67.0	22.0	16.6	91.3	38.9	10.4
Wisconsin	506.6	440.5	130.6	42.3	32.7	67.7	53.9	25.3	17.4	108.1	39.4	9.8
Wyoming	423.8	378.0	112.7	37.7	28.6	46.2	42.8	20.3	13.2	100.4	35.3	8.7
Puerto Rico§	409.6	329.8	93.7	51.7	34.7	23.9	12.0	17.1	13.0	143.9	16.7	4.5
United States	**489.4**	**421.1**	**125.2**	**44.4**	**33.9**	**69.3**	**51.7**	**23.2**	**16.0**	**104.1**	**35.0**	**8.6**

*Per 100,000, age adjusted to the 2000 US standard population. †Data for these states are not included in US combined rates because either the registry did not consent or incidence data did not meet inclusion standards for all years during 2012-2016 according to the North American Association of Central Cancer Registries (NAACCR). ‡Rates are based on cases diagnosed during 2012-2015. §Data for Puerto Rico are not included in US combined rates for comparability to previously published US rates.

Source: NAACCR, 2019. 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, 2013-2017

	All sites		Breast	Colon & rectum		Lung & bronchus		Non-Hodgkin lymphoma		Pancreas		Prostate
State	**Male**	**Female**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
Alabama	221.3	143.3	21.5	19.6	13.0	68.5	36.8	6.9	4.1	13.3	9.9	21.2
Alaska	181.5	140.2	19.4	17.0	14.3	45.7	34.2	6.3	4.2	11.2	10.1	18.0
Arizona	165.5	121.9	19.2	15.2	10.6	38.3	28.5	6.2	3.9	11.6	8.8	17.5
Arkansas	224.0	150.4	21.1	19.7	13.6	71.9	42.5	7.0	4.2	12.7	9.5	18.6
California	167.6	124.3	19.5	14.8	10.9	34.9	25.3	6.7	4.1	11.8	9.1	19.7
Colorado	160.8	118.7	18.9	13.9	10.5	31.0	25.7	6.4	3.4	10.7	7.9	21.5
Connecticut	170.0	125.3	17.8	13.0	9.4	39.6	31.0	7.0	4.1	12.2	9.4	17.9
Delaware	198.7	142.3	21.3	16.9	10.7	55.0	37.2	8.5	4.4	14.1	10.3	16.6
Dist. of Columbia	185.8	150.7	26.6	18.3	13.2	40.2	28.9	5.9	3.4	14.8	11.4	28.0
Florida	178.8	127.1	19.1	15.6	10.9	47.4	32.2	6.6	4.0	12.1	8.9	16.7
Georgia	201.3	135.6	22.0	18.9	12.1	56.7	32.1	6.8	4.0	12.3	9.3	22.0
Hawaii	159.9	110.8	16.1	14.8	10.3	39.0	23.5	5.7	3.3	12.4	9.8	14.1
Idaho	181.6	133.8	21.6	15.2	11.1	39.0	29.0	7.7	5.2	13.2	10.0	22.9
Illinois	196.9	143.2	21.3	18.1	12.7	52.3	36.0	7.2	4.3	13.1	9.5	20.1
Indiana	213.8	148.1	20.9	18.1	13.0	64.0	40.8	8.4	4.7	13.6	9.9	19.4
Iowa	198.5	138.2	18.7	17.1	12.5	54.0	34.9	8.3	4.7	13.0	9.6	19.5
Kansas	193.7	138.7	19.4	18.0	12.2	51.9	35.9	7.0	4.7	12.6	10.0	18.6
Kentucky	239.6	162.4	21.2	20.1	13.9	80.8	50.6	8.6	4.5	13.0	9.8	19.6
Louisiana	221.5	149.6	23.1	20.5	14.1	64.5	38.1	7.9	4.3	14.8	11.0	20.8
Maine	206.7	147.1	18.6	14.7	11.3	59.3	40.8	7.7	4.8	12.0	10.4	20.5
Maryland	186.7	137.5	21.7	16.4	11.7	46.2	33.3	6.9	4.0	13.6	9.7	20.0
Massachusetts	183.3	132.5	17.8	13.9	10.5	44.8	34.3	6.7	4.2	13.0	9.9	18.4
Michigan	198.4	145.7	20.7	16.5	12.1	54.3	38.8	7.8	4.8	13.9	10.7	18.7
Minnesota	179.0	131.7	17.9	14.2	10.8	42.6	32.6	7.8	4.6	12.8	9.7	19.9
Mississippi	240.7	154.3	23.5	22.6	15.0	75.6	39.1	7.0	3.9	15.4	11.0	24.7
Missouri	207.5	147.4	21.5	17.7	12.2	62.6	41.8	7.3	4.2	13.2	9.6	17.5
Montana	177.9	135.8	19.5	16.1	10.8	39.5	35.9	7.2	4.1	11.5	9.6	22.7
Nebraska	186.6	135.5	20.1	17.2	12.6	48.3	33.2	7.4	4.5	13.2	9.3	18.3
Nevada	182.6	141.9	21.8	19.3	14.0	45.8	38.2	6.8	3.5	11.7	9.4	19.7
New Hampshire	187.4	138.9	18.9	13.9	11.6	48.3	38.2	7.0	4.5	12.1	8.8	18.9
New Jersey	175.5	134.0	21.2	16.7	11.9	40.8	31.0	7.1	4.1	12.7	10.1	17.7
New Mexico	167.4	122.6	19.3	16.4	11.3	33.5	24.7	5.8	3.8	11.2	8.6	19.6
New York	174.0	129.5	19.2	15.4	11.1	42.4	30.0	7.0	4.1	12.7	9.7	18.0
North Carolina	202.0	137.5	20.9	16.2	11.2	60.0	35.6	6.9	4.0	12.9	9.4	19.9
North Dakota	176.3	127.0	18.0	16.3	11.0	45.6	29.7	6.6	4.7	12.2	8.3	17.8
Ohio	209.7	150.1	22.3	18.4	13.1	60.4	39.4	7.9	4.7	13.3	10.4	19.1
Oklahoma	219.4	152.4	22.4	20.9	13.9	65.0	41.9	7.9	4.7	12.6	9.6	20.4
Oregon	185.9	140.4	20.1	15.2	11.4	43.5	34.8	7.5	4.6	13.3	10.1	20.7
Pennsylvania	199.8	142.7	21.2	17.8	12.6	52.5	34.8	7.7	4.6	14.1	10.2	18.7
Rhode Island	197.1	140.4	18.0	14.8	10.8	53.2	39.9	6.6	4.4	13.9	9.9	18.7
South Carolina	209.2	139.2	21.5	17.5	11.8	58.9	34.0	6.6	4.3	13.2	9.9	21.8
South Dakota	192.7	134.4	19.1	19.8	13.0	49.9	33.9	7.0	4.3	12.2	10.0	19.0
Tennessee	224.1	149.4	21.8	18.5	13.0	70.0	41.1	8.0	4.7	12.9	9.8	19.8
Texas	183.4	127.4	19.8	17.6	11.2	45.2	28.4	6.8	4.1	11.6	9.0	17.8
Utah	146.0	108.9	20.1	12.9	9.7	22.3	15.4	6.8	4.1	10.8	8.3	20.0
Vermont	196.6	141.0	17.7	16.3	13.5	49.6	37.4	7.9	4.5	12.3	9.5	19.1
Virginia	190.5	135.1	21.5	16.6	11.3	50.5	32.6	6.8	4.1	13.1	9.4	19.8
Washington	180.9	134.6	19.9	14.5	10.5	43.0	32.8	7.6	4.4	12.3	9.3	20.2
West Virginia	223.0	160.0	21.8	20.4	15.7	69.5	43.7	7.7	4.8	11.6	9.4	17.4
Wisconsin	191.9	137.1	19.0	15.3	11.2	48.0	34.1	7.7	4.4	13.6	10.0	20.8
Wyoming	163.6	123.1	18.3	14.0	9.7	36.5	29.2	7.0	4.4	11.7	8.6	16.0
Puerto Rico†	148.0	93.2	17.8	19.5	12.1	18.7	8.7	4.7	2.5	7.9	5.5	25.9
United States	**189.3**	**135.5**	**20.3**	**16.6**	**11.7**	**49.3**	**33.2**	**7.1**	**4.2**	**12.7**	**9.6**	**19.1**

*Per 100,000, age adjusted to the 2000 US standard population. †Rates for Puerto Rico are for 2012-2016 and are not included in overall US combined rates.

Source: US Mortality Data, National Center for Health Statistics, Centers for Disease Control and Prevention, 2019.

How Is Cancer Staged?

Stage describes the extent or spread of cancer at the time of diagnosis. Proper staging is essential for optimizing therapy and assessing prognosis. For most cancers, stage is based on the size or extent of the primary tumor and whether the cancer has spread to nearby lymph nodes or other areas of the body. Several staging systems are used to classify cancer. A system of summary staging is used for descriptive and statistical analyses of population-based 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.)

Clinicians mainly use a different staging system, called TNM. The TNM system assesses cancer growth and spread in 3 ways: size/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. However, some cancers do not have a stage IV (e.g., testis) and others (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?

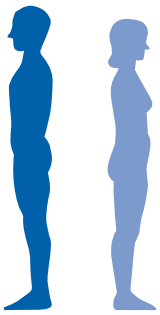
The costs of cancer can be measured in several ways, including direct medical costs (total of all health care expenditures), as well as indirect costs (such as lost earnings due to missed work). The Agency for Healthcare Research and Quality estimates that cancer-related direct medical costs in the US in 2015 were $80.2 billion, with 52% of those costs resulting from hospital outpatient or office-based provider visits and 38% from inpatient hospital stays. These estimates are based on the Medical Expenditure Panel Survey, the most complete, nationally representative data on health care and expenditures (visit https://meps.ahrq.gov/mepsweb/ for more information). In addition to these costs, researchers at the American Cancer Society recently estimated that more than $94 billion in earnings were lost in the US in 2015 due to cancer death.

Lack of health insurance and other barriers prevents many Americans from receiving optimal cancer prevention, early detection, and treatment. According to the US Census Bureau, 27.5 million Americans (8.5%) were uninsured at any point during the 2018 calendar year, down more than 13 million from 2013 because of the implementation in January 2014 of several new provisions of the Affordable Care Act (ACA). 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, 18% and 10%, respectively, compared to 5% of non-Hispanic whites. The percentage of uninsured ranged from 3% in Massachusetts and the District of Columbia to 18% 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 ACA helps save lives from cancer, see Advocacy on page 64.

Figure 3. Leading Sites of New Cancer Cases and Deaths – 2020 Estimates

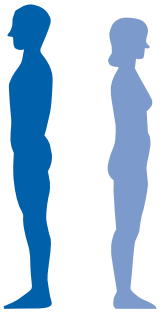
Estimated New Cases

Male			Female		
Prostate	191,930	21%	Breast	276,480	30%
Lung & bronchus	116,300	13%	Lung & bronchus	112,520	12%
Colon & rectum	78,300	9%	Colon & rectum	69,650	8%
Urinary bladder	62,100	7%	Uterine corpus	65,620	7%
Melanoma of the skin	60,190	7%	Thyroid	40,170	4%
Kidney & renal pelvis	45,520	5%	Melanoma of the skin	40,160	4%
Non-Hodgkin lymphoma	42,380	5%	Non-Hodgkin lymphoma	34,860	4%
Oral cavity & pharynx	38,380	4%	Kidney & renal pelvis	28,230	3%
Leukemia	35,470	4%	Pancreas	27,200	3%
Pancreas	30,400	3%	Leukemia	25,060	3%
All sites	**893,660**		**All sites**	**912,930**	



Estimated Deaths

Male			Female		
Lung & bronchus	72,500	23%	Lung & bronchus	63,220	22%
Prostate	33,330	10%	Breast	42,170	15%
Colon & rectum	28,630	9%	Colon & rectum	24,570	9%
Pancreas	24,640	8%	Pancreas	22,410	8%
Liver & intrahepatic bile duct	20,020	6%	Ovary	13,940	5%
Leukemia	13,420	4%	Uterine corpus	12,590	4%
Esophagus	13,100	4%	Liver & intrahepatic bile duct	10,140	4%
Urinary bladder	13,050	4%	Leukemia	9,680	3%
Non-Hodgkin lymphoma	11,460	4%	Non-Hodgkin lymphoma	8,480	3%
Brain & other nervous system	10,190	3%	Brain & other nervous system	7,830	3%
All sites	**321,160**		**All sites**	**285,360**	



Estimates are rounded to the nearest 10, and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder. Estimates do not include Puerto Rico or other US territories. Ranking is based on modeled projections and may differ from the most recent observed data.

Selected Cancers

This section provides information on the occurrence, risk factors, symptoms, early detection, and treatment for the most commonly diagnosed cancers, and may have limited relevance to rarer cancers or cancer subtypes. (For information on rare cancers, see the Special Section in *Cancer Facts & Figures 2017* at cancer.org/statistics.) Cancer incidence trends are based on data from 2000 through 2016 from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) registries, and mortality trends are based on deaths from 1975 through 2017 reported by the National Center for Health Statistics. Generally, trends are described based on the average annual percent change in the most recent 5 or 10 years, as appropriate. See Sources of Statistics on page 67 for more information.

Breast

New cases and deaths: In the US in 2020, there will be an estimated 276,480 new cases of invasive breast cancer diagnosed in women (Figure 3); 2,620 cases diagnosed in men; and an additional 48,530 cases of ductal carcinoma in situ (DCIS) diagnosed in women (Table 1). An estimated 42,690 breast cancer deaths (42,170 women, 520 men) will occur in 2020.

Incidence trends: From 2007 to 2016, invasive female breast cancer incidence rates increased slightly, by 0.3% per year.

Mortality trends: The female breast cancer death rate peaked at 33.2 (per 100,000) in 1989, then declined by 40% to 19.8 in 2017. This progress reflects earlier detection (through screening, as well as increased awareness of symptoms) and improved treatment, and translates to an

estimated 375,900 fewer breast cancer deaths than would have been expected if the death rate had remained at its peak. During 2013 to 2017, the death rate decreased by 1.3% per year.

Risk factors: Older age and being female are the strongest risk factors for breast cancer. Potentially modifiable factors associated with increased risk include weight gain after the age of 18 and/or being overweight or obese (for postmenopausal breast cancer); menopausal hormone therapy (combined estrogen and progestin); alcohol consumption; and physical inactivity. Breastfeeding for at least one year decreases risk. Non-modifiable factors that increase risk include a personal or family history of breast or ovarian cancer; inherited genetic variations in breast cancer susceptibility genes (e.g., *BRCA1* or *BRCA2*); certain benign breast conditions, such as atypical hyperplasia; a history of ductal carcinoma in situ (DCIS) or lobular carcinoma in situ (LCIS); high breast tissue density (the amount of glandular tissue relative to fatty tissue measured on a mammogram); and high-dose radiation to the chest at a young age (e.g., for treatment of lymphoma). Reproductive factors that increase risk include a long menstrual history (menstrual periods that start early and/or end late in life); not having children or having children after age 30; high natural levels of sex hormones; and recent use of hormonal contraceptives.

Early detection: Mammography is a low-dose x-ray procedure used to detect breast cancer at an early stage. Early diagnosis reduces the risk of dying from breast cancer and increases treatment options. However, like any screening tool, mammography is not perfect. It can miss cancer (false negative) or appear abnormal in the absence of cancer (false positive); about 12% of women who are screened have an abnormal mammogram, but only 5% of women with an abnormal mammogram have cancer. False-positives are most likely during a woman's first mammogram. Other potential harms include detection of cancers and in situ lesions (e.g., DCIS) that would never have progressed or caused harm (i.e., overdiagnoses), and cumulative radiation exposure, which increases breast cancer risk. For women at average risk of breast cancer, the American Cancer Society recommends that those 40 to 44 years of age have the option to begin annual mammography; those 45 to 54 undergo annual mammography; and those 55 years of age and older 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 breast magnetic resonance imaging (MRI) is recommended to accompany mammography, typically starting at age 30. For more information on breast cancer screening, see the American Cancer Society's screening guidelines on page 70.

Signs and symptoms: Early breast cancer usually has no symptoms and is most often diagnosed through mammography screening. When symptoms occur, the most common is a painless lump or mass in the breast. Other symptoms may include persistent changes to the breast, such as thickening, swelling, or redness, and nipple abnormalities such as spontaneous discharge (especially if bloody), scaliness, or retraction.

Treatment: Treatment usually involves either breast-conserving surgery (surgical removal of the tumor and a rim of surrounding tissue, sometimes called a lumpectomy) or mastectomy (surgical removal of the entire breast), depending on tumor characteristics (e.g., size and extent of spread) and patient preference. One or more underarm lymph nodes are usually evaluated during surgery to determine whether the tumor has spread beyond the breast. Radiation is recommended for most patients having breast-conserving surgery. For women with early-stage 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 survival equivalent to mastectomy. Although most patients undergoing mastectomy do not need radiation, it is sometimes recommended when the tumor is large or lymph nodes are involved. Women undergoing mastectomy who elect breast reconstruction have several options, including the type of tissue or implant used to restore breast shape. Reconstruction may be performed at the time of mastectomy (immediate reconstruction) or later as a second procedure (delayed reconstruction), but it often requires more than one

surgery. Depending on cancer stage, subtype, and sometimes other test results (e.g., Oncotype DX), treatment may also involve chemotherapy (before or after surgery), hormone (anti-estrogen) therapy, targeted therapy, and/or more recently, immunotherapy (e.g. checkpoint inhibitors).

Survival: The 5- and 10-year relative survival rates for women with invasive breast cancer are 91% and 84%, respectively. Sixty-two percent of cases are diagnosed at a localized stage (confined to the breast, no spread to lymph nodes), for which the 5-year survival is 99% (Table 8). Survival rates are about 9% lower (in absolute terms) for black women than for white women (Table 7). Reducing disparities in outcomes for black women is a focus of the American Cancer Society and many other national cancer organizations.

See *Breast Cancer Facts & Figures* at cancer.org/statistics for more information on breast cancer.

Childhood Cancer (Ages 0-14 years)

New cases and deaths: An estimated 11,050 new cancer cases will be diagnosed among children ages 0 to 14 years in the US in 2020, and an estimated 1,190 children will die of the disease. One in 389 children will be diagnosed with cancer by age 15, and it is the second-leading cause of death among children ages 1-14 years after accidents.

Incidence trends: Childhood cancer incidence rates have slowly increased each year since at least 1975. From 2007 to 2016, rates increased on average by 0.8% annually.

Mortality trends: The death rate for cancer in children ages 0-14 years declined by more than half from 1975 (4.9 per 100,000) to 2017 (2.0 per 100,000), largely due to improvements in treatment and high rates of participation in clinical trials. However, the pace of decline slowed from about 3% annually during the late 1970s through the early 1990s to 1.3% annually since then.

Risk factors: There are few known risk factors for childhood cancer. Most cancers in children are believed to arise spontaneously due to random cell mutations, with no external cause. Exposure to ionizing radiation, such as that from prior radiotherapy, increases the risk of childhood leukemia and possibly other cancers. Solid organ transplant recipients are at increased risk for non-Hodgkin lymphoma, largely because of drugs that suppress the immune system to prevent organ rejection. Cancer risk is also increased in children with certain genetic syndromes (e.g., Down syndrome, Li-Fraumeni syndrome, and Beckwith-Wiedemann syndrome).

Signs and symptoms: Early diagnosis of childhood cancer is often hampered by nonspecific symptoms shared by common childhood conditions. Parents should ensure that children have regular medical checkups and be alert to unusual, persistent symptoms, including 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 more specific symptoms for the major categories of pediatric cancer according to the International Classification of Childhood Cancer (ICCC); the distribution of each cancer type provided in parentheses is among all cancers in children ages 0 to 14 years in the US, including benign and borderline malignant brain tumors and cancers not classified by the ICCC.

- Leukemia (28% of all childhood cancers) may cause bone and joint pain, fatigue, weakness, pale skin, bleeding or bruising easily, fever, or infection.
- Brain and other central nervous system tumors (26%) may cause headaches, nausea, vomiting, blurred or double vision, seizures, dizziness, and difficulty walking or handling objects.
- Neuroblastoma (6%), a cancer of the peripheral nervous system that is most common in children younger than 5 years of age, usually appears as a swelling in the abdomen.
- Wilms tumor (5%), also called nephroblastoma, is a kidney cancer that may appear as swelling or a lump in the abdomen.

- Non-Hodgkin lymphoma (5%; includes Burkitt lymphoma) and Hodgkin lymphoma (3%), often cause lymph nodes to swell and appear as a lump in the neck, armpit, or groin; other symptoms can include fatigue, weight loss, and fever.
- Rhabdomyosarcoma (3%), a soft tissue sarcoma that can occur in the head and neck, genitourinary area, trunk, and extremities, may cause pain and/or a mass or swelling.
- Retinoblastoma (2%), an eye cancer that usually occurs in children younger than 5 years of age, is often recognized because the pupil appears white or pink instead of the normal red color in flash photographs or during an eye examination.
- Osteosarcoma (2%), a bone cancer that most often occurs in adolescents, commonly appears as sporadic pain in the affected bone that may worsen at night or with activity and eventually progresses to local swelling.
- Ewing sarcoma (1%), another cancer usually arising in the bone in adolescents, typically appears as pain at the tumor site.

Treatment: Childhood cancers are treated 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 with the best currently available treatment, should be considered.

Survival: Overall, childhood cancer survival has improved markedly over the past 40 years due to new and improved treatments. The 5-year relative survival for all ICCC groups combined during the most recent time period (2009-2015) is 84%, although rates vary considerably depending on cancer type and stage, patient age, and other characteristics. For example, the 5-year survival for Hodgkin lymphoma is 98%; for retinoblastoma it is 96%; Wilms tumor, 93%; non-Hodgkin lymphoma, 91%; leukemia, 87% (91% for acute lymphocytic leukemia and 66% for acute myeloid leukemia); neuroblastoma, 81%; Ewing sarcoma, 76%; brain and other central nervous system tumors (excluding benign brain tumors), 74%; rhabdomyosarcoma, 71%; and osteosarcoma, 69%. Pediatric cancer survivors may experience treatment-related side effects long after active treatment, including impairment in organ function (e.g., cognitive defects) and new cancers. The Children's Oncology Group (COG) has developed guidelines for screening for and managing late effects in survivors of childhood cancer. See the COG website at survivorshipguidelines.org for more information.

See the *Cancer Facts & Figures 2014* Special Section: Childhood & Adolescent Cancers at cancer.org/statistics and the Childhood Cancer Research Landscape Report at cancer.org for more information on childhood cancer.

Colon and Rectum

New cases and deaths: In 2020, an estimated 104,610 cases of colon cancer and 43,340 cases of rectal cancer will be diagnosed in the US, and a total of 53,200 people will die from these cancers (Table 1). Unfortunately, accurate statistics on colon and rectal cancer deaths separately are not available because many deaths from rectal cancer are misclassified as colon cancer on death certificates. The substantial misclassification is attributed at least in part to the widespread use of the term "colon cancer" to refer to both colon and rectal cancer in educational messaging.

Incidence trends: Colorectal cancer incidence has generally declined since the mid-1980s due to changes in risk factor exposures and the uptake of screening. However, this overall trend is driven by older adults (who have the highest rates) and masks increasing incidence in younger age groups. From 2007 to 2016, incidence rates declined by 3.6% annually among adults 55 years of age and older but increased by 2% annually among adults younger than age 55.

Mortality trends: The colorectal cancer death rate dropped by 54% from 1970 (29.2 per 100,000) to 2017 (13.5 per 100,000) because of changing patterns in risk factors, increased screening, and improvements in treatment.

Table 6. Probability (%) of Developing Invasive Cancer during Selected Age Intervals by Sex, US, 2014-2016*

		Birth to 49	50 to 59	60 to 69	70 and older	Birth to death
All sites†	Male	3.5 (1 in 29)	6.2 (1 in 16)	13.3 (1 in 8)	32.7 (1 in 3)	40.1 (1 in 2)
	Female	5.8 (1 in 17)	6.4 (1 in 16)	10.2 (1 in 10)	26.7 (1 in 4)	38.7 (1 in 3)
Breast	Female	2.0 (1 in 49)	2.4 (1 in 42)	3.5 (1 in 28)	7.0 (1 in 14)	12.8 (1 in 8)
Colon & rectum	Male	0.4 (1 in 262)	0.7 (1 in 143)	1.1 (1 in 90)	3.3 (1 in 30)	4.4 (1 in 23)
	Female	0.4 (1 in 274)	0.5 (1 in 190)	0.8 (1 in 126)	3.0 (1 in 33)	4.1 (1 in 25)
Kidney & renal pelvis	Male	0.2 (1 in 415)	0.4 (1 in 266)	0.7 (1 in 153)	1.4 (1 in 74)	2.2 (1 in 46)
	Female	0.2 (1 in 661)	0.2 (1 in 551)	0.3 (1 in 317)	0.7 (1 in 136)	1.2 (1 in 82)
Leukemia	Male	0.3 (1 in 391)	0.2 (1 in 550)	0.4 (1 in 249)	1.5 (1 in 69)	1.9 (1 in 54)
	Female	0.2 (1 in 499)	0.1 (1 in 838)	0.2 (1 in 433)	0.9 (1 in 109)	1.3 (1 in 77)
Lung & bronchus	Male	0.1 (1 in 730)	0.6 (1 in 158)	1.8 (1 in 57)	6.0 (1 in 17)	6.7 (1 in 15)
	Female	0.2 (1 in 659)	0.6 (1 in 169)	1.4 (1 in 70)	4.8 (1 in 21)	6.0 (1 in 17)
Melanoma of the skin‡	Male	0.4 (1 in 228)	0.5 (1 in 197)	0.9 (1 in 109)	2.6 (1 in 38)	3.6 (1 in 28)
	Female	0.6 (1 in 156)	0.4 (1 in 245)	0.5 (1 in 194)	1.2 (1 in 86)	2.5 (1 in 41)
Non-Hodgkin lymphoma	Male	0.3 (1 in 367)	0.3 (1 in 340)	0.6 (1 in 176)	1.9 (1 in 53)	2.4 (1 in 41)
	Female	0.2 (1 in 529)	0.2 (1 in 463)	0.4 (1 in 238)	1.4 (1 in 72)	1.9 (1 in 52)
Prostate	Male	0.2 (1 in 441)	1.8 (1 in 57)	4.7 (1 in 21)	8.2 (1 in 12)	11.6 (1 in 9)
Thyroid	Male	0.2 (1 in 449)	0.1 (1 in 694)	0.2 (1 in 558)	0.2 (1 in 405)	0.7 (1 in 144)
	Female	0.9 (1 in 112)	0.4 (1 in 252)	0.4 (1 in 273)	0.4 (1 in 251)	1.9 (1 in 52)
Uterine cervix	Female	0.3 (1 in 367)	0.1 (1 in 831)	0.1 (1 in 921)	0.2 (1 in 595)	0.6 (1 in 159)
Uterine corpus	Female	0.3 (1 in 323)	0.6 (1 in 157)	1.0 (1 in 95)	1.5 (1 in 69)	3.1 (1 in 33)

*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 6.7.7. Statistical Research and Applications Branch, National Cancer Institute, 2019. surveillance.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.

However, trends vary by age; from 2008 to 2017, the death rate declined by 2.6% per year among adults ages 55 and older but increased by 1% per year among adults younger than age 55.

Risk factors: More than half (55%) of colorectal cancers in the US are attributable to potentially modifiable risk factors according to a study by American Cancer Society researchers. Modifiable factors that increase risk include excess body weight, physical inactivity, long-term smoking, high consumption of red or processed meat, low calcium intake, heavy alcohol consumption, and very low intake of fruits and vegetables and whole-grain fiber. Hereditary and medical factors that increase risk include a personal or family history of colorectal cancer and/or adenomatous polyps, certain inherited genetic conditions (e.g., Lynch syndrome), a personal history of chronic inflammatory bowel disease (ulcerative colitis or Crohn's 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. Decision making about aspirin use should include a conversation with your health care provider.

Early detection: 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. Regular adherence to screening with either stool testing or structural exams (e.g., colonoscopy) results in a similar reduction in premature colorectal cancer death over a lifetime. New guidelines from the American Cancer Society recommend that men and women at average risk for colorectal cancer be regularly screened beginning at 45 years of age, with more individualized decision making from ages 76 to 85 years based on health status/life expectancy, patient preferences, and prior screening history. For more information on the American Cancer Society's recommendations for colorectal cancer screening, see page 70.

Signs and symptoms: Symptoms 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, abdominal cramping or pain, decreased appetite, and weight loss. In some cases, the cancer causes blood loss that leads to anemia (low number of red blood cells), resulting in symptoms such as weakness and fatigue. Increasing incidence of colorectal cancer in young individuals, who are often diagnosed with advanced disease, reinforces the need for timely evaluation of persistent symptoms in all patients. Early-stage colorectal cancer typically does not have symptoms, which is why screening is usually necessary to detect this cancer early.

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

Survival: The 5-year relative survival rate for colorectal cancer is 64%. Only 39% of patients are diagnosed with localized disease, for which 5-year survival is 90% (Table 8).

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

Kidney and Renal Pelvis

New cases and deaths: In 2020, an estimated 73,750 new cases of kidney (renal) cancer will be diagnosed in the US and 14,830 people will die from the disease (Table 1). Most kidney cancers are renal cell carcinomas; other types include cancer of the renal pelvis (5%), which behaves more like bladder cancer, and Wilms tumor (1%), a childhood cancer that usually develops before the age of 5 (see Childhood Cancer on page 12). Men are twice as likely as women to be diagnosed with kidney cancer.

Incidence trends: The increase in kidney cancer incidence rates since at least 1975 appears to have slowed in recent years. The rise, mostly in localized stage diagnoses, is partly attributed to incidental detection of asymptomatic tumors because of the increased use of medical imaging. From 2007 to 2016, the rate increased by 0.5% per year in men and was stable in women.

Mortality trends: In contrast to incidence trends, kidney cancer mortality has been declining in recent decades; from 2008 to 2017, the death rate decreased by 1% per year.

Risk factors: About half of kidney cancers could potentially be prevented by eliminating excess body weight and tobacco smoking, which are strong risk factors. Additional risk factors include high blood pressure; chronic renal failure; and occupational exposure to certain chemicals, such as trichloroethylene. A small proportion of renal cell cancers are the result of rare hereditary conditions (e.g., von Hippel-Lindau disease). Alcohol consumption (up to about 2 drinks per day) is associated with a reduced risk of kidney cancer; however, the risks of heavy alcohol consumption far outweigh this benefit.

Signs and symptoms: Symptoms include blood in the urine, a pain or lump in the lower back or abdomen, fatigue, weight loss, fever, and anemia.

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 extreme temperature to destroy the tumor. Adjuvant treatment (after surgery) with a targeted therapy drug may be an option for certain patients at high risk for cancer recurrence. For metastatic disease, immunotherapy and targeted therapies are typically the main treatment options, sometimes along with removal of the kidney.

Survival: The 5-year relative survival rate for kidney and renal pelvis cancer is 75%. Two-thirds of cases are diagnosed at a local stage, for which the 5-year relative survival rate is 93% (Table 8).

Leukemia

New cases and deaths: In 2020, an estimated 60,530 new cases of leukemia will be diagnosed in the US and 23,100 people will die from the disease (Table 1). Leukemia is a cancer of the bone marrow and blood that is classified into four main groups based on cell type and rate of growth: acute lymphocytic leukemia (ALL), acute myeloid leukemia (AML), chronic myeloid leukemia (CML), and chronic lymphocytic leukemia (CLL). (Although CLL is included with leukemia in this report to enable description of trends over time, it is now recognized to be the same cancer as small lymphocytic lymphoma (SLL), and these cancers are collectively referred to as CLL/SLL). Among adults (20 years of age and older), the most common types of leukemia are CLL (37%) and AML (32%), whereas in children and adolescents (ages 0 to 19 years), ALL is most common, accounting for 74% of cases. (See page 12 for information about childhood cancer.)

Incidence trends: From 2007 to 2016, the incidence rate was stable for CLL and increased by about 1% per year for ALL and 2% per year for CML and AML.

Mortality trends: In contrast to incidence trends, the death rate from 2008 to 2017 was stable for AML and decreased by 1% per year for ALL and CML and by about 3% per year for CLL.

Risk factors: Risk of most types of leukemia is increased among individuals exposed to high-level ionizing radiation, most commonly from cancer treatment. Certain types of chemotherapy also increase risk of some types of leukemia. In addition, risk is increased in people with certain genetic abnormalities and in workers exposed to some chemicals, such as benzene (e.g., during oil refining or rubber manufacturing). Cigarette smoking is a risk factor for AML in adults, and there is accumulating evidence that parental smoking before and after childbirth may increase acute leukemia risk in children. Excess body weight may increase risk of some leukemia subtypes.

Signs and symptoms: Symptoms of leukemia, which can appear suddenly for acute subtypes, include fatigue, paleness, weight loss, repeated infections, fever, bleeding or bruising easily, bone or joint pain, and swelling in the lymph nodes or abdomen. Chronic leukemia typically progresses slowly with few symptoms during early stages.

Treatment: Chemotherapy, sometimes in combination with targeted drugs, is used to treat most acute leukemias. Several targeted drugs are effective for treating CML because they attack cells with the Philadelphia chromosome, an acquired genetic abnormality that is the hallmark of the disease. Some of these drugs are also used to treat a type of ALL involving a similar genetic defect. CLL that is not progressing or causing symptoms may not require treatment right away, but these patients need to be closely monitored. More aggressive CLL is treated with targeted drugs and/or chemotherapy. 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 CAR T-cell therapy, have shown much promise, even against some hard-to-treat leukemias.

Survival: Survival varies substantially by age and leukemia subtype. The current 5-year relative survival rate for adults (ages 20 and older) is 25% for AML; 37% for ALL; 69% for CML; and 85% for CLL. For patients ages 0-19 years, it is 67% for AML and 89% for ALL. Advances in treatment have resulted in large improvements in survival for most types of leukemia. For example, 5-year relative survival for CML has more than tripled, up from 22% in the mid-1970s, largely due to the development of targeted drugs.

Liver

New cases and deaths: In 2020, an estimated 42,810 new cases of liver cancer (including intrahepatic bile duct cancers) will be diagnosed in the US and 30,160 people will die from the disease (Table 1). Approximately three-fourths of liver cancers are hepatocellular carcinoma (HCC). Liver cancer incidence is 3 times higher in men than in women.

Incidence trends: Liver cancer incidence rates have more than tripled since 1980; from 2007 to 2016, the rate increased by about 2% per year.

Mortality trends: The death rate for liver cancer has doubled from about 3 (per 100,000) during the 1980s to 6.6 during 2013-2017, but may have begun to stabilize in recent years.

Risk factors: Approximately 70% of liver cancer cases in the US could potentially be prevented through the elimination of exposure to risk factors, the most important of which are excess body weight, type 2 diabetes, chronic infection with hepatitis B virus (HBV) and/or hepatitis C virus (HCV), heavy alcohol consumption (3 or more drinks per day), and tobacco smoking. Risk is also increased by eating food contaminated with aflatoxin (poison from a fungus that can grow on improperly stored foods, such as nuts and grains). Accumulating evidence suggests that coffee drinking may reduce risk.

Prevention: A vaccine that protects against HBV infection has been available since 1982. There is no vaccine available to prevent HCV infection, although new combination antiviral therapies can often clear established infections and substantially reduce cancer risk. The Centers for Disease Control and Prevention (CDC) recommends one-time HCV testing for everyone born from 1945 to 1965 (i.e., baby boomers) because this group accounts for about three-fourths of HCV-infected individuals in the US; however, fewer than 1 in 8 baby boomers have been tested. In August 2019, the US Preventive Services Task Force released a draft statement recommending that all people ages 18 to 79 years be tested because screening has a substantial net benefit. Preventive measures for HBV and 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 safer 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 (e.g., those with cirrhosis) with ultrasound or blood tests.

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.

Treatment: Early-stage liver cancer can sometimes be treated successfully with liver transplantation or surgery to remove part of the liver, although few patients have enough healthy liver for this option. Other treatment options include tumor ablation (destruction), embolization (blocking blood flow), or radiation therapy. Patients diagnosed at an advanced stage may be offered targeted therapies or immunotherapy.

Survival: The 5-year relative survival rate is 18%, up from 3% four decades ago. Forty-four percent of patients are diagnosed with localized-stage disease, for which 5-year survival is still only 33% (Table 8).

Lung and Bronchus

New cases and deaths: In 2020, an estimated 228,820 new cases of lung cancer will be diagnosed in the US and 135,720 people will die from the disease (Table 1).

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. The incidence rate decreased from 2007 to 2016 by almost 3% per year in men and by 1.5% per year in women.

Mortality trends: The lung cancer death rate has declined by 51% since 1990 in men and by 26% since 2002 in women due to reductions in smoking, with the pace accelerating in recent years; from 2008 to 2017, the rate decreased by about 4% per year in men and 3% per year in women.

Risk factors: Cigarette smoking is by far the most important risk factor for lung cancer, with approximately 80% of lung cancer deaths in the US still caused by smoking. Risk increases with both quantity and duration of smoking. Cigar and pipe smoking also increase risk.

Table 7. Trends in 5-year Relative Survival Rates* (%) by Race, US, 1975-2015

	All races			White			Black		
	1975-77	1987-89	2009-15	1975-77	1987-89	2009-15	1975-77	1987-89	2009-15
All sites	49	55	69	50	57	70	39	43	64
Brain & other nervous system	23	29	34	22	28	33	25	32	40
Breast (female)	75	84	91	76	85	92	62	71	83
Colon & rectum	50	60	66	50	60	67	45	52	60
Colon	51	60	65	51	61	66	45	52	56
Rectum	48	58	69	48	59	69	44	52	68
Esophagus	5	9	21	6	10	23	4	7	12
Hodgkin lymphoma	72	79	89	72	80	89	70	72	85
Kidney & renal pelvis	50	57	76	50	57	75	49	55	77
Larynx	66	66	62	67	67	64	58	56	50
Leukemia	34	43	66	35	44	67	33	35	60
Liver & intrahepatic bile duct	3	5	20	3	6	19	2	3	16
Lung & bronchus	12	13	21	12	13	21	11	11	19
Melanoma of the skin	82	88	94	82	88	94	57†	79†	70†
Myeloma	25	27	54	24	27	53	29	30	55
Non-Hodgkin lymphoma	47	51	75	47	51	76	49	46	70
Oral cavity & pharynx	53	54	68	54	56	70	36	34	51
Ovary	36	38	48	35	38	48	42	34	40
Pancreas	3	4	10	3	3	10	2	6	9
Prostate	68	83	99	69	84	99	61	71	97
Stomach	15	20	32	14	18	31	16	19	33
Testis	83	95	97	83	96	97	73†‡	88†	93
Thyroid	92	94	99	92	94	99	90	92	97
Urinary bladder	72	79	78	73	80	79	50	63	65
Uterine cervix	69	70	69	70	73	71	65	57	58
Uterine corpus	87	82	83	88	84	86	60	57	64

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 9 areas from 1975 to 1977, 1987 to 1989, and 2009 to 2015, all followed through 2016. †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, 1975-2016*, National Cancer Institute, Bethesda, MD, https://seer.cancer.gov/csr/1975_2016/, based on November 2018 SEER data submission, posted to the SEER website, April 2019.

Exposure to radon gas, which is released from soil and can accumulate in indoor air, is the second-leading cause of lung cancer in the US. Other risk factors include exposure to secondhand smoke, asbestos (particularly among smokers), certain metals (chromium, cadmium, arsenic), some organic chemicals, radiation, air pollution, and diesel exhaust. Specific occupational exposures that increase risk include rubber manufacturing, paving, roofing, painting, and chimney sweeping.

Early detection: In a large US clinical trial, screening with low-dose spiral computed tomography (LDCT) reduced lung cancer mortality by about 20% compared to standard chest x-ray among current or former (quit within 15 years) heavy smokers (at least a pack a day for 30 years). More favorable outcomes were recently reported by two European trials. The American Cancer Society recommends annual lung cancer screening for current or former heavy smokers ages 55 to 74 years who are in relatively good health and have undergone evidence-based smoking-cessation counseling (current smokers) and a process of informed shared decision making with a clinician that included a description of the potential benefits and harms of screening. For more information on lung cancer screening, see the American Cancer Society's screening guidelines on page 70.

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

Treatment: Appropriate treatment for lung cancer is based on whether the tumor is small cell (13%) or non-small cell (84%), as well as the stage and molecular characteristics. For early-stage non-small cell lung cancer, surgery is the usual treatment, sometimes with chemotherapy, alone or in combination with radiation therapy. Advanced-stage non-small cell lung cancer is usually treated with chemotherapy and/or targeted drugs or immunotherapy. Early-stage small cell lung cancer is usually treated with chemotherapy, alone or combined with radiation. People with advanced small cell lung cancer might be treated with chemotherapy with or without immunotherapy; a large percentage of patients on this regimen briefly experience remission, although the cancer often returns.

Survival: The 5-year relative survival rate for lung cancer is 19% overall (16% for men and 23% for women); 24% for non-small cell; and 6% for small cell tumors. Only 16% of lung cancers are diagnosed at a localized stage, for which the 5-year survival rate is 57% (Table 8).

Lymphoma

New cases and deaths: In 2020, an estimated 85,720 new cases of lymphoma will be diagnosed in the US and 20,910 people will die from the disease (Table 1). This cancer begins in immune system cells and can occur almost anywhere in the body. Lymphomas are broadly classified as either Hodgkin lymphoma (8,480 cases and 970 deaths) or non-Hodgkin lymphoma (NHL, 77,240 cases and 19,940 deaths), and are further classified based on the type of cell in which the cancer starts and many other characteristics, such as cell-surface markers and anatomic site. (Although chronic lymphocytic leukemia is now classified as a subtype of NHL, statistics for NHL herein are based on the historical classification for the purpose of describing trends and do not include these cancers.)

Incidence trends: Incidence rates during 2007-2016 decreased by 1.5% per year for Hodgkin lymphoma and by 0.4% per year for NHL, although patterns vary by subtype (see onlinelibrary.wiley.com/doi/10.3322/caac.21357/abstract).

Mortality trends: The death rate has been declining since at least 1975 for Hodgkin lymphoma and since 1997 for NHL. These declines are due mainly to improvements in treatment, although for NHL, reductions in incidence and improved survival for human immunodeficiency virus (HIV)-associated subtypes have also contributed. From 2008 to 2017, the death rate decreased by about 4% per year for Hodgkin lymphoma and 2% per year for NHL.

Risk factors: Typical of most cancers, the risk of NHL increases with age. In contrast, Hodgkin lymphoma incidence peaks first during adolescence/early adulthood and again in later life. Most 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 and who have autoimmune disorders (e.g., Sjogren syndrome, lupus, and rheumatoid arthritis). Certain infectious agents (e.g., Epstein Barr virus) increase the risk of some lymphoma subtypes directly, whereas others increase risk indirectly by weakening (e.g., HIV) or continuously activating (e.g., *Helicobacter pylori* and hepatitis C virus) the immune system. Studies also suggest that certain behavioral risk factors (e.g., body weight) and environmental exposures influence risk for some subtypes.

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

Treatment: NHL patients are usually treated with chemotherapy, although radiation, alone or in combination with chemotherapy, is sometimes used. Targeted or immunotherapy drugs are used for some NHL subtypes. If NHL persists or recurs after standard treatment, stem cell transplantation may be an option. Newer therapies that boost the body's immune system (e.g., CAR T-cell therapy) have shown promising results for some hard-to-treat lymphomas.

Hodgkin lymphoma is usually treated with chemotherapy and/or radiation therapy, depending on disease stage and cell type. If these treatments are ineffective, options may include stem cell transplantation and/or treatment with a monoclonal antibody linked to a chemotherapy drug, as well as immunotherapy.

Survival: Survival varies widely by lymphoma subtype and stage of disease; overall 5-year relative survival is 87% for Hodgkin lymphoma and 72% for NHL.

Oral Cavity and Pharynx

New cases and deaths: In 2020, an estimated 53,260 new cases of cancer of the oral cavity and pharynx (throat) will be diagnosed in the US and 10,750 people will die from the disease (Table 1). Incidence rates are more than twice as high in men as in women.

Incidence trends: From 2007 to 2016, incidence rates decreased by 1% to 2% per year among black men and women but increased annually by about 1% among non-Hispanic white men and women. These increases are largely driven by rising rates for a subset of cancers associated with human papillomavirus (HPV) infection that arise in the oropharynx (part of the throat behind the oral cavity, including the back one-third of the tongue, soft palate, and tonsils).

Mortality trends: The death rate for cancers of the oral cavity and pharynx continued its long decline during 2008-2017 among blacks (by about 2% per year), but increased by 0.7% per year among whites, mostly reflecting an uptick for subsites associated with HPV.

Risk factors: Known risk factors include any form of tobacco use and alcohol consumption, with a synergistic relationship conferring 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: HPV vaccines have primarily been evaluated against genital diseases but will likely prevent most HPV-associated oral cancers as well. Unfortunately, immunization rates are much lower than for other disease-preventing vaccines, with only 51% of adolescents ages 13 to 17 years (49% of boys and 54% of girls) up to date with HPV vaccination in 2018.

Signs and symptoms: Symptoms may include an ulcer 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 jaw are often late symptoms.

Treatment: Surgery and/or radiation therapy are standard treatments; chemotherapy is often added for high-risk or advanced disease. Chemotherapy or targeted therapy may be combined with radiation as initial treatment in some cases. 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 overall is 65% but is much lower in blacks (48%) than in whites (67%). Studies indicate better survival for patients with HPV-associated cancer. Only 29% of cases are diagnosed at a local stage, for which 5-year survival is 84%.

Ovary

New cases and deaths: In 2020, an estimated 21,750 new cases of ovarian cancer will be diagnosed in the US and 13,940 women will die from the disease (Table 1). Most (90%) cases are epithelial ovarian cancer, the majority of which are high-grade serous tumors, which have the fewest established risk factors and worst prognosis.

Incidence trends: Ovarian cancer incidence rates have declined since the mid-1980s, decreasing by 1.6% per year from 2007-2016.

Mortality trends: Ovarian cancer death rates have declined since the early 2000s, decreasing by 2.3% per year from 2008-2017.

Risk factors: The most important risk factor other than age is a strong family history of breast or ovarian cancer. Women who have certain inherited mutations (e.g., *BRCA1* or *BRCA2*) or genetic conditions (e.g., Lynch

Table 8. Five-year Relative Survival Rates* (%) by Stage at Diagnosis, US, 2009-2015

	All stages	Local	Regional	Distant		All stages	Local	Regional	Distant
Breast (female)	90	99	86	27	Oral cavity & pharynx	65	84	66	39
Colon & rectum	64	90	71	14	Ovary	48	92	75	29
Colon	63	90	71	14	Pancreas	9	37	12	3
Rectum	67	89	71	15	Prostate	98	>99	>99	31
Esophagus	20	47	25	5	Stomach	32	69	31	5
Kidney†	75	93	70	12	Testis	95	99	96	73
Larynx	60	77	45	33	Thyroid	98	>99	98	56
Liver‡	18	33	11	2	Urinary bladder§	77	70	36	5
Lung & bronchus	19	57	31	5	Uterine cervix	66	92	56	17
Melanoma of the skin	92	99	65	25	Uterine corpus	81	95	69	17

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 18 areas from 2009-2015, all followed through 2016. †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: Source: Howlader N, Noone AM, Krapcho M, et al (eds). *SEER Cancer Statistics Review, 1975-2016*, National Cancer Institute, Bethesda, MD, https://seer.cancer.gov/csr/1975_2016/, based on November 2018 SEER data submission, posted to the SEER website, April 2019.

syndrome) are at increased risk. Other medical conditions and characteristics associated with increased risk include a personal history of breast cancer, endometriosis, or pelvic inflammatory disease, and adult height. Modifiable factors associated with increased risk include excess body weight, menopausal hormone therapy (estrogen alone or combined with progesterone), and cigarette smoking, which is associated with a rare subtype (mucinous). Factors associated with lower risk include pregnancy, fallopian tube ligation or removal (salpingectomy), and use of oral contraceptives (OCs), with risk reductions of 40% among long-term (10+ years) OC users. It is unclear whether genital talc-based powder use increases the risk of ovarian cancer, in part because most of the evidence is from case-control studies, which are especially prone to bias, and because the type of body powder (i.e., with or without talc) and location of use (i.e., genital vs. non-genital) was sometimes unclear.

Early detection: Currently, there is no recommended screening test for ovarian cancer, although clinical trials to identify effective strategies are underway. Women who are at high risk or have symptoms may be offered a thorough pelvic exam in combination with transvaginal ultrasound and a blood test for the CA125 tumor marker, although this strategy has not been proven to be effective in reducing ovarian cancer mortality and is associated with serious harms due to false-positive diagnoses.

Signs and symptoms: Early ovarian cancer usually has no obvious symptoms. However, some women experience persistent, nonspecific symptoms, such as back pain, bloating, pelvic or abdominal pain, difficulty eating or feeling full quickly, or urinary urgency or frequency in the months before 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.

Treatment: Treatment includes surgery and often chemotherapy and targeted therapy. 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). Additional abdominal organs may be removed in women with advanced disease, whereas only the involved ovary and fallopian tube may be removed in younger women with very early-stage tumors who want to preserve fertility. The goal of surgery is to remove as much of the tumor as possible, referred to as debulking, and stage the cancer. More accurate surgical staging (microscopic examination of tissue from different parts of the pelvis and abdomen) has been associated with better outcomes among patients with early-stage disease. For advanced

disease, chemotherapy administered directly into the abdomen improves survival, although the risk for side effects is high. 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 only 48% because most patients (59%) 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%. Five-year survival is twice as high in women younger than age 65 (60%) than in those 65 and older (31%).

Pancreas

New cases and deaths: In 2020, an estimated 57,600 new cases of pancreatic cancer will be diagnosed in the US and 47,050 people will die from the disease (Table 1). Most cases (93%) develop in the exocrine tissue of the pancreas, which makes enzymes to digest food. Endocrine tumors (7%), commonly referred to as pancreatic neuroendocrine tumors (NETs), develop in hormone-producing cells and have a younger median age at diagnosis and better prognosis.

Incidence trends: From 2007 to 2016, the incidence rate for pancreatic cancer increased by 0.7% per year in whites and 0.3% per year in blacks.

Mortality trends: During 2008 to 2017, the death rate for pancreatic cancer increased slightly (by 0.4% per year) in whites and decreased slightly (by 0.5% per year) in blacks.

Risk factors: Cigarette smokers have about twice the risk of pancreatic cancer as never smokers. Use of smokeless tobacco also increases risk. Other risk factors include type 2 diabetes, excess body weight, a family history of pancreatic cancer, and a personal history of chronic pancreatitis. Heavy 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.

Signs and symptoms: Symptoms for pancreatic cancer, which usually do not appear until the disease is advanced, include weight loss, abdominal discomfort that may radiate to the back, and occasionally the development of type 2 diabetes. Tumors sometimes cause jaundice (yellowing of the skin and eyes), which can facilitate earlier diagnosis. Signs of advanced-stage disease may include severe abdominal pain, nausea, and vomiting.

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 the cancer has usually spread beyond the pancreas by the time it is diagnosed. For those who do 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 targeted agents and immunotherapies.

Survival: For all stages combined, the 5-year relative survival rate is 9%. Even for the small percentage of people diagnosed with local disease (10%), 5-year survival is only 37%. The majority of patients are diagnosed at a distant stage (53%), for which 5-year survival is 3%.

Prostate

New cases and deaths: In 2020, an estimated 191,930 new cases of prostate cancer will be diagnosed in the US and 33,330 men will die from the disease (Table 1). The incidence of prostate cancer is about 60% higher in blacks than in whites for reasons that remain unclear.

Incidence trends: Incidence rates for prostate cancer spiked dramatically in the late 1980s and early 1990s, in large part because of a surge in screening with the prostate-specific antigen (PSA) blood test. Likewise, the decline in rates that has occurred since around 2000, and accelerated in recent years, is likely due to reduced PSA screening, partly due to changes in guidelines. From 2007 to 2016, the rate decreased by 3.8% per year on average.

Mortality trends: The prostate cancer death rate has declined by 52%, from a peak of 39.3 (per 100,000) in 1993

to a low of 18.8 in 2017, although it appears to have stabilized in recent years. The rapid reduction in prostate cancer mortality is attributed to earlier detection through PSA testing and advances in treatment.

Risk factors: Well-established risk factors for prostate cancer are increasing age, African ancestry, a family history of the disease, and certain inherited genetic conditions (e.g., Lynch syndrome and *BRCA1* and *BRCA2* mutations). Black men in the US and the Caribbean 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. There is accumulating evidence that smoking increases the risk of fatal prostate cancer and excess body weight increases risk of aggressive and fatal prostate cancer.

Early detection: No organization presently endorses 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 or harm), along with the high potential for serious side effects associated with prostate cancer treatment. Rather, many organizations recommend an "informed decision-making" approach whereby men are educated about screening and encouraged to make a personal choice. 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 and 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 40.

Signs and symptoms: Early-stage prostate cancer usually has no symptoms. More advanced disease shares symptoms with benign prostate conditions, including 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. Late-stage prostate cancer commonly spreads to the bones, which can cause pain in the hips, spine, ribs, or other areas.

Treatment: Recent changes in the grading system for prostate cancer have improved tumor characterization and disease management. Careful monitoring of disease progression (called active surveillance) instead of immediate treatment is appropriate for many patients, particularly men who are diagnosed at an early stage, have less aggressive tumors, and are older. Treatment options for early-stage disease include surgery, external beam radiation, or radioactive seed implants (brachytherapy). Hormone 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, which could be used to minimize unnecessary treatment by distinguishing early-stage cancers that are potentially more aggressive from those that are less likely to progress if left untreated.

Late-stage prostate cancer treatment options include hormonal therapy, chemotherapy, and/or radiation therapy. 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. 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 attack prostate cancer cells specifically. Other types of drugs can be used to treat prostate cancer that has spread to the bones.

Survival: The vast majority (90%) 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 disease diagnosed at a distant stage is 31%. The 10-year survival rate for all stages combined is 98%.

Skin

New cases and deaths: 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 (i.e., keratinocyte carcinoma or KC), also referred to as nonmelanoma skin cancer – is difficult to estimate because 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.

Invasive melanoma accounts for about 1% of all skin cancer cases, but the vast majority of skin cancer deaths. In 2020, an estimated 100,350 new cases of melanoma will be diagnosed in the US and 6,850 people will die from the disease (Table 1). Incidence is most common among non-Hispanic whites, who have an annual rate of 28 cases per 100,000, compared to 7 in American Indians/Alaska Natives; 5 in Hispanics; and 1 in non-Hispanic blacks and Asians/Pacific Islanders. 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 largely reflects age and sex differences in historical occupational and recreational exposure to ultraviolet radiation, although use of indoor tanning among young women also contributes. Differences in early-detection practices and use of health care may also play a role.

Incidence trends: The overall incidence of melanoma of the skin rose rapidly over the past 30 years, but trends in the past decade vary by age. From 2007 to 2016, the rate decreased by 1.2% per year in individuals younger than 50 years of age while increasing by 2.2% per year among those ages 50 and older.

Mortality trends: Mortality trends also vary by age, with a declining trend in individuals younger than 50 years of age since the mid-1980s, but only in the past decade in older adults. Advances in treatment have accelerated declines in the past five years; from 2013 to 2017, the death rate for melanoma declined by 7.0% per year in adults younger than 50 years of age and by 5.7% per year in older adults.

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. Excess exposure to ultraviolet (UV) radiation from sunlight or the use of indoor tanning increases risk of all common types of skin cancer. Risk is also increased for people who are sun-sensitive (e.g., sunburn easily or have natural blond or red hair color) and those who have a history of excessive sun exposure (including sunburns) or skin cancer. Risk is also increased in people with a weakened immune system and certain genetic syndromes.

Prevention: Most skin cancer cases and deaths are caused by exposure to UV radiation, and thus potentially preventable. Exposure to intense UV radiation can be minimized by wearing protective clothing (e.g., long sleeves, a wide-brimmed hat, etc.); wearing sunglasses that block ultraviolet rays; applying broad-spectrum sunscreen that has a sun protection factor (SPF) of at least 30 to unprotected skin as directed; seeking shade; and not sunbathing or indoor tanning. Children and adolescents should be especially protected from the sun (and indoor tanning) because severe sunburns early in life may particularly increase risk of melanoma. Communities can help prevent skin cancer through educational interventions in schools and providing shade at schools, recreational sites, and occupational setting. In 2014, the US surgeon general released a Call to Action to Prevent Skin Cancer because of the growing burden of this largely preventable 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: The best way to detect skin cancer early is to be aware of new or changing skin spots or 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 clinician. Periodic skin examination, perhaps with the help of a partner for areas that are hard for you to see, may be helpful in identifying changes.

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 skin growth; or a sore that doesn't heal. Changes that progress over a month or more should be evaluated by a clinician. 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. 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); 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. Most cases of KC are cured by removing the lesion through minor surgery or other techniques (e.g., 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 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 FDA approval of several new immunotherapy and targeted drugs that can be very effective. Chemotherapy may be used but 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 for melanoma is 92%. Eighty-four percent of cases are diagnosed at a localized stage, for which the 5-year survival rate is 99% (Table 8). More than half of patients diagnosed with distant-stage disease now survive at least one year because of recent advances in treatment.

Thyroid

New cases and deaths: In 2020, there will be an estimated 52,890 new cases of thyroid cancer diagnosed in the US and 2,180 people will die from the disease (Table 1). The incidence rate is 3 times higher in women than in men.

Incidence trends: Until recently, thyroid cancer was the most rapidly increasing cancer in the US, largely due to increased detection (probably including some overdiagnosis) because of increased use of imaging and more sensitive diagnostic procedures. However, the increase of about 7% per year during the 2000s has slowed to 2% per year in men and rates have stabilized in women during 2012 to 2016, likely due in part to the adoption of more conservative diagnostic criteria by clinicians.

Mortality trends: The death rate for thyroid cancer increased slightly during 2008 to 2017 (0.6% per year) but appears to have stabilized in recent years.

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, radiation exposure early in life (e.g., during cancer treatment), excess body weight, and certain rare genetic syndromes, such as familial adenomatous polyposis (FAP). 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 before cancer develops.

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 done for another reason.

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 patient age, tumor size and cell type, 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 pituitary gland from producing thyroid-stimulating hormone, decreasing the likelihood of recurrence. For some types of advanced thyroid cancer, targeted drugs, known as tyrosine kinase inhibitors, can be used to help shrink or slow tumor growth.

Survival: The 5-year relative survival rate is 98%, largely because two-thirds of cases are diagnosed at a local stage, but also because treatment is usually successful; 56% of patients diagnosed with distant-stage disease survive at least five years (Table 8).

Urinary Bladder

New cases and deaths: In 2020, an estimated 81,400 new cases of bladder cancer will be diagnosed in the US and 17,980 people will die from the disease (Table 1). The incidence rate is about 4 times higher in men than in women and 2 times higher in white men than in black men.

Incidence trends: After decades of slowly increasing, bladder cancer incidence rates declined from 2007 to 2016 by about 1% per year.

Mortality trends: In contrast, the death rate for urinary bladder cancer has generally declined since at least the mid-1970s; from 2008 to 2017, the rate decreased by 0.3% per year.

Risk factors: Smoking is the most well-established risk factor for bladder cancer, accounting for almost half (47%) of all cases in the US. 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 or long-term urinary catheters.

Early detection: There is currently no screening method recommended for people at average risk. People at increased risk may be screened by examination of the bladder wall with a cystoscope (slender tube fitted with a camera lens and light that is inserted through the urethra), microscopic examination of cells from urine or bladder tissue, or other tests.

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.

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 (BCG-bacillus Calmette-Guérin) or chemotherapy drugs directly into the bladder (intravesical therapy). More advanced cancers may require removal of the entire bladder (cystectomy). Patient outcomes are improved with the use of chemotherapy before cystectomy. Distant-stage cancers are typically treated with chemotherapy, sometimes along with radiation. Immunotherapy and targeted therapy drugs are newer options if chemotherapy cannot be used or is no longer working. Timely follow-up care is extremely important for all patients because of the high likelihood of cancer recurrence, or a subsequent bladder cancer.

Survival: The 5-year relative survival rate for bladder cancer is 77%. Half (51%) of all cases are diagnosed before the tumor has spread beyond the layer of cells in which it developed (in situ), for which the 5-year survival is 96%.

Uterine Cervix

New cases and deaths: In 2020, an estimated 13,800 cases of invasive cervical cancer will be diagnosed and about 4,290 deaths will occur in the US (Table 1).

Incidence trends: The cervical cancer incidence rate has dropped by more than half since the mid-1970s, largely due to the widespread uptake of screening with the Pap test (described below). However, the rate in white women had stabilized during the most recent decade of data (2007 to 2016) while continuing to decline in black women (by 2.8% per year). Studies suggest that some recent declines in incidence in young women may be associated with HPV vaccine uptake.

Mortality trends: The cervical cancer death rate has also dropped by more than half since the mid-1970s due to declines in incidence and the early detection of cancer through screening. Like incidence, however, continued declines during 2008 to 2017 in black women (by 2.6% per year) are in contrast to stable rates in white women.

Risk factors: Almost all cervical cancers are caused by persistent infection with certain types of human papillomavirus (HPV). HPV infections are common in healthy women and only rarely cause cervical cancer. Although 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 that gradually declines after cessation.

Prevention: Vaccines that protect against the types of HPV that cause 90% of cervical cancers, as well as several other diseases and cancers, are routinely recommended for children ages 11 to 12 years. While the vaccines are recommended for use in ages 9 to 26 years, the CDC recommends vaccinating all boys and girls by age 13. In 2016, the recommended number of vaccine doses was reduced from three to two as long as the first dose is given before age 15; three doses are required for full protection when the first dose is given after the 15th birthday. The CDC recommends shared clinical decision making regarding HPV vaccination in adults ages 27 to 45 years. Unfortunately, the immunization rate remains low in the US; in 2018, 54% of girls and 49% of boys 13 to 17 years of age were up to date with the HPV vaccination series. HPV vaccines cannot protect against established infections and do not protect against all types of HPV, which is why it is important for all women, even those who have been vaccinated, to follow cervical cancer screening guidelines. Screening can prevent cervical cancer through detection and treatment of precancerous lesions, which are now detected far more frequently than invasive cancer. Most cervical precancers develop slowly, so cancer can usually be prevented if a woman is screened regularly. The Pap test is a simple procedure in which a small sample of cells is collected from the cervix and examined under a microscope, and was historically the only screening option. The newer HPV test, which detects HPV infections associated with cervical cancer, can forecast cervical cancer risk and is currently recommended for use in conjunction with the Pap test or as a stand-alone test in women ages 30 to 65 years. The HPV test can also identify women at risk for a type of cervical cancer (adenocarcinoma) that is often missed by Pap tests and accounts for 29% of cases.

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 years, with an emphasis on the incorporation of HPV testing in addition to the Pap test for ages 30 to 65 years. For more detailed information on the American Cancer Society's screening guideline for the early detection of cervical cancer, see page 70.

Signs and symptoms: Preinvasive cervical lesions often have no symptoms. Once abnormal 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 cause menstrual bleeding to last longer or be heavier than usual. Bleeding may also occur after sexual intercourse, douching, a pelvic exam, or menopause. Increased vaginal discharge may also be a symptom.

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. For early-stage disease, studies indicate that minimally invasive surgery (laparoscopy) is associated with worse survival than open surgery. 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. Immunotherapy may be another option for metastatic or recurrent cancer.

Survival: The 5-year relative survival rate for cervical cancer overall is 66% but ranges from 46% for black women 50 and older to 78% for white women younger than age 50. Five-year survival is 92% for the 44% of patients diagnosed with localized stage.

Uterine Corpus (Endometrium)

New cases and deaths: In 2020, an estimated 65,620 cases of cancer of the uterine corpus (body of the uterus) will be diagnosed in the US and 12,590 women will die from the disease (Table 1). Cancer of the uterine corpus is often referred to as endometrial cancer because more than 90% of cases occur in the endometrium (lining of the uterus).

Incidence trends: From 2007 to 2016, the incidence rate increased by about 1% per year among white women and by about 2% per year among black women.

Mortality trends: From 2008 to 2017, the death rate for cancer of the uterine corpus increased by about 2% per year among both white women and black women.

Risk factors: According to American Cancer Society research, an estimated 70% of uterine corpus cancers are attributable to excess body weight and insufficient physical activity, and thus potentially preventable.

Obesity and abdominal fatness substantially increase the risk of uterine cancer, partly by increasing the amount of circulating estrogen, which is a strong risk factor. Other factors that increase estrogen exposure include the use of postmenopausal estrogen alone (estrogen plus progestin does not appear to increase risk), late menopause, and a history of polycystic ovary syndrome. Tamoxifen, a drug used to prevent breast cancer, increases risk slightly because it has estrogen-like effects on the uterus. Medical conditions that increase risk include Lynch syndrome and type 2 diabetes. Pregnancy and use of oral contraceptives or intrauterine devices are associated with reduced risk.

Early detection: There is no recommended 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 a clinician. 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.

Signs and symptoms: The most common symptom is abnormal uterine bleeding or spotting, especially in postmenopausal women. Pain during urination, intercourse, or in the pelvic area and non-bloody vaginal discharge can also be symptoms.

Treatment: Uterine cancers are usually treated with surgery (e.g., hysterectomy), radiation, hormones, and/or chemotherapy, depending on the stage of disease. Immunotherapy and targeted therapy drugs might be options in certain situations as well.

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 to be diagnosed with early-stage disease (69% versus 54%); however, survival is substantially lower for black women for every stage of diagnosis.

Special Section: Cancer in Adolescents and Young Adults

Overview

In 2020, there will be approximately 89,500 new cancer cases and 9,270 cancer deaths in adolescents and young adults (AYAs) ages 15 to 39 years in the United States (Table S1). These patients are often grouped with younger or older patient populations, which masks important differences in cancer distribution, tumor biology, and survivorship. For example, an increasing body of evidence indicates that several types of cancer in AYAs are molecularly distinct from those that occur in other age groups, suggesting possible differences in how cancers in this age group develop and are most effectively treated.[1,2] In addition, for some cancer types, AYAs are more likely to be diagnosed at a late stage because of both delays in diagnosis due to the rarity of cancer in this age group and higher uninsured rates and higher prevalence of aggressive disease.[3,4] AYA patients also have a high risk of long-term and late effects, including infertility, sexual dysfunction, heart problems, and future cancers.[5-8]

Despite the number of obstacles facing AYA cancer patients, this group was understudied in the US until the mid-2000s, when the National Cancer Institute (NCI), in collaboration with the LIVESTRONG Foundation, convened a group of experts to report on priority areas for AYAs across the cancer continuum.[9] Although this landmark report provided the impetus for rapid progress over the past decade, several challenges remain, including research gaps in basic biology, treatment, and survivorship, as well as persistent disparities in health care access and survival for some common cancers.[10]

Table S1. Estimated Cancer Cases and Deaths in AYAs by Age, US, 2020

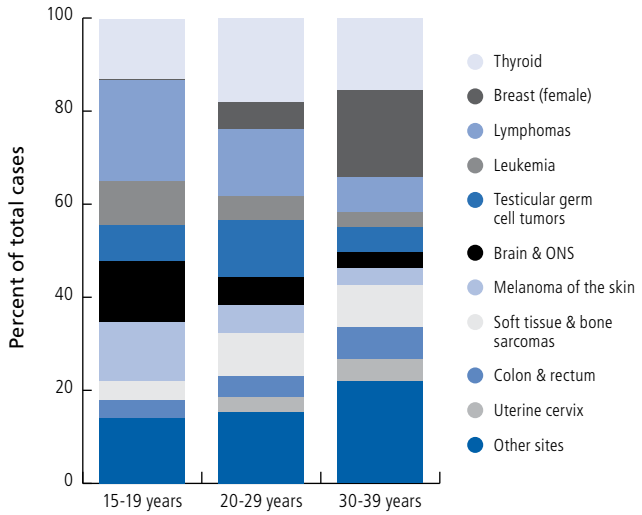
Age	Estimated cases	Estimated deaths
15-19 years	5,800	540
20-29 years	24,900	2,210
30-39 years	58,800	6,520
Total	89,500	9,270

In this special section, we provide an overview of trends in cancer incidence, mortality, and survival and discuss some of the unique challenges among AYAs. In order to fully describe the heterogeneity in the disease burden within AYAs, cancer occurrence is also described separately by age group.

Leading cancers in AYAs

The most common cancers among AYAs vary substantially by age and are shown in Figure S1. Adolescents (15- to 19-year-olds) have a unique cancer profile that includes childhood cancers (e.g., acute lymphocytic leukemia), adult cancers (e.g., thyroid and melanoma of the skin), and a disproportionately high burden of lymphoma. For example, Hodgkin lymphoma accounts for 13% of cancer cases in adolescents compared to 9% in ages 20-29 years and 3% in ages 30-39 years.[11] Conversely, adults 20-39 years have a higher proportion of solid tumors. In 2020, the most commonly

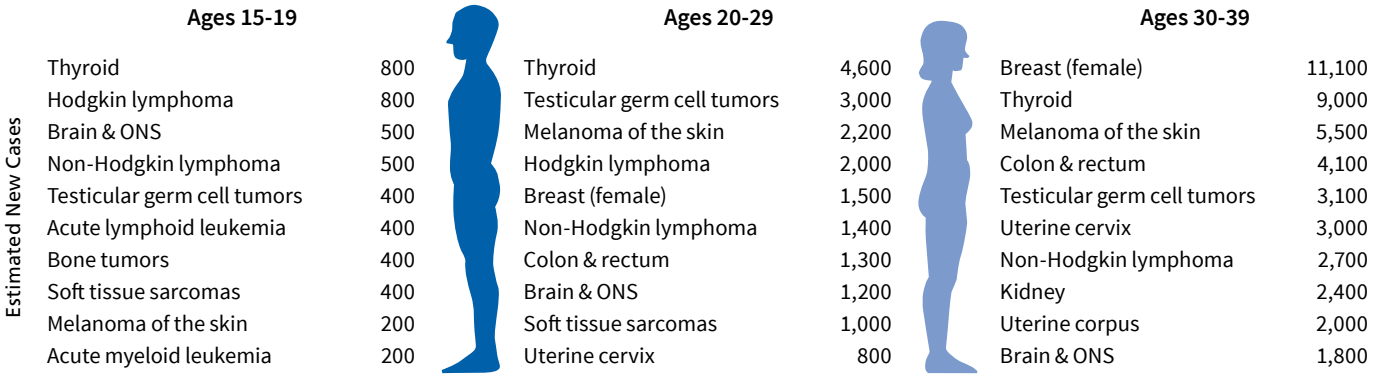
Figure S1. Case Distribution (%) of Leading Cancer Types in AYAs, US, 2012-2016



Coding for cancers of the thyroid, female breast, colon & rectum, and uterine cervix and melanoma of the skin are based on the SEER adult recode variable, excluding a small number of sarcomas.

Source: NAACCR, 2019.

Figure S2. Leading Sites of New Cancer Cases in AYAs, Both Sexes Combined – 2020 Estimates



ONS = other nervous system. Estimates are rounded to the nearest 100 and exclude basal cell and squamous cell skin cancers, benign and borderline brain, and in situ carcinoma of any kind. Ranking is based on modeled progress and may differ from the most recent observed data.

diagnosed cancers will be thyroid, testicular germ cell tumors (GCTs), and melanoma of the skin in ages 20-29 years and female breast, thyroid, and melanoma in ages 30-39 years (Figure S2).

Common cancer risk factors in AYAs

Little is known about the causes of many pediatric cancers that occur in AYAs, and established risk factors for adult cancers are based on studies conducted among older populations. Although the majority of cases in AYAs occur in the absence of a known hereditary predisposition,[12-14] certain genetic syndromes are strongly linked to early-onset cancers, such as:

- Lynch syndrome and colorectal, ovarian, and endometrial cancers[15]
- Familial adenomatous polyposis and colorectal cancer[16]
- Li-Fraumeni syndrome and several cancer types, including breast, sarcoma, brain, and leukemia[17]
- MEN2 familial syndrome and medullary thyroid cancer[18]

In addition, a history of cancer in a parent or sibling increases the risk of being diagnosed with cancer at a younger age, especially if the relative was diagnosed at a young age.[13, 19, 20] For example, men with a first-degree relative with a history of a testicular GCT are four times more likely to develop the disease compared to those without this medical history.[12, 21]

Research is still ongoing to describe the complex interactions between environmental exposures, health behaviors, and/or genetic susceptibility that likely precipitate the development of cancer in AYAs. For example, melanoma of the skin in AYAs appears to occur among susceptible individuals through genetic interactions with early-life UV exposure, whereas melanoma in older adults likely reflects cumulative lifetime UV exposure among those with less susceptibility.[22] However, some exposures may be linked to early-onset disease regardless of heredity. In one study, excess body weight was associated with an increased risk of early-onset colorectal cancer among women regardless of family history of the disease.[23]

Exposure to infectious agents is another important risk factor among AYAs. Infections associated with cancers in AYAs include human papillomavirus, Epstein-Barr virus, human immunodeficiency virus (HIV), and human herpesvirus 8. Importantly, although smoking-related cancers other than cervical are generally uncommon in AYAs, cigarette smoking increases susceptibility to these cancer-related infections.[24]

Cancer in AYAs by sex and race/ethnicity

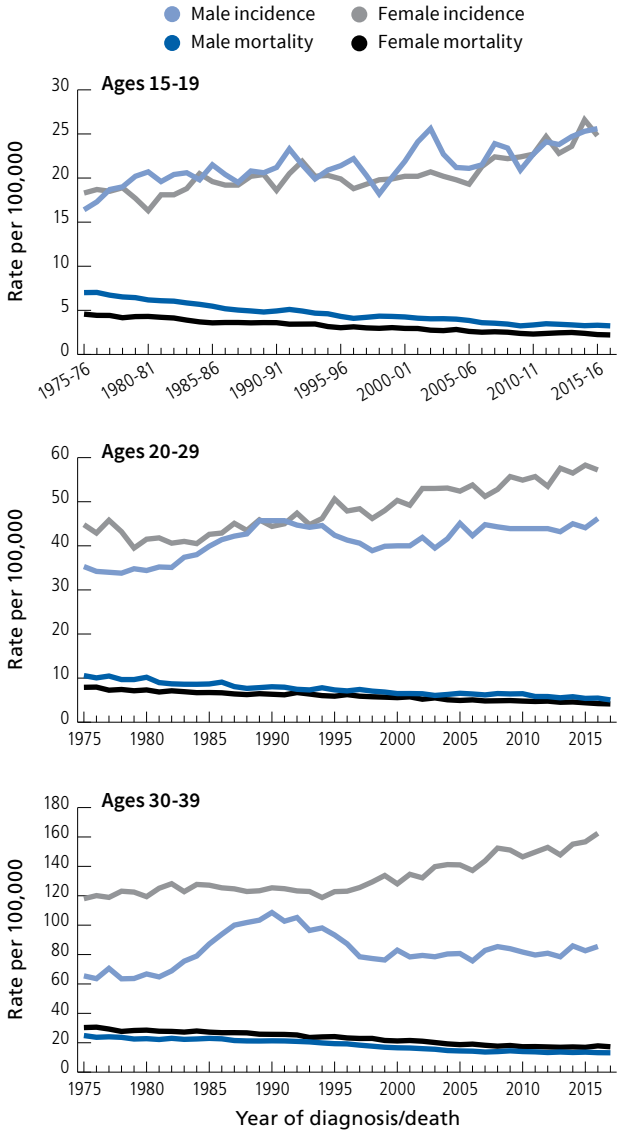
Sex

During 2012-2016, cancer incidence rates for all sites combined were similar in females and males ages 15-19 years (23 versus 24 cases per 100,000, respectively) but 30% higher in females compared to males ages 20-29 years (55 versus 42 per 100,000) and nearly double in females ages 30-39 years (161 versus 84 per 100,000).[11] Higher incidence rates in women ages 20-39 years are primarily driven by breast cancer, as well as higher rates of thyroid cancer and melanoma of the skin. For example, thyroid cancer incidence rates among women in their 20s are more than fivefold those among men (15 versus 3 per 100,000 during 2012-2016, respectively).[11] Notably, although lung cancer is rare in AYAs, incidence rates in women in their 30s are higher than those in men, in contrast to higher rates among men compared to women 50 years of age and older.[25] Higher lung cancer rates in young women are not fully explained by smoking prevalence.

Despite lower overall rates, incidence is higher in males than females for a number of cancers in AYAs. In particular, gonadal GCTs are substantially more common in males than females across all age groups, for reasons that are largely unknown but may reflect sex-specific interactions between genetic factors and maternal hormones prior to birth.[26] Testicular GCTs are the most commonly diagnosed cancer among young adult men, with rates peaking in the 30-39 age group (13 per 100,000 during 2012-2016).[11] Conversely, ovarian GCTs are rare and rates peak during adolescence (0.8 per 100,000).

In contrast to incidence, cancer mortality in males is slightly higher than in females among adolescents and young adults in their 20s (Figure S3), primarily reflecting higher incidence rates among males for cancers with lower survival (e.g., brain tumors and soft tissue and bone sarcomas).[27] Notably, melanoma and thyroid cancer death rates in females are similar to or lower than those in males despite higher incidence rates because much of the overall case burden is due to overdiagnosis (i.e., the detection of cancers that would never have progressed or caused harm), and males are slightly more likely to be diagnosed with distant-stage disease. Leukemia is the leading cause of cancer death in both males and females ages 15-29 years, whereas brain and breast cancers are the leading causes of death in males and females, respectively, ages 30-39 years. Although cervical cancer is highly preventable, it is the second-leading cause of cancer death among women ages 20-39 years.

Figure S3. Trends in AYA Cancer Incidence and Mortality Rates for All Cancers Combined by Age and Sex, US, 1975-2017



Rates are age adjusted to the 2000 US standard population and incidence rates are adjusted for reporting delays. Rates for 15- to 19-year-olds are two-year moving averages.

Sources: Incidence – SEER 9 registries; Mortality – National Center for Health Statistics (NCHS), 2019.

Race/Ethnicity

While AYAs account for 5% of cancer cases in the US overall, they represent about 1 in 10 cases among Hispanics and Asians/Pacific Islanders,[11] reflecting the young age structure of these populations. AYA cancer incidence rates are highest in non-Hispanic whites (83 per 100,000), followed by non-Hispanic blacks (63 per 100,000), and are lowest in Asians/Pacific Islanders (54 per 100,000) (Figure S4). However, non-Hispanic blacks have the highest cancer mortality rates (11 per 100,000) despite 25% lower incidence rates than those in non-Hispanic whites. In women, this largely reflects substantial disparities in breast cancer; breast cancer mortality rates in non-Hispanic black women in their 30s are nearly double those in non-Hispanic whites (8.5 versus 4.5 deaths per 100,000, respectively).[28]

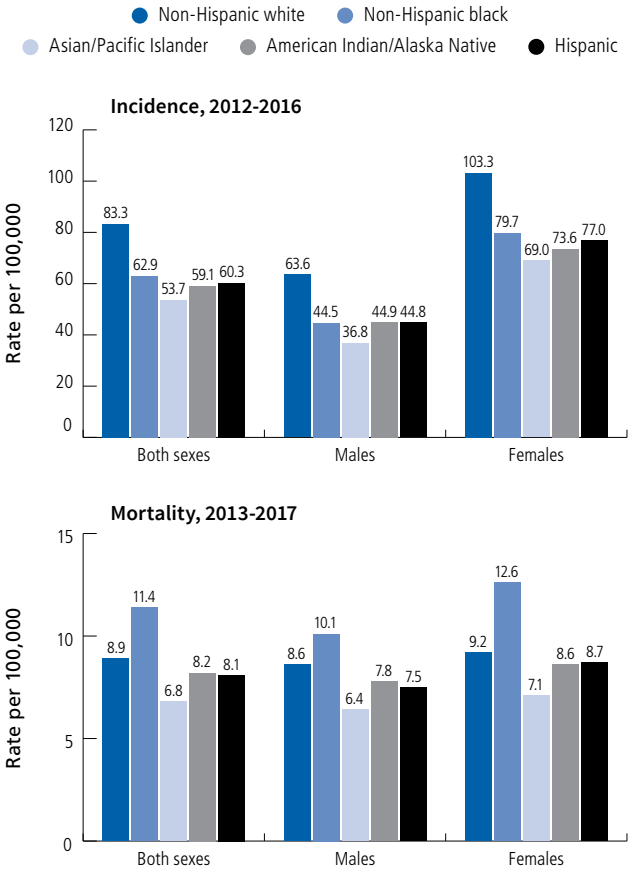
Trends in AYA cancer occurrence

Trends in incidence rates

In contrast to steadier trends among adolescents and young adult women, cancer incidence among young adult men increased rapidly in the late 1980s and declined in the early 1990s in parallel with the human immunodeficiency virus (HIV)/acquired immune deficiency syndrome (AIDS) epidemic (Figure S3). This pattern primarily reflects a peak in the occurrence of Kaposi sarcoma (Figure S5). The HIV/AIDS epidemic did not contribute substantially to trends in female AYAs or male adolescents.

During the past decade of available data (2007-2016), rates in men ages 20-39 years were largely stable, whereas incidence rates increased by about 1% annually in

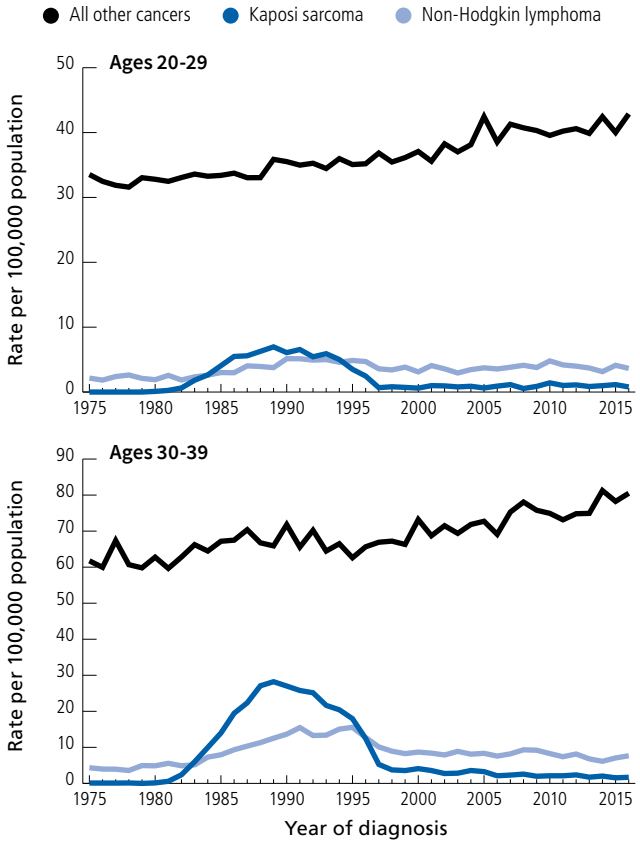
Figure S4. AYA Cancer Incidence and Mortality Rates by Sex and Race/Ethnicity, US, 2012-2017



Rates are per 100,000 and age adjusted to the 2000 US standard population. Rates for AIs/ANs are based on Preferred/Referred Delivery Care Area counties.

Sources: Incidence – NAACCR, 2019. Mortality – NCHS, 2019.

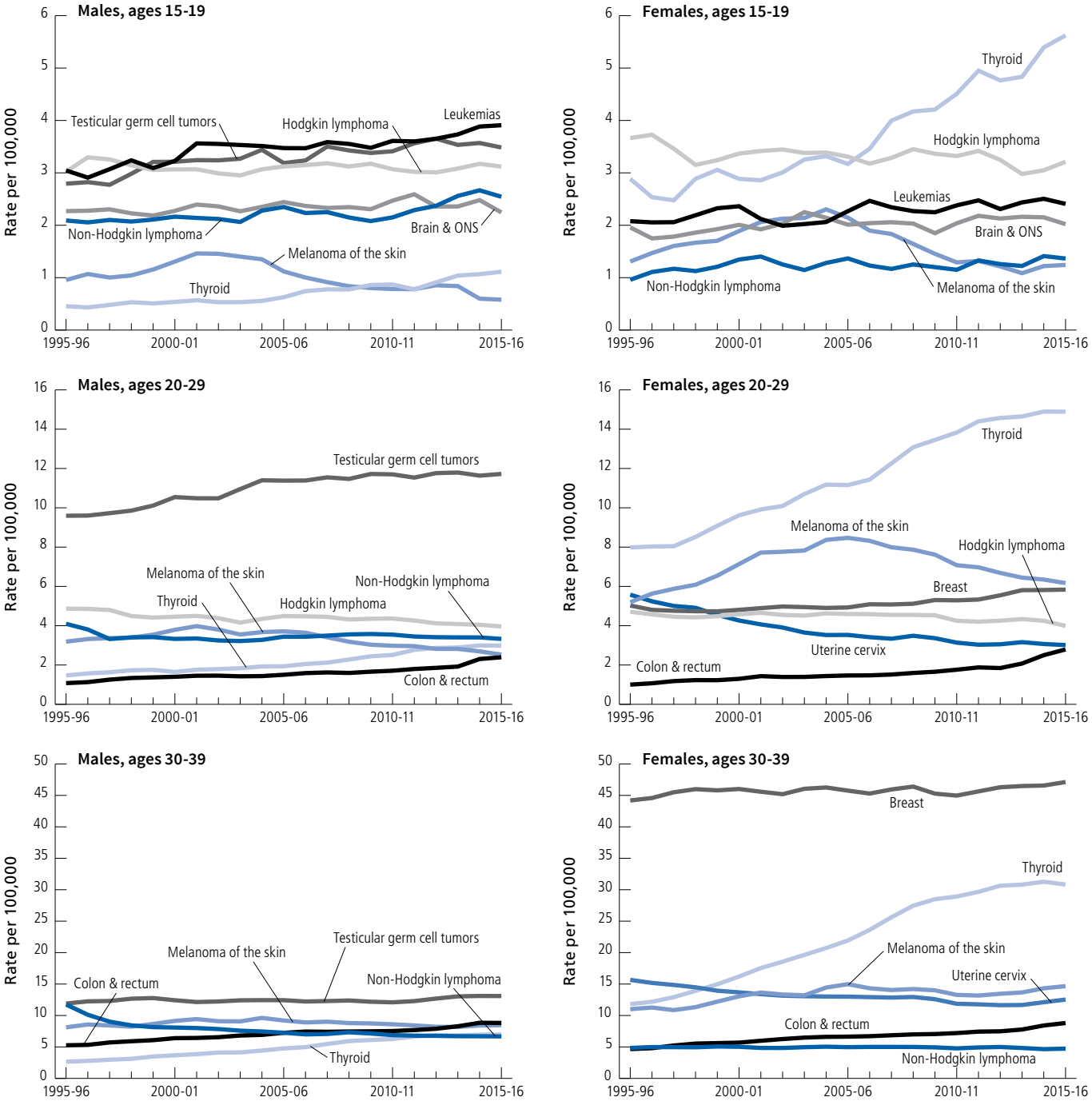
Figure S5. Kaposi Sarcoma and Non-Hodgkin Lymphoma Incidence Rates in Comparison to All Other Cancers Combined among Young Adult Men, US, 1975-2016



Incidence rates are age adjusted to the 2000 US standard population and are adjusted for reporting delays.

Sources: SEER 9 registries, 2019.

Figure S6. Trends in AYA Cancer Incidence Rates by Site and Age, US, 1995-2016

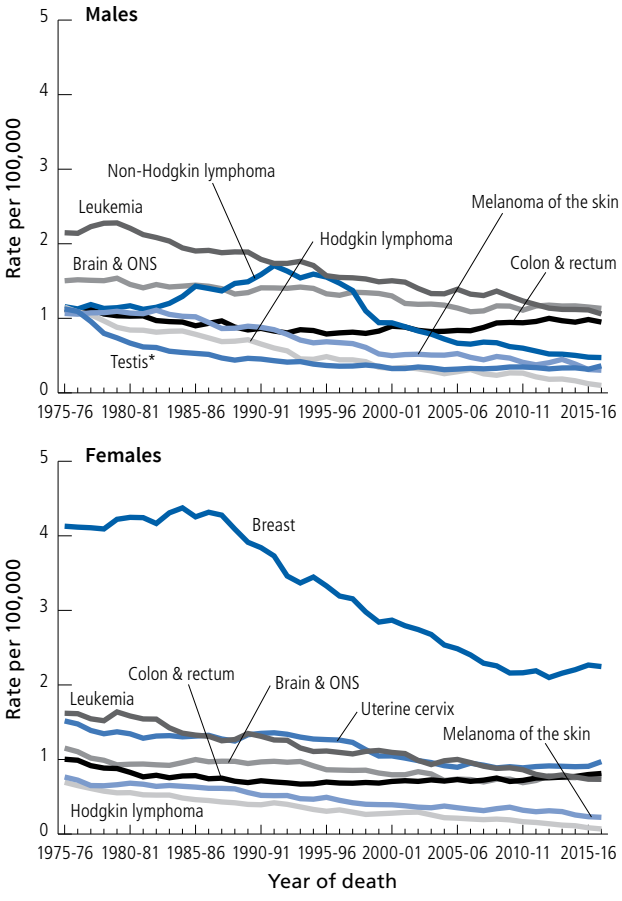


Rates are age-adjusted to the 2000 US standard population and are two-year moving averages.
Source: NAACCR, 2019.

adolescents and 0.4% to 1.1% annually in women ages 20-39 years. Contemporary trends, especially among women, are driven by rapid increases in thyroid cancer incidence rates as a result of rising detection of papillary thyroid tumors (Figure S6).[29] During 2007-2016, the steepest increases in thyroid cancer incidence rates occurred among adolescents, 4.9% per year among males and 4.1% per year among females. In adults ages 20-39

years, rates increased for cancers of the colorectum (3%-6% per year), uterine corpus (3%), kidney (3%), and female breast (0.2%-2%), with more rapid increases occurring among those in their 20s. While rates are also increasing in older adults for kidney and uterine corpus cancers, increases in AYAs are steeper.[30] Increasing attention has been given to the possible contribution of the obesity epidemic and related factors (e.g., poor diet) to rising incidence rates of many cancers in young adults, such as colorectal and uterine corpus.[23, 30] Increasing kidney cancer rates may partly reflect increased detection via advances in imaging. Rates also increased in all AYA age groups for leukemia in both sexes and testicular GCTs in men. Increases in leukemia may be linked to increased exposure to radiation and chemotherapy for the treatment of previous cancers, as well as obesity, although it is unclear to what extent each of these factors contributes.[30-32] Little is known about the causes of rising incidence rates of testicular GCTs, but trends may reflect changes in prenatal hormonal exposures, as well as other environmental exposures.[33, 34]

Figure S7. Trends in AYA Cancer Mortality Rates by Site and Sex, US, 1975-2017



Rates are age-adjusted to the 2000 US standard population and are two-year moving averages. *Includes all tumors of the testis or ovaries, as histological information is unavailable on death certificates.

Source: NCHS, 2019.

In contrast, melanoma incidence rates have rapidly declined in adolescents (6% annually during 2007-2016) and adults in their 20s (3% annually) after peaking in the early- to mid-2000s. Among adults in their 30s, melanoma rates remained stable in females and slightly declined among males. Recent declines in younger AYAs may reflect successful interventions to increase sun-protective behaviors and reduce indoor tanning.[35] Similarly, cervical cancer incidence rates decreased by 2% annually during 2007-2016 among women in their 20s but appear to have stabilized among women in their 30s. The stable trend in women ages 30-39 years largely reflects attenuating declines in squamous cell cervical cancer rates due to recent slight declines in cervical cancer screening with the Pap test.[36, 37] Incidence rates have largely declined or remained stable for other common AYA cancers, including Hodgkin lymphoma, non-Hodgkin lymphoma, soft tissue sarcomas, bone and joint tumors, and brain cancer.

Trends in mortality rates

Cancer mortality rates in AYAs have been declining in all age/sex groups since at least 1975 (Figure S3). However, these trends do not reflect the impact of the HIV/AIDS-related cancers because these deaths are often attributed to the underlying viral infection. In addition, Kaposi sarcoma was not a separate reportable cause of death until 1999. During the most recent 10 years of available data (2008-2017), mortality rates for all cancers combined declined on average by about 1% per year in men but appear to have stabilized in recent years among women. In contrast to declines for many common cancers, death rates in AYAs during 2008-2017 increased for colorectal and uterine corpus cancer and were stable for cervical, thyroid, and testicular cancer (Figure S7).[27] Female breast cancer death rates have also stabilized in recent years after more than two decades of declines.

Cancer survival in AYAs

Overall 5-year survival has increased since the mid-1970s among AYAs with the exception of a decline during the HIV/AIDS epidemic among young adult men. Five-year relative survival rates for AYA patients diagnosed during 2009-2015 were generally similar across age groups (83%-86%) and comparable to that in children (84%), but substantially higher than that in adults 40 years of age and older (66%).[38] High overall survival in AYAs reflects 5-year relative survival rates of 94% or greater for many of the most common cancers, such as thyroid and testicular cancer, melanoma, and Hodgkin lymphoma, but masks lower rates for leukemias, brain tumors, and bone and soft tissue sarcomas (Table S2). Importantly, overall AYA cancer survival may be artificially inflated as a result of overdetection of thyroid cancer, which has >99% 5-year survival.[39]

Notably, there are some cancer types for which survival progress in AYAs has lagged behind that in children.[39] For example, AYAs have substantially worse 5-year relative survival than children for acute lymphocytic leukemia overall (60% versus 91%, respectively) and in every AYA age group (Table S2),[38] which may reflect differences in biology and/or clinical trial participation.[40] Similarly, the 5-year survival rate in AYAs for non-Kaposi soft tissue sarcoma was lower than that in children for patients diagnosed during 2009-2015 (73% versus 81%) despite a higher rate during 1975-77 (70% versus 58%).[41] This is partly due to the higher occurrence of aggressive clinical characteristics among non-Kaposi sarcomas in AYAs compared to those in children, but also reflects lower clinical trial participation among AYAs.[42]

AYAs have better 5-year relative survival for most cancers compared to older adults, with the exception of female breast (86% in AYAs versus 91% in ages 45-64 years).[38] AYA female breast cancer patients are less likely than older adults to be diagnosed with early-stage disease (47% versus 60% in ages 45-54 years, 65% in ages 55-64 years, and 68% in ages 65+ respectively),[11] which likely reflects diagnostic delays, as well as a higher prevalence of aggressive molecular subtypes.[43, 44] (See *Breast Cancer*

Table S2. Cancer Incidence (2012-2016), Mortality (2013-2017), and 5-year Relative Survival (2009-2015) Rates in AYAs by Age, US

	15-19 years			20-29 years			30-39 years		
	Incidence rate	Death rate	5-year survival, %	Incidence rate	Death rate	5-year survival, %	Incidence rate	Death rate	5-year survival, %
All cancer types	23.5	2.8	85%	48.5	4.9	86%	122.5	15.3	83%
Acute lymphocytic leukemia	1.7	0.3	74%	0.9	0.3	52%	0.7	0.3	51%
Acute myeloid leukemia	1.0	0.3	66%	1.1	0.3	59%	1.6	0.5	57%
Bone tumors	1.6	0.5	67%	0.8	0.3	68%	0.8	0.2	74%
Brain & ONS*	2.2	0.5	77%	2.5	0.6	73%	3.7	1.5	66%
Breast (female)	0.1	–	85%	5.7	0.4	83%	46.6	4.8	86%
Colon & rectum	0.9	<0.1	82%	2.2	0.3	68%	8.3	1.8	68%
Hodgkin lymphoma	3.1	<0.1	97%	4.1	0.1	95%	3.4	0.2	94%
Kidney & renal pelvis	0.2	<0.1	73%	0.9	0.1	83%	4.9	0.3	90%
Melanoma of the skin	1.0	<0.1	95%	4.5	0.2	96%	11.2	0.6	94%
Non-Hodgkin lymphoma	1.9	0.1	88%	2.9	0.3	83%	5.8	0.6	83%
Soft tissue sarcoma	1.3	0.3	69%	2.1	0.4	69%	3.6	0.5	74%
Testicular germ cell tumors	3.5	<0.1	96%	11.7	0.2	95%	13.0	0.2	96%
Thyroid	3.1	–	99%	8.7	<0.1	>99%	18.8	<0.1	>99%
Uterine cervix	0.1	–	–	3.1	0.3	82%	12.1	1.9	80%
Uterine corpus	0.1	–	–	1.3	0.1	88%	7.8	0.5	91%

– Data not shown due to fewer than 16 cases or deaths. ONS: Other nervous system. Incidence and death rates are per 100,000 and are age adjusted to the 2000 US standard population. *Excludes benign and borderline brain. Mortality and incidence are not directly comparable for some cancer types for which cases are defined using histology information, including testicular germ cell tumors, brain & ONS, bone tumors, and soft tissue sarcomas.

Source: Incidence – NAACCR, 2019. Mortality – NCHS, 2019. Survival – SEER 18 registries, 2019.

Facts & Figures 2019-2020, available on cancer.org, for more information.) In contrast, 5-year relative colorectal cancer survival in AYAs is higher than that in screening-age adults ages 50+ (68% versus 64%, respectively) despite a greater likelihood of being diagnosed with distant-stage disease (24% versus 20% during 2012-2016, respectively).[38]

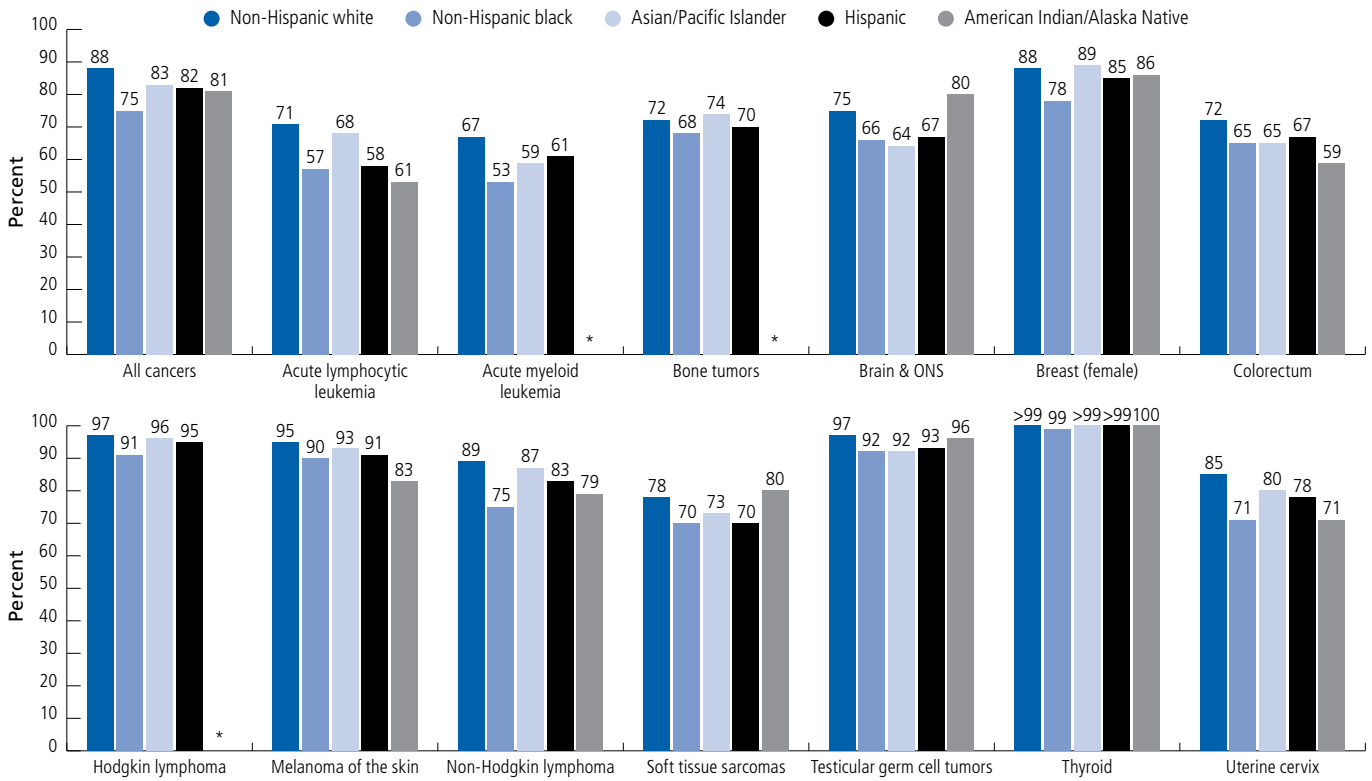
Compared to non-Hispanic whites, 5-year cause-specific survival in AYAs for all cancer types combined is lower in racial/ethnic minorities, especially non-Hispanic blacks (75% versus 88%, respectively) (Figure S8).[38] By cancer type, some of the largest black-white racial disparities occur for acute lymphocytic leukemia (57% versus 71%, respectively), melanoma (90% versus 95%), and female breast cancer (78% versus 88%). These disparities are largely driven by delays in diagnosis and treatment as a result of differences in insurance status and access to care, but also by differences in tumor characteristics, such as estrogen-receptor status for female breast cancer.[3,45]

Prevention and early detection of cancer in AYAs

Stage distribution for selected common cancers in AYAs is shown in Figure S9. Compared to screening-age adults, AYAs are more likely to be diagnosed at a distant stage for female breast and colorectal cancers.[3,4] Although routine cancer screening in individuals younger than 40 years of age is only recommended for cervical cancer (beginning at age 21; see page 70), increased awareness through self-examination could alert AYAs to changes in the skin, breasts, and testicles. In 2018, 74% of adults ages 21-29 years and 90% of those ages 30-39 years were up-to-date with cervical cancer screening, compared to 86% of adults ages 40-65 years.[46]

Several cancers in AYAs could potentially be prevented. For example, almost all cervical cancers can be prevented through screening, which allows for the removal of precancerous lesions, as well as human papillomavirus

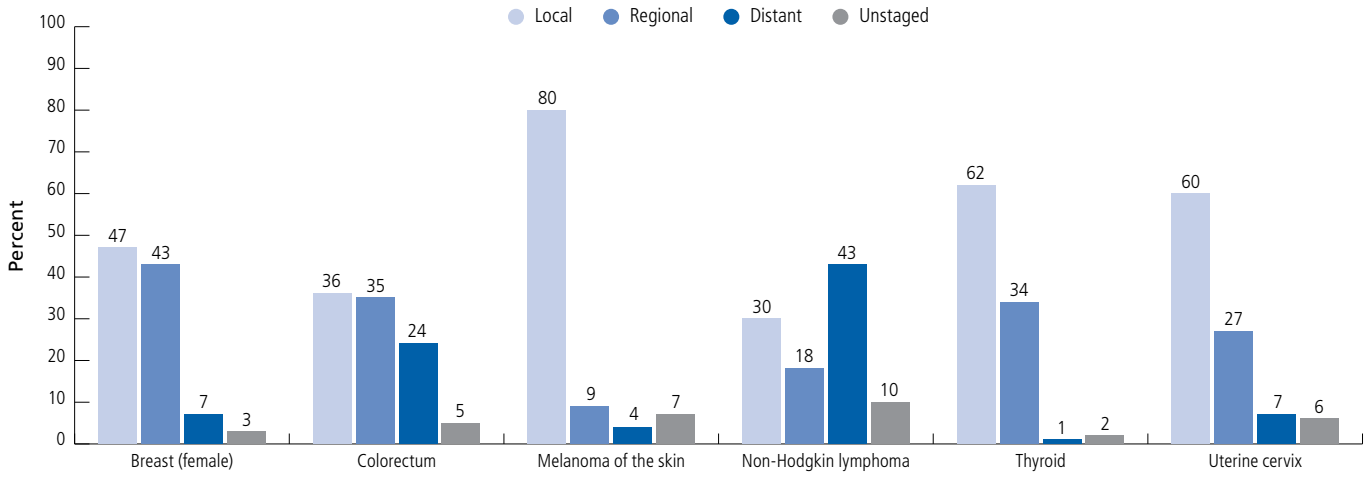
Figure S8. Five-year Cause-specific Survival by Race/Ethnicity for Selected Cancers in AYAs, US, 2009-2015



*Data are suppressed for American Indians/Alaska Natives for acute myeloid leukemia, bone tumors, and Hodgkin lymphoma due to sparse case numbers (<25 cases). Patients were diagnosed during 2009-2015 and followed through 2016.

Source: SEER 18 registries, 2019.

Figure S9. Stage Distribution for Selected Cancers in AYAs, US, 2012-2016



Source: NAACCR, 2019.

(HPV) vaccination, which is recommended for females up to age 26 and, depending on risk, males up to age 21.[47] Although studies have been primarily limited to the effectiveness of the HPV vaccine in preventing cervical cancer, the vaccine will likely prevent most other HPV-related cancers. From 2011-2012 to 2015-2016, HPV vaccination prevalence (receipt of ≥2 doses) increased among AYAs ages 18-26 years but remained low overall, especially in males (32% in ages 18-21 years and 17% in ages 22-26 years, compared to 54% in females).[48] This, combined with the comparatively low use of screening in women ages 20-29 years, highlights important targets for decreasing the burden of cervical and other HPV-associated cancers in AYAs. Finally, cervical and other tobacco-related cancers could be prevented through reducing cigarette smoking prevalence in AYAs. In 2018, cigarette smoking prevalence was similar between AYAs and older adults (15% and 16%, respectively).[46]

Reducing exposure to excess UV radiation through sun protective behaviors and not sunbathing or using indoor tanning are important for preventing melanoma and other skin cancers. The risk of melanoma is about 60% higher for people who begin using indoor tanning before the age of 35, and risk increases with duration and intensity of use.[49, 50] Although indoor tanning has decreased in the US,[35] in 2015, indoor tanning prevalence in women was 10% in ages 18-29 years and 7% in ages 30-39 years, compared to 4% in ages 40+; indoor tanning use among men was low (1-2%).[46]

Many additional cancers could be prevented in AYAs by reducing obesity prevalence. Increasing incidence rates for many solid tumors have been linked to rising excess bodyweight. Although trends may have leveled off in children and young adults in the past decade,[51] in 2015-2016, the prevalence of excess body weight (body mass index [BMI] ≥25 kg/m^2) among young adults ages 20-39 years was 65% (68% in men; 62% in women).[52]

Treatment considerations for AYAs with cancer

AYA patients can be treated at pediatric or adult cancer centers depending on cancer type.[53] It is important that the treatment team has experience in AYA oncology, as there are several special considerations for this age group. For example, it may be possible to adjust the treatment regimen to help limit the risk of late effects, such as sexual dysfunction and organ damage, given the long life expectancy of AYA patients. The type of treatment received should consider the patient's health and functional status; cognitive and physical development; and preferences and needs.[54] The possibility of adverse side effects, coupled with the financial and psychosocial challenges of undergoing treatment during several

important early-life transitions, may contribute to delays in treatment and gaps in adherence.[55] The National Comprehensive Cancer Network (NCCN) guidelines for AYA oncology recommend that AYA patients be encouraged to enroll in clinical trials as appropriate because of the substantial knowledge gaps in AYA cancer treatment.[54]

Fertility preservation and sexual function

Fertility counseling and preservation are crucial components in the management of AYA cancer because many cancer treatments directly or indirectly affect fertility.[56, 57] The American Society for Clinical Oncology (ACSO) clinical practice guidelines recommend that fertility preservation be discussed with all new patients at the time of diagnosis because efforts such as sperm banking and embryo/oocyte cryopreservation (the freezing of fertilized or unfertilized eggs) should be started in advance of treatment.[58] In one study of AYA cancer survivors, 18% of males and 38% of females had not made such fertility preservation arrangements because they were not aware of these options.[59] Other reasons for not making arrangements included cost; concerns regarding the impact of fertility preservation on outcomes (e.g., delaying cancer treatment, effects on offspring); and physician recommendation against delaying treatment, especially among females.[59]

Semen cryopreservation (sperm banking) is the established method for fertility preservation in men, including those with low sperm counts, and may also be possible in younger adolescents.[60-62] Research is ongoing with regard to cryopreservation (freezing) of stem cells from the testis, which may be an option in the future for prepubescent males.[62]

The established strategy for female fertility preservation in AYA women is egg (oocyte) cryopreservation.[63] Embryo cryopreservation is also an option, but requires that patients either have a partner or donor sperm for fertilization. Oocyte cryopreservation can take 2-3 weeks; the patient's ovaries are first stimulated with injectable hormones to produce mature eggs (oocytes), which are then retrieved in a procedure under anesthesia and cryopreserved in the lab the same day. When the patient desires to use the eggs in the future, they are thawed and fertilized with sperm to create embryos (via in vitro fertilization), and are then transferred into the woman's uterus. When cancer treatment cannot be delayed and/or the patient has not reached puberty, ovarian tissue cryopreservation may be an option for fertility preservation at some institutions.[58, 64, 65]

When female patients are planning to receive radiation therapy to the pelvic or groin area, ovarian transposition (a surgical repositioning of the ovaries) is an option. The procedure helps to preserve ovarian function by surgically positioning the ovaries away from the site of radiation. Typically, one or both ovaries are separated from the uterus and attached to the abdominal wall. Patients who undergo ovarian transposition may want to consider combining it with other fertility preservation options because the ovaries may not be completely protected from radiation exposure. In addition, the ovaries often cannot be reconnected in adults after they have been separated from the uterus, so these patients require referral to a reproductive endocrinologist when they wish to conceive.

Many cancer treatments can also interfere with sexual functioning both during and after treatment; in one study, nearly 50% of pelvic and breast cancer survivors experienced severe, long-term sexual dysfunction.[66] However, cancer patients often receive insufficient counseling and treatment for these concerns.[67] The American Society for Clinical Oncology recommends that problems with sexual health and dysfunction resulting from cancer or its treatment be discussed with all patients.[68] Patients may experience problems such as negative body image, low libido, and/or pain during intercourse, which can be addressed through a combination of psychosocial and/or psychosexual counseling, over-the-counter treatments (e.g., vaginal lubricants), or other medications (e.g., low-dose vaginal estrogen in women or phosphodiesterase type 5 inhibitors in men).

Cancer treatment during pregnancy

Although cancer during pregnancy is extremely rare (1 per 1,000 live births),[69] all women of childbearing potential should receive a pregnancy test before beginning

treatment.[54] Cancer during pregnancy poses significant treatment challenges and should be managed by a multidisciplinary team that includes obstetricians, gynecologic oncologists, and perinatologists in addition to medical, surgical, and radiation oncologists,[70] ideally with expertise in cancer during pregnancy.

While surgery for cancer is usually safe during pregnancy, some treatment options, such as radiotherapy, should generally be avoided, and chemotherapy should be avoided during the first trimester.[71] Limited research suggests chemotherapy during the second and third trimester may be associated with low birth weight and preterm labor,[72] but a multicenter prospective study found no significant adverse cognitive or cardiac effects among children.[73] The safety of hormonal therapies and targeted treatments during pregnancy has not been fully evaluated in humans.[54]

Survivorship concerns in AYA cancer

As of January 1, 2019, there were 678,420 adolescents and young adults (47,760 adolescents ages 15-19 years and 630,660 young adults ages 20-39 years) living in the United States with a history of a cancer diagnosis, some of whom were diagnosed as children.[74] AYA cancer survivors must cope with psychosocial, physical, and financial effects of cancer and its treatment, which range from mild to severe. A high proportion of AYA survivors report a variety of unmet needs within a year after diagnosis, such as access to a mental health professional (56%), cancer rehabilitation (58%), or pain management services (63%).[75]

Unfortunately, little is known about the long-term survivorship experience among AYAs compared to those who were diagnosed as children, and much continues to be extrapolated from childhood cancer cohorts.[54] Prospective studies of AYA cancer survivors in the US are still relatively nascent in comparison to decades-long cohort studies in children and older adults. The first national prospective cohort study of AYA cancer survivors in the US, the AYA Health Outcomes and Patient Experience (AYA HOPE) study, was conducted among those diagnosed during 2007-2008.[76]

Long-term and late effects

AYA cancer survivors are at risk of a number of late and long-term effects that can influence cognitive and physical functioning.[77, 78] In particular, they report worse overall psychosocial functioning than other cancer survivors as well as their cancer-free peers, which may reflect difficultly in coping with treatment and recovery during early-life transitions.[79-81] Problems with fertility, sexual dysfunction, and body image, particularly among women, are also common among AYA cancer survivors.[8, 82] Cancer and its treatment can cause substantial disruptions in school and work, as well as changes in functioning and appearance, leading to feelings of shame and isolation that can create further challenges in resuming daily life activities.[83] Cancer rehabilitation or other types of physical therapy may be helpful in some instances.

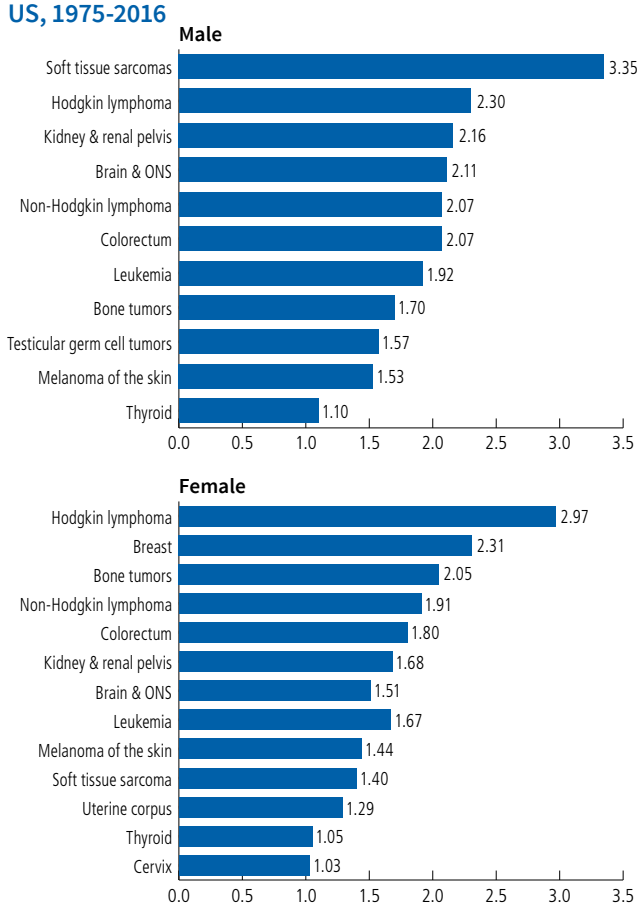
Certain types of chemotherapy used for common AYA cancers, such as anthracyclines for lymphomas, sarcomas, and brain tumors, have been associated with a long-term increased risk of heart problems in AYA cancer survivors.[84, 85] Testicular cancer survivors who were treated with cisplatin-based chemotherapy are at increased risk of heart and neurologic complications, such as numbness and hearing impairment.[86]

See *Cancer Treatment & Survivorship Facts & Figures 2019-2021*, available on cancer.org, for more information on long-term and late effects for common cancers.

Risk of subsequent cancers

The risk of subsequent cancers among AYA survivors can be approximated by comparing the number of new cancers in this population to the number expected in the general population, which is referred to as the observed-to-expected (O/E) ratio. Risk varies by original cancer type and sex and is highest for soft tissue sarcoma (males); Hodgkin lymphoma; and female breast cancer and lowest for thyroid and cervical cancer (Figure S10). The risk of subsequent cancers is related to many factors, including underlying genetic predisposition, adverse health behaviors, and type of initial treatment received. For example, a recent study showed that AYAs had a higher risk of subsequent tobacco-related cancers compared to the general population, likely reflecting

Figure S10. Observed-to-expected (O/E) Ratios for Subsequent Cancers by Primary Site, Ages 15-39, US, 1975-2016



Source: SEER 9 registries, 2019.

their higher historical smoking prevalence compared to the general AYA population.[87] Depending on the type of treatment received and underlying familial risk, some AYA cancer survivors are recommended to initiate screening for colorectal and female breast cancers at a younger age than those at average risk.[54]

Financial concerns

Young adults continue to be the least likely to have health insurance compared to other age groups. In 2017, uninsured rates in 20- to 25-year-olds and 26- to 39-year-olds were 15%, compared to 10% among 40- to 64-year-olds.[88] Lack of health insurance is associated with diagnosis delays, leading to more extensive treatment and poorer outcomes.[89] Not surprisingly, AYA cancer survivors have more financial hardship and out-of-pocket medical costs than the general population.[90] As a result, young adult survivors have higher rates of bankruptcy and more frequently forgo needed medical care due to cost compared to older survivors.[91] Financial distress among AYA survivors is often compounded by nonmedical costs, such as student loans and raising children.

Resources for clinicians and patients

National organizations and websites that provide information and support to adolescents and young adults with cancer:

- The OncoFertility Consortium (https://www.savemyfertility.org/)
- LIVESTRONG (LIVESTRONG Fertility: https://www.livestrong.org/we-can-help/livestrong-fertility)
- Children's Oncology Group (http://www.survivorshipguidelines.org)
- The Samfund: Support for Young Adult Cancer Survivors (https://www.thesamfund.org)
- Teen Cancer America (https://teencanceramerica.org)
- Cancer and Careers (https://www.cancerandcareers.org/en)
- Young Survival Coalition (https://www.youngsurvival.org)

References

1. Tricoli JV, Boardman LA, Patidar R, et al. A mutational comparison of adult and adolescent and young adult (AYA) colon cancer. *Cancer*. 2018;124: 1070-1082.

2. Tricoli JV, Blair DG, Anders CK, et al. Biologic and clinical characteristics of adolescent and young adult cancers: Acute lymphoblastic leukemia, colorectal cancer, breast cancer, melanoma, and sarcoma. *Cancer*. 2016;122: 1017-1028.

3. Smith EC, Ziogas A, Anton-Culver H. Delay in surgical treatment and survival after breast cancer diagnosis in young women by race/ethnicity. *JAMA Surg*. 2013;148: 516-523.

4. Barr RD, Ferrari A, Ries L, Whelan J, Bleyer WA. Cancer in Adolescents and Young Adults: A Narrative Review of the Current Status and a View of the Future. *JAMA Pediatr*. 2016;170: 495-501.

5. Chao C, Bhatia S, Xu L, et al. Incidence, Risk Factors, and Mortality Associated With Second Malignant Neoplasms Among Survivors of Adolescent and Young Adult Cancer. *JAMA Netw Open*. 2019;2: e195536.

6. Lee JS, DuBois SG, Coccia PF, Bleyer A, Olin RL, Goldsby RE. Increased risk of second malignant neoplasms in adolescents and young adults with cancer. *Cancer*. 2016;122: 116-123.

7. Chao C, Xu L, Bhatia S, et al. Cardiovascular Disease Risk Profiles in Survivors of Adolescent and Young Adult (AYA) Cancer: The Kaiser Permanente AYA Cancer Survivors Study. *J Clin Oncol*. 2016;34: 1626-1633.

8. Olsson M, Steineck G, Enskar K, Wilderang U, Jarfelt M. Sexual function in adolescent and young adult cancer survivors-a population-based study. *J Cancer Surviv*. 2018;12: 450-459.

9. US Department of Health and Human Services. Closing the Gap: Research and Care Imperatives for Adolescents and Young Adults with Cancer. Report of the Adolescent and Young Adult Oncology Progress Review Group. NIH Publication No. 06-6067. Washington, DC: US Department of Health and Human Services; 2006., 2006.

10. Smith AW, Seibel NL, Lewis DR, et al. Next steps for adolescent and young adult oncology workshop: An update on progress and recommendations for the future. *Cancer*. 2016;122: 988-999.

11. SEER*Stat Database: NAACCR Incidence Data – CiNA Analytic File, 1995-2016, for Expanded Races, Custom File With County, ACS Facts and Figures projection Project (which includes data from CDC's National Program of Cancer Registries (NPCR), CCCR's Provincial and Territorial Registries, and the NCI's Surveillance, Epidemiology and End Results (SEER) Registries), certified by the North American Association of Central Cancer Registries (NAACCR) as meeting high-quality incidence data standards for the specified time periods, submitted December 2018.

12. Greene MH, Kratz CP, Mai PL, et al. Familial testicular germ cell tumors in adults: 2010 summary of genetic risk factors and clinical phenotype. *Endocr Relat Cancer*. 2010;17: R109-121.

13. Shiyanbola OO, Arao RF, Miglioretti DL, et al. Emerging Trends in Family History of Breast Cancer and Associated Risk. *Cancer Epidemiol Biomarkers Prev*. 2017;26: 1753-1760.

14. Pearlman R, Frankel WL, Swanson B, et al. Prevalence and Spectrum of Germline Cancer Susceptibility Gene Mutations Among Patients With Early-Onset Colorectal Cancer. *JAMA Oncol*. 2017;3: 464-471.

15. Bonadona V, Bonaiti B, Olschwang S, et al. Cancer risks associated with germline mutations in MLH1, MSH2, and MSH6 genes in Lynch syndrome. *JAMA*. 2011;305: 2304-2310.

16. Galiatsatos P, Foulkes WD. Familial adenomatous polyposis. Am J Gastroenterol. 2006;101: 385-398.

17. Mai PL, Best AF, Peters JA, et al. Risks of first and subsequent cancers among TP53 mutation carriers in the National Cancer Institute Li-Fraumeni syndrome cohort. *Cancer*. 2016;122: 3673-3681.

18. Waguespack SG, Rich TA, Perrier ND, Jimenez C, Cote GJ. Management of medullary thyroid carcinoma and MEN2 syndromes in childhood. *Nat Rev Endocrinol*. 2011;7: 596-607.

19. Metcalfe K, Lubinski J, Lynch HT, et al. Family history of cancer and cancer risks in women with BRCA1 or BRCA2 mutations. *J Natl Cancer Inst*. 2010;102: 1874-1878.

20. Rosato V, Bosetti C, Levi F, et al. Risk factors for young-onset colorectal cancer. *Cancer Causes Control*. 2013;24: 335-341.

21. Nordsborg RB, Meliker JR, Wohlfahrt J, Melbye M, Raaschou-Nielsen O. Cancer in first-degree relatives and risk of testicular cancer in Denmark. *Int J Cancer*. 2011;129: 2485-2491.

22. Anderson WF, Pfeiffer RM, Tucker MA, Rosenberg PS. Divergent cancer pathways for early-onset and late-onset cutaneous malignant melanoma. *Cancer*. 2009;115: 4176-4185.

23. Liu PH, Wu K, Ng K, et al. Association of Obesity With Risk of Early-Onset Colorectal Cancer Among Women. *JAMA Oncol*. 2019;5: 37-44.

24. Collins S, Rollason TP, Young LS, Woodman CB. Cigarette smoking is an independent risk factor for cervical intraepithelial neoplasia in young women: a longitudinal study. *Eur J Cancer*. 2010;46: 405-411.

25. Jemal A, Miller KD, Ma J, et al. Higher Lung Cancer Incidence in Young Women Than Young Men in the United States. *N Engl J Med*. 2018;378: 1999-2009.

26. Arora RS, Alston RD, Eden TO, Geraci M, Birch JM. Comparative incidence patterns and trends of gonadal and extragonadal germ cell tumors in England, 1979 to 2003. *Cancer*. 2012;118: 4290-4297.

27. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Mortality – All COD, Total U.S. (1969-2017) <Early release with Vintage 2017 Katrina/Rita Population Adjustment> – Linked To County Attributes – Total U.S., 1969-2017 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released May 2019. Underlying mortality data provided by NCHS (www.cdc.gov/nchs).

28. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Mortality – All COD, Total U.S. (1990-2017) <Early release with Vintage 2017 Katrina/Rita Population Adjustment> – Linked To County Attributes – Total U.S., 1969-2017 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released May 2019. Underlying mortality data provided by NCHS (www.cdc.gov/nchs).

29. Davies L, Welch HG. Current thyroid cancer trends in the United States. *JAMA Otolaryngol Head Neck Surg*. 2014;140: 317-322.

30. Sung H, Siegel RL, Rosenberg PS, Jemal A. Emerging cancer trends among young adults in the USA: analysis of a population-based cancer registry. *Lancet Public Health*. 2019;4: e137-e147.

31. Morton LM, Swerdlow AJ, Schaapveld M, et al. Current knowledge and future research directions in treatment-related second primary malignancies. *EJC Suppl*. 2014;12: 5-17.

32. Castillo JJ, Reagan JL, Ingham RR, et al. Obesity but not overweight increases the incidence and mortality of leukemia in adults: a meta-analysis of prospective cohort studies. *Leuk Res*. 2012;36: 868-875.

33. Bray F, Ferlay J, Devesa SS, McGlynn KA, Moller H. Interpreting the international trends in testicular seminoma and nonseminoma incidence. *Nat Clin Pract Urol*. 2006;3: 532-543.

34. Morimoto LM, Zava D, McGlynn KA, et al. Neonatal Hormone Concentrations and Risk of Testicular Germ Cell Tumors (TGCT). *Cancer Epidemiol Biomarkers Prev*. 2018;27: 488-495.

35. Holman DM, Freeman MB, Shoemaker ML. Trends in Melanoma Incidence Among Non-Hispanic Whites in the United States, 2005 to 2014. *JAMA Dermatol*. 2018;154: 361-362.

36. Islami F, Fedewa SA, Jemal A. Trends in cervical cancer incidence rates by age, race/ethnicity, histological subtype, and stage at diagnosis in the United States. Prev Med. 2019;123: 316-323.

37. White A, Thompson TD, White MC, et al. Cancer Screening Test Use – United States, 2015. *MMWR Morb Mortal Wkly Rep*. 2017;66: 201-206.

38. 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 2018 Sub (2000-2016) <Katrina/Rita Population Adjustment> – Linked To County Attributes – Total U.S., 1969-2017 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2019, based on the November 2018 submission.

39. Siegel SE, Coccia PF, Barr R, Hayes-Lattin B, Bleyer A. RE: A reappraisal of sex-specific cancer survival trends among adolescents and young adults in the United States. *J Natl Cancer Inst*. 2019.

40. Tricoli JV, Seibel NL, Blair DG, Albritton K, Hayes-Lattin B. Unique characteristics of adolescent and young adult acute lymphoblastic leukemia, breast cancer, and colon cancer. *J Natl Cancer Inst*. 2011;103: 628-635.

41. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence – SEER 9 Regs Research Data, Nov 2018 Sub (1975-2016) <Katrina/Rita Population Adjustment> – Linked To County Attributes – Total U.S., 1969-2017 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2019, based on the November 2018 submission.

42. Bleyer A, Montello M, Budd T, Saxman S. National survival trends of young adults with sarcoma: lack of progress is associated with lack of clinical trial participation. *Cancer*. 2005;103: 1891-1897.

43. Ruddy KJ, Gelber S, Tamimi RM, et al. Breast cancer presentation and diagnostic delays in young women. *Cancer*. 2014;120: 20-25.

44. Anders CK, Johnson R, Litton J, Phillips M, Bleyer A. Breast cancer before age 40 years. *Semin Oncol*. 2009;36: 237-249.

45. DeRouen MC, Parsons HM, Kent EE, Pollock BH, Keegan THM. Sociodemographic disparities in survival for adolescents and young adults with cancer differ by health insurance status. *Cancer Causes Control*. 2017;28: 841-851.

46. National Center for Health Statistics. National Health Interview Surveys, 2015 and 2018. Public-use data files and documentation. https://www.cdc.gov/nchs/nhis/index.htm.

47. Meites E, Szilagyi PG, Chesson HW, Unger ER, Romero JR, Markowitz LE. Human Papillomavirus Vaccination for Adults: Updated Recommendations of the Advisory Committee on Immunization Practices. *MMWR Morb Mortal Wkly Rep*. 2019;68: 698-702.

48. Patel EU, Grabowski MK, Eisenberg AL, Packman ZR, Gravitt PE, Tobian AAR. Increases in Human Papillomavirus Vaccination Among Adolescent and Young Adult Males in the United States, 2011-2016. *J Infect Dis*. 2018;218: 109-113.

49. Boniol M, Autier P, Boyle P, Gandini S. Cutaneous melanoma attributable to sunbed use: systematic review and meta-analysis. *BMJ*. 2012;345: e4757.

50. Lazovich D, Isaksson Vogel R, Weinstock MA, Nelson HH, Ahmed RL, Berwick M. Association Between Indoor Tanning and Melanoma in Younger Men and Women. *JAMA Dermatol*. 2016;152: 268-275.

51. Hales CM, Fryar CD, Carroll MD, Freedman DS, Ogden CL. Trends in Obesity and Severe Obesity Prevalence in US Youth and Adults by Sex and Age, 2007-2008 to 2015-2016. *JAMA*. 2018;319: 1723-1725.

52. National Center for Health Statistics. National Health and Nutrition Examination Survey, 2015-2016. Public-use data file and documentation.

53. Ferrari A, Thomas D, Franklin AR, et al. Starting an adolescent and young adult program: some success stories and some obstacles to overcome. *J Clin Oncol*. 2010;28: 4850-4857.

54. Network. NCC. Adolescent and Young Adult (AYA) Oncology. NCCN Clinical Practice Guidelines in Oncology. Version 1.2020. July 11, 2019.

55. Kondryn HJ, Edmondson CL, Hill J, Eden TO. Treatment non-adherence in teenage and young adult patients with cancer. *Lancet Oncol*. 2011;12: 100-108.

56. Levine J, Canada A, Stern CJ. Fertility preservation in adolescents and young adults with cancer. *J Clin Oncol*. 2010;28: 4831-4841.

57. Johnson RH, Kroon L. Optimizing fertility preservation practices for adolescent and young adult cancer patients. *J Natl Compr Canc Netw*. 2013;11: 71-77.

58. Oktay K, Harvey BE, Partridge AH, et al. Fertility Preservation in Patients With Cancer: ASCO Clinical Practice Guideline Update. *J Clin Oncol*. 2018;36: 1994-2001.

59. Shnorhavorian M, Harlan LC, Smith AW, et al. Fertility preservation knowledge, counseling, and actions among adolescent and young adult patients with cancer: A population-based study. *Cancer*. 2015;121: 3499-3506.

60. Hagenas I, Jorgensen N, Rechnitzer C, et al. Clinical and biochemical correlates of successful semen collection for cryopreservation from 12-18-year-old patients: a single-center study of 86 adolescents. *Hum Reprod*. 2010;25: 2031-2038.

61. Nielsen CT, Skakkebaek NE, Richardson DW, et al. Onset of the release of spermatozoa (spermarche) in boys in relation to age, testicular growth, pubic hair, and height. J Clin Endocrinol Metab. 1986;62: 532-535.

62. Halpern JA, Hill R, Brannigan RE. Guideline based approach to male fertility preservation. Urol Oncol. 2019.

63. Practice Committees of American Society for Reproductive M, Society for Assisted Reproductive T. Mature oocyte cryopreservation: a guideline. *Fertil Steril*. 2013;99: 37-43.

64. Van der Ven H, Liebenthron J, Beckmann M, et al. Ninety-five orthotopic transplantations in 74 women of ovarian tissue after cytotoxic treatment in a fertility preservation network: tissue activity, pregnancy and delivery rates. *Hum Reprod*. 2016;31: 2031-2041.

65. Dittrich R, Hackl J, Lotz L, Hoffmann I, Beckmann MW. Pregnancies and live births after 20 transplantations of cryopreserved ovarian tissue in a single center. *Fertil Steril*. 2015;103: 462-468.

66. Sadovsky R, Basson R, Krychman M, et al. Cancer and sexual problems. *J Sex Med*. 2010;7(1 Pt 2):349-73.

67. Lindau ST, Abramsohn EM, Matthews AC. A manifesto on the preservation of sexual function in women and girls with cancer. *Am J Obstet Gynecol*. 2015;213(2):166-74.

68. Carter J, Lacchetti C, Andersen BL, et al. Interventions to Address Sexual Problems in People With Cancer: American Society of Clinical Oncology Clinical Practice Guideline Adaptation of Cancer Care Ontario Guideline. *J Clin Oncol*. 2018;36(5):492-511.

69. Smith LH, Dalrymple JL, Leiserowitz GS, Danielsen B, Gilbert WM. Obstetrical deliveries associated with maternal malignancy in California, 1992 through 1997. *Am J Obstet Gynecol*. 2001;184: 1504-1512; discussion 1512-1503.

70. Lishner M, Avivi I, Apperley JF, et al. Hematologic Malignancies in Pregnancy: Management Guidelines From an International Consensus Meeting. *J Clin Oncol*. 2016;34: 501-508.

71. Loibl S, Schmidt A, Gentilini O, et al. Breast Cancer Diagnosed During Pregnancy: Adapting Recent Advances in Breast Cancer Care for Pregnant Patients. *JAMA Oncol*. 2015;1: 1145-1153.

72. Koren G, Carey N, Gagnon R, Maxwell C, Nulman I, Senikas V. Cancer chemotherapy and pregnancy. *J Obstet Gynaecol Can*. 2013;35: 263-278.

73. Amant F, Vandenbroucke T, Verheecke M, et al. Pediatric Outcome after Maternal Cancer Diagnosed during Pregnancy. *N Engl J Med*. 2015;373: 1824-1834.

74. Miller KD, Nogueira L, Mariotto AB, et al. Cancer treatment and survivorship statistics, 2019. *CA Cancer J Clin*. 2019;69: 363-385.

75. Keegan TH, Lichtensztajn DY, Kato I, et al. Unmet adolescent and young adult cancer survivors information and service needs: a population-based cancer registry study. *J Cancer Surviv*. 2012;6: 239-250.

76. Smith AW, Keegan T, Hamilton A, et al. Understanding care and outcomes in adolescents and young adult with Cancer: A review of the AYA HOPE study. *Pediatr Blood Cancer*. 2019;66: e27486.

77. Barnett M, McDonnell G, DeRosa A, et al. Psychosocial outcomes and interventions among cancer survivors diagnosed during adolescence and young adulthood (AYA): a systematic review. *J Cancer Surviv*. 2016;10: 814-831.

78. Warner EL, Kent EE, Trevino KM, Parsons HM, Zebrack BJ, Kirchhoff AC. Social well-being among adolescents and young adults with cancer: A systematic review. *Cancer*. 2016;122: 1029-1037.

79. Lang MJ, Giese-Davis J, Patton SB, Campbell DJT. Does age matter? Comparing post-treatment psychosocial outcomes in young adult and older adult cancer survivors with their cancer-free peers. *Psychooncology*. 2018;27: 1404-1411.

80. Bellizzi KM, Smith A, Schmidt S, et al. Positive and negative psychosocial impact of being diagnosed with cancer as an adolescent or young adult. *Cancer*. 2012;118: 5155-5162.

81. Dieluweit U, Debatin KM, Grabow D, et al. Social outcomes of long-term survivors of adolescent cancer. *Psychooncology*. 2010;19: 1277-1284.

82. Olsson M, Enskar K, Steineck G, Wilderang U, Jarfelt M. Self-Perceived Physical Attractiveness in Relation to Scars Among Adolescent and Young Adult Cancer Survivors: A Population-Based Study. *J Adolesc Young Adult Oncol*. 2018;7: 358-366.

83. Zebrack B, Isaacson S. Psychosocial care of adolescent and young adult patients with cancer and survivors. *J Clin Oncol*. 2012;30: 1221-1226.

84. Henson KE, Reulen RC, Winter DL, et al. Cardiac Mortality Among 200 000 Five-Year Survivors of Cancer Diagnosed at 15 to 39 Years of Age: The Teenage and Young Adult Cancer Survivor Study. *Circulation*. 2016;134: 1519-1531.

85. Mulrooney DA, Yeazel MW, Kawashima T, et al. Cardiac outcomes in a cohort of adult survivors of childhood and adolescent cancer: retrospective analysis of the Childhood Cancer Survivor Study cohort. *BMJ*. 2009;339: b4606.

86. Abouassaly R, Fossa SD, Giwercman A, et al. Sequelae of treatment in long-term survivors of testis cancer. *Eur Urol*. 2011;60: 516-526.

87. Bright CJ, Reulen RC, Winter DL, et al. Risk of subsequent primary neoplasms in survivors of adolescent and young adult cancer (Teenage and Young Adult Cancer Survivor Study): a population-based, cohort study. *Lancet Oncol*. 2019;20: 531-545.

88. US Census Bureau. Current Population Survey, Annual Social and Economic Supplement, 2018. Available from: https://www.census.gov/cps/data/cpstablecreator.html. Accessed November 11, 2019.

89. Keegan THM, Parsons HM, Chen Y, et al. Impact of health insurance on stage at cancer diagnosis among adolescent and young adults. *J Natl Cancer Inst*. 2019.

90. Guy GP, Jr., Yabroff KR, Ekwueme DU, et al. Estimating the health and economic burden of cancer among those diagnosed as adolescents and young adults. *Health Aff* (Millwood). 2014;33: 1024-1031.

91. Zheng Z, Jemal A, Han X, et al. Medical financial hardship among cancer survivors in the United States. *Cancer*. 2019;125: 1737-1747.

Tobacco Use

Despite decades of declines in cigarette smoking prevalence, about 30% of all cancer deaths,[1,2] and as much as 40% of those among men in some Southern states,[3] are still caused by smoking cigarettes. This is partly because smoking rates remain high in many segments of the population.[4] Tobacco use remains the leading preventable cause of death in the US.

Cigarette Smoking

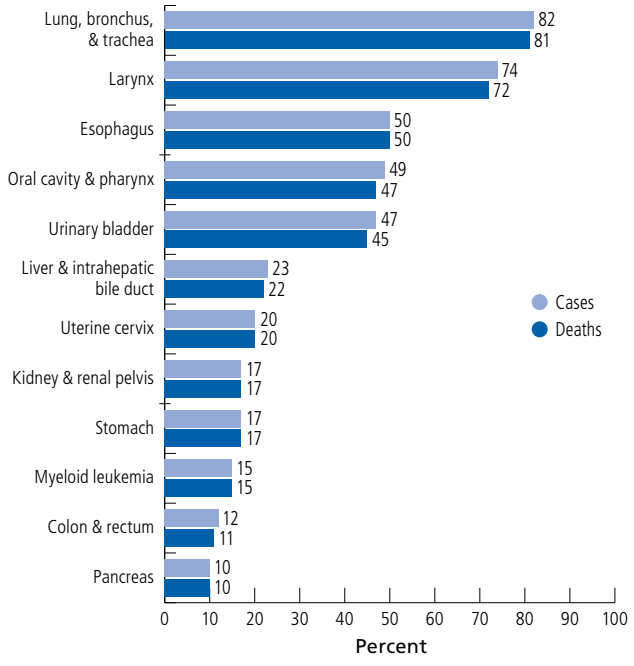
Cigarette smoking increases the risk of several cancers, including those of the oral cavity and pharynx, larynx, lung, esophagus, pancreas, uterine cervix, kidney, bladder, stomach, colorectum, liver; and acute myeloid leukemia (Figure 4).[5] Smoking may also increase risk of fatal prostate cancer and a rare type of ovarian cancer.[5-7] Health consequences increase with both duration and intensity of smoking.

- The prevalence of current cigarette smoking among US adults ages 18 and older declined from 42% in 1965 to 14% (more than 34 million adults) in 2018.[8,9]
- The gender gap in smoking prevalence is wider among non-Hispanic blacks (men: 19% versus women: 12%), Hispanics (13% versus 7%), and non-Hispanic Asians (10% versus 5%) than among non-Hispanic whites (17% versus 14%).[9]
- Smoking prevalence is highest, and has declined most slowly, among those with low levels of education; among adults ages 25 and older in 2018, 24% of those with less than a high school diploma and 36% of those with a GED (General Educational Development) were current smokers, compared to 4% of those with graduate degrees.[9]
- State-level adult smoking prevalence in 2018 ranged from 9% in Utah to 27% in West Virginia.[10]
- From 1999 to 2018, current cigarette smoking (past month) among US high school students decreased from 29% to 8%.[11,12]
- In 2018, current cigarette smoking among high school students was 9% in boys and 7% in girls, and it was higher in non-Hispanic whites (10%) and Hispanics (7%) than non-Hispanic blacks (3%).[12]

Other Combustible Tobacco Products

In addition to cigarettes, tobacco is used in other combustible forms such as cigars, pipes, waterpipes (also known as hookahs or shishas), and roll-your-own products. Regular cigar smokers have an increased risk of cancers of the lung, oral cavity, larynx, and esophagus, and have 4 to 10 times the risk of dying from these cancers compared to never smokers.[13-15] The most common types of cigars in the US are large cigars, cigarillos, and small cigars. Lower tax rates on cigars compared to cigarettes can lead smokers to switch to small cigars that resemble cigarettes.[16,17] Cigars are often sold as singles and some include flavorings,[18] both of which are particularly appealing to youth. Waterpipe smoking, which often occurs in social settings (e.g., hookah bars), is considered

Figure 4. Proportion of Cancer Deaths Attributable to Cigarette Smoking in Adults 30 Years and Older, US, 2014



Source: Islami F, et al. *CA Cancer J Clin* 2018; 68(1):31.

more socially acceptable than cigarettes.[19] Although many users perceive waterpipe smoking to be less harmful than cigarettes because the smoke moves through water prior to inhalation, it delivers the same or higher levels of toxins[20] and probably has the same adverse health effects, although the evidence is still accumulating.[21-23]

- From 2002 to 2016, cigar smoking prevalence declined among non-Hispanic whites and Hispanics, but it did not change substantially among non-Hispanic blacks or non-Hispanics of other races.[24]
- In 2018, cigar smoking was higher among non-Hispanic American Indians/Alaska Natives (8%) compared to non-Hispanic blacks (5%), non-Hispanic whites (4%), and Hispanics (3%),9 although these percentages differ by cigar type.[25]
- Overall, 4% of adults in 2018 (men: 7%, women: 1%) reported smoking cigars every day or some days.[9]
- Among high school students in 2018, 8% (boys: 9%, girls: 6%) had smoked cigars at least once in the past month, down from 15% in 1999.[11, 12]
- In 2018, the current (past month) prevalence of waterpipe smoking among high school students was 4%.[12]

E-cigarettes (Vaping Devices)

A new category of devices for tobacco delivery emerged in the mid-to-late 2000s that aerosolizes a liquid nicotine solution, referred to by researchers as electronic nicotine delivery systems (ENDS) or vaporized nicotine products (VNPs) and known colloquially as "e-cigarettes" or "vapes." More recently, JUUL brand products became the largest-selling e-cigarette brand in traditional retail outlets.[26] ENDS users inhale aerosol produced from cartridges, tanks, or pods filled with a liquid that typically contains nicotine, propylene glycol (PG) and/or vegetable glycerin (VG), and flavoring. While ENDS are regulated as tobacco products in the US because the nicotine is derived from tobacco leaves, they are promoted by manufacturers as high-tech alternatives to traditional cigarettes, harm-reduction tools, cessation aids, and/or a way to bypass some smoke-free laws. While the risks of long-term use are not yet known, there is accumulating evidence that ENDS use causes short-term adverse effects on airways and blood vessels.[27-29] Based on more than 200 possible cases of severe pulmonary disease associated with the use of ENDS, likely as the result of an unknown chemical exposure, the CDC published "interim guidance" in September 2019 recommending that individuals consider not using ENDS until a definitive cause is identified.[30] According to a 2019 American Cancer Society position statement on ENDS, no youth or young adult should begin using ENDS. Current ENDS users should not also smoke cigarettes or switch to smoking cigarettes, and former smokers now using ENDS should not revert to smoking. Adults who continue to use them should be aware of symptoms (e.g., cough, shortness of breath, chest pain, nausea, vomiting, etc.) and seek medical attention for any health concerns. Potentially harmful substances include metals and other hazardous chemicals that can seep into the inhaled aerosol, and some commonly used flavoring components (e.g., diacetyl) are hazardous to the lungs. E-cigarettes are additionally concerning because they are addictive and may be a gateway to combustible tobacco products among individuals who would otherwise have been nonsmokers; adolescents and young adults who use e-cigarettes are more likely than nonusers to begin using combustible tobacco products.[31-33] A standard JUUL brand ENDS pod contains nicotine at levels comparable to a pack of 20 regular cigarettes, and delivers it faster than other ENDS.[34] E-cigarette use among youth and young adults is particularly concerning since nicotine can impair adolescent brain development.[35]

- In 2017, 3% of adults reported current (every day or some days) e-cigarette use, ranging from about 1% in people ages 65 and older to 5% in people ages 18 to 24 years.[36]
- Current (past month) e-cigarette use increased by 78% between 2017-2018 (11.7% to 20.8%) among high school students, contributing to a 14-fold increase since 2011 (1.5%).[37]
- In 2018, 27% of non-Hispanic white high school students reported current e-cigarette use, compared to 15% of Hispanics and 8% of non-Hispanic blacks.[12]

Smokeless Tobacco Products

Smokeless tobacco products include moist snuff, chewing tobacco, snus (a "spitless," moist powder tobacco, often in a pouch), and a variety of other tobacco-containing products that are not smoked. These products can cause oral, esophageal, and pancreatic cancers, as well as precancerous lesions of the mouth, and are thus not a safe alternative to cigarettes.[38] Switching from combustible tobacco to smokeless products has been shown to result in a higher risk of tobacco-related death than complete tobacco cessation.[39] The tobacco industry markets smokeless tobacco as a cigarette alternative in smoke-free settings and develops new smokeless products, many of which have specific appeal to youth because they are relatively low in price and easy to conceal.

- Smokeless tobacco use among US adults has remained stable since 2003;[40] in 2018, 5% of men and <1% of women were current (every day or some days) users of smokeless tobacco products.[9]
- State-level adult smokeless tobacco use in 2018 ranged from 1% in New Jersey to 9% in West Virginia and Wyoming.[10]
- In 2018, 8% of high school boys and 3% of girls used smokeless tobacco in the past month.[12]

Secondhand Smoke

There is no safe level of exposure to secondhand smoke (SHS), which contains more than 5,300 compounds and 70 carcinogens.[41] Nonsmokers who are exposed to SHS are at increased risk of lung diseases (including cancer), heart disease, and respiratory illnesses.[42-45] Comprehensive smoke-free laws are effective in reducing SHS exposure, modifying smoking behavior, and reducing the risk of smoking-related disease.[44]

- In 2014, an estimated 5,840 nonsmoking adults in the US were diagnosed with lung cancer as a result of SHS exposure.[2]
- Nationwide, SHS exposure among nonsmokers declined from 88% in 1988-1991 to 25% in 2013-2014, but remains substantially higher among individuals with low income.[4, 46]
- Approximately 10% of nonsmokers (12.6 million adults) were exposed to SHS in the workplace in 2015, a rate that has remained unchanged since 2010 and is higher among younger, male, and manual labor (blue-collar) workers.[47]

Additionally, provisions in the Affordable Care Act require most private and some public health insurance plans to provide at least minimum coverage of evidence-based cessation treatments (i.e., counseling, NRT, medications), although for many smokers, minimum coverage falls short of what is needed for long-term cessation.

State tobacco control programs also have a critical role to play in reducing tobacco use. The US surgeon general's goals for state tobacco control programs focus on preventing smoking initiation, promoting cessation, eliminating SHS exposure, and eliminating disparities in tobacco use,[58] and the Centers for Disease Control and Prevention recommends funding levels for these programs.[59] In fiscal year 2019, funding for tobacco control programs was >50% of recommended levels in only four states (Alaska, California, North Dakota, and Oklahoma) and <1% of recommended levels in six states (Connecticut, Georgia, Missouri, New Hampshire, Tennessee, and West Virginia).[60] Furthermore, although there have been improvements in Medicaid coverage for tobacco cessation, as of June 30, 2017, only 10 states covered individual counseling, group counseling, and the seven FDA-approved cessation medications (the nicotine patch, gum, lozenge, nasal spray, and inhaler and bupropion and varenicline).[61]

Conclusion

Since the 1964 Surgeon General's Report, smoking prevalence has declined by about two-thirds and millions of premature deaths have been averted. Nevertheless, much more can be done to further reduce the health and economic burden of tobacco, particularly among specific populations with high smoking rates. Numerous studies confirm that comprehensive tobacco control, including higher taxes, 100% smoke-free environments, coverage for tobacco dependence treatment, plain standardized cigarette packaging, and tobacco marketing restrictions, can successfully reduce deaths, disabilities, and economic disruption from tobacco use.

For more information about tobacco control in the US, including the role of taxation, see *Cancer Prevention & Early Detection Facts & Figures* at cancer.org/statistics. For a comprehensive presentation of tobacco-related problems and solutions on a global scale, see *The Tobacco Atlas* at tobaccoatlas.org.

References

1. 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*. 2015;25: 179-182.

2. Islami F, Goding Sauer A, Miller KD, et al. Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States. *CA Cancer J Clin*. 2018;68: 31-54.

3. Lortet-Tieulent J, Goding Sauer A, Siegel RL, et al. State-Level Cancer Mortality Attributable to Cigarette Smoking in the United States. *JAMA Intern Med*. 2016;176: 1792-1798.

4. Drope J, Liber AC, Cahn Z, et al. Who's still smoking? Disparities in adult cigarette smoking prevalence in the United States. *CA Cancer J Clin*. 2018;68: 106-115.

5. 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. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 2014.

6. 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.

7. Foerster B, Pozo C, Abufaraj M, et al. Association of Smoking Status With Recurrence, Metastasis, and Mortality Among Patients With Localized Prostate Cancer Undergoing Prostatectomy or Radiotherapy: A Systematic Review and Meta-analysis. *JAMA Oncol*. 2018;4: 953-961.

8. National Center for Health Statistics. *Health, United States, 2017: With Chartbook on Long-term Trends in Health*. Hyattsville, MD, 2018.

9. National Center for Health Statistics. National Health Interview Survey, 2018. Public-use data file and documentation. Available from URL: http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm Accessed June 25, 2019.

10. Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Data, 2018. Available from URL: https://www.cdc.gov/brfss/data_tools.htm Accessed September 11, 2019.

11. Centers for Disease Control and Prevention. Youth Tobacco Surveillance United States, 1998-1999. *MMWR Surveill Summ*. 2000;49.

12. Gentzke AS, Creamer M, Cullen KA, et al. Vital Signs: Tobacco Product Use Among Middle and High School Students – United States, 2011-2018. *MMWR Morb Mortal Wkly Rep*. 2019;68:157-164.

13. Baker F, Ainsworth SR, Dye JT, et al. Health risks associated with cigar smoking. *JAMA*. 2000;284: 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*. 2000;92: 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*. 2016;25: 538-544.

17. Delnevo CD, Hrywna M, Giovenco DP, Miller Lo EJ, O'Connor RJ. Close, but no cigar: certain cigars are pseudo-cigarettes designed to evade regulation. *Tob Control*. 2017;26: 349-354.

18. US Department of Health and Human Services. *Preventing Tobacco Use Among Youth and Young Adults: 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 and Prevention and Health Promotion, Office of Smoking and Health, 2012.

19. Berg CJ, Stratton E, Schauer GL, et al. Perceived Harm, Addictiveness, and Social Acceptability of Tobacco Products and Marijuana Among Young Adults: Marijuana, Hookah, and Electronic Cigarettes Win. *Subst Use Misuse*. 2015;50: 79-89.

20. Knishkowy B, Amitai Y. Water-pipe (narghile) smoking: an emerging health risk behavior. *Pediatrics*. 2005;116: e113-119.

21. Waziry R, Jawad M, Ballout RA, Al Akel M, Akl EA. The effects of waterpipe tobacco smoking on health outcomes: an updated systematic review and meta-analysis. *Int J Epidemiol*. 2017;46: 32-43.

22. Montazeri Z, Nyiraneza C, El-Katerji H, Little J. Waterpipe smoking and cancer: systematic review and meta-analysis. *Tob Control*. 2017;26: 92-97.

23. Haddad L, Kelly DL, Weglicki LS, Barnett TE, Ferrell AV, Ghadban R. A Systematic Review of Effects of Waterpipe Smoking on Cardiovascular and Respiratory Health Outcomes. *Tob Use Insights*. 2016;9: 13-28.

24. Weinberger AH, Delnevo CD, Zhu J, et al. Trends in Cigar Use in the United States, 2002 to 2016: Diverging Trends by Race/Ethnicity. *Nicotine Tob Res*. 2019.

25. Corey CG, Holder-Hayes E, Nguyen AB, et al. US Adult Cigar Smoking Patterns, Purchasing Behaviors, and Reasons for Use According to Cigar Type: Findings From the Population Assessment of Tobacco and Health (PATH) Study, 2013-2014. *Nicotine Tob Res*. 2018;20: 1457-1466.

26. Huang J, Duan Z, Kwok J, et al. Vaping versus JUULing: how the extraordinary growth and marketing of JUUL transformed the US retail e-cigarette market. *Tob Control*. 2018.

27. Layden JE, Ghinai I, Pray I, et al. Pulmonary Illness Related to E-Cigarette Use in Illinois and Wisconsin – Preliminary Report. *N Engl J Med*. 2019.

28. Biondi-Zoccai G, Sciarretta S, Bullen C, et al. Acute Effects of Heat-Not-Burn, Electronic Vaping, and Traditional Tobacco Combustion Cigarettes: The Sapienza University of Rome-Vascular Assessment of Proatherosclerotic Effects of Smoking (SUR-VAPES) 2 Randomized Trial. *J Am Heart Assoc*. 2019;8: e010455.

29. Antoniewicz L, Brynedal A, Hedman L, Lundback M, Bosson JA. Acute Effects of Electronic Cigarette Inhalation on the Vasculature and the Conducting Airways. *Cardiovasc Toxicol*. 2019.

30. Schier JG, Meiman JG, Layden J, et al. Severe Pulmonary Disease Associated with Electronic-Cigarette Product Use – Interim Guidance. *MMWR Morb Mortal Wkly Rep*. 2019;68:787-790.

31. Leventhal AM, Strong DR, Kirkpatrick MG, et al. Association of Electronic Cigarette Use With Initiation of Combustible Tobacco Product Smoking in Early Adolescence. *JAMA*. 2015;314: 700-707.

32. Miech R, Patrick ME, O'Malley PM, Johnston LD. E-cigarette use as a predictor of cigarette smoking: results from a 1-year follow-up of a national sample of 12th grade students. *Tob Control*. 2017;26: e106-e111.

33. Soneji S, Barrington-Trimis JL, Wills TA, et al. Association Between Initial Use of e-Cigarettes and Subsequent Cigarette Smoking Among Adolescents and Young Adults: A Systematic Review and Meta-analysis. *JAMA Pediatr*. 2017;171: 788-797.

34. Willett JG, Bennett M, Hair EC, et al. Recognition, use and perceptions of JUUL among youth and young adults. *Tob Control*. 2019;28: 115-116.

35. US Department of Health and Human Services. *E-Cigarette Use Among Youth and Young Adults*. Rockville, MD: US Department of Health and Human Services, Office of the Surgeon General, 2016.

36. National Center for Health Statistics. National Health Interview Survey, 2017. Public-use data file and documentation. Available from URL: http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm Accessed July 9, 2018.

37. Cullen KA, Ambrose BK, Gentzke AS, Apelberg BJ, Jamal A, King BA. Notes from the Field: Use of Electronic Cigarettes and Any Tobacco Product Among Middle and High School Students – United States, 2011-2018. *MMWR Morb Mortal Wkly Rep*. 2018;67: 1276-1277.

38. Boffetta P, Hecht S, Gray N, Gupta P, Straif K. Smokeless tobacco and cancer. *Lancet Oncol*. 2008;9: 667-675.

39. Henley SJ, Connell CJ, Richter P, et al. Tobacco-related disease mortality among men who switched from cigarettes to spit tobacco. *Tob Control*. 2007;16: 22-28.

40. Chang JT, Levy DT, Meza R. Trends and Factors Related to Smokeless Tobacco Use in the United States. *Nicotine Tob Res*. 2016;18: 1740-1748.

41. *Personal habits and indoor combustions: A review of human carcinogens, Volume 100 E*. Lyon: International Agency for Research on Cancer, 2012.

42. 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.

43. 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.

44. Institute of Medicine. *Secondhand Smoke Exposure and Cardiovascular Effects: Making Sense of the Evidence*. Washington, DC: Institute of Medicine, 2009.

45. Centers for Disease Control and Prevention. Vital Signs: Nonsmokers' Exposure to Secondhand Smoke – United States, 1999-2008. *MMWR Morb Mortal Wkly Rep*. 2010;59: 1141-1146.

46. Tsai J, Homa DM, Gentzke AS, et al. Exposure to Secondhand Smoke Among Nonsmokers – United States, 1988-2014. *MMWR Morb Mortal Wkly Rep*. 2018;67: 1342-1346.

47. Dai H, Hao J. The Prevalence of Exposure to Workplace Secondhand Smoke in the United States: 2010 to 2015. *Nicotine Tob Res*. 2017;19: 1300-1307.

48. American Nonsmokers' Rights Foundation. Overview List – How many Smokefree Laws? Available from URL: http://no-smoke.org/wp-content/uploads/pdf/mediaordlist.pdf Accessed July 22, 2019.

49. US Department of Housing and Urban Development. Smoke-Free Public Housing. Available from URL: https://www.hud.gov/smokefreepublichousing Accessed August 8, 2018.

50. Blake KD, Klein AL, Walpert L, et al. Smoke-free and tobacco-free colleges and universities in the United States. *Tob Control*. 2019.

51. Brody DJ, Lu Z, Tsai J. Secondhand Smoke Exposure Among Nonsmoking Youth: United States, 2013-2016. *NCHS Data Brief*. 2019;348.

52. 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.

53. Weinberger AH, Giovenco DP, Zhu J, Lee J, Kashan RS, Goodwin RD. Racial/ethnic differences in daily, nondaily, and menthol cigarette use and smoking quit ratios in the United States: 2002 to 2016. *Prev Med*. 2019;125: 32-39.

54. Babb S, Malarcher A, Schauer G, Asman K, Jamal A. Quitting Smoking Among Adults – United States, 2000-2015. *MMWR Morb Mortal Wkly Rep*. 2017;65: 1457-1464.

55. Levy DT, Meza R, Zhang Y, Holford TR. Gauging the Effect of U.S. Tobacco Control Policies From 1965 Through 2014 Using SimSmoke. *Am J Prev Med*. 2016;50: 535-542.

56. Apelberg BJ, Feirman SP, Salazar E, et al. Potential Public Health Effects of Reducing Nicotine Levels in Cigarettes in the United States. *N Engl J Med*. 2018.

57. US Food and Drug Administration. (2019, August 15). FDA proposes new required health warnings with color images for cigarette packages and advertisements to promote greater public understanding of negative health consequences of smoking. [Press release]. Retrieved from https://www.fda.gov/news-events/press-announcements/fda-proposes-new-required-health-warnings-color-images-cigarette-packages-and-advertisements-promote.

58. 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.

59. Centers for Disease Control and Prevention. *Best Practices for Comprehensive Tobacco Control Programs-2014*. Atlanta, GA: U.S. 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, 2014.

60. Truth Initiative, Campaign for Tobacco-Free Kids, American Heart Association, et al. *Broken Promises to Our Children: A State-by-State Look at the 1998 State Tobacco Settlement 20 Years Later*, 2018.

61. DiGiulio A, Jump Z, Yu A, et al. State Medicaid Coverage for Tobacco Cessation Treatments and Barriers to Accessing Treatments – United States, 2015-2017. *MMWR Morb Mortal Wkly Rep*. 2018;67: 390-395.

Excess Body Weight, Alcohol, Diet, & Physical Activity

Aside from avoiding tobacco use, maintaining a healthy weight and limiting alcohol consumption are the most effective strategies for reducing the risk of cancer.[1] An estimated 18% of cancer cases are attributable to the combined effects of excess body weight, alcohol consumption, physical inactivity, and an unhealthy diet.[2] The American Cancer Society's nutrition and physical activity guidelines (see sidebar) provide a framework to help individuals adopt healthy behaviors. Adults who most closely follow these recommendations are 10%-20% less likely to be diagnosed with cancer and 25% less likely to die from the disease.[3] Community action strategies are included in the guidelines because of the strong influence of environment on individual food and activity choices.

Excess Body Weight

An estimated 5% of cancers in men and 11% in women can be attributed to excess body weight.[2] Excess body weight (i.e., being overweight or obese) is associated with an increased risk of developing several types of cancer: uterine corpus (endometrium), esophagus (adenocarcinoma), liver, stomach (gastric cardia), kidney (renal cell), brain (meningioma), multiple myeloma, pancreas, colorectum, gallbladder, ovary, female breast (postmenopausal), and thyroid.[4] Excess body weight may also increase the risk of non-Hodgkin lymphoma (diffuse large B-cell lymphoma), male breast cancer, and fatal prostate cancer.[4] Limited evidence suggests that excess body weight negatively impacts breast cancer survival.[5] Evidence is growing about the adverse health consequences of cumulative exposure to excess body fat over the life course as a result of excessive weight gain that begins during childhood.[6, 7]

Overweight prevalence among men (about 40%) and women (about 25%-30%) has remained relatively stable since the early 1960s. However, obesity prevalence has markedly increased; in 1960-1962, 11% of men and 16% of women were obese, and by 2015-2016, approximately 38% of men and 41% of women were obese.[8]

In 2015-2016, obesity prevalence among men was highest in Hispanics (43%), followed by non-Hispanic whites (38%), non-Hispanic blacks (37%), and non-Hispanic Asians (10%); among women, obesity was highest among non-Hispanic blacks (55%), followed by Hispanics (51%), non-Hispanic whites (38%), and non-Hispanic Asians (15%).[9]

Among youth (ages 2-19 years), overweight prevalence increased from 10% in the early 1970s to 17% in 2015-2016. Obesity prevalence has risen more sharply from 5% in the early 1970s to about 19% in 2015-2016.[10]

In 2015-2016, excess body fatness was prevalent in 26% of children ages 2-5 years; 34% of children ages 6-11 years; and 40% of adolescents ages 12-19 years.[11]

Alcohol

An estimated 6% of cancer cases can be attributed to alcohol consumption.[2] Alcohol consumption increases risk for cancers of the mouth, pharynx, larynx, esophagus, liver, colorectum, female breast, and stomach.[12] Cancer risk increases with alcohol volume,

The American Cancer Society's nutrition and physical activity guidelines[1]

Individual choices:

- Achieve and maintain a healthy weight* throughout life.
- Adopt a physically active lifestyle.
- Consume a healthy diet with an emphasis on plant sources.
- Limit alcohol consumption.

Community action:

- Increase access to affordable, healthy foods.
- Provide safe, enjoyable, and accessible environments for physical activity.

*Weight recommendations are often determined by body mass index (BMI), which is a function of weight to height squared. BMI categories for adults: healthy weight=18.5 to 24.9 kg/m^2, overweight=25.0 to 29.9 kg/m^2, obese=30.0 kg/m^2 or higher. BMI categories for children are based on percentile rankings and growth charts.

and even a few drinks per week may increase risk for some cancers. Alcohol consumption combined with tobacco use synergistically increases the risk of cancers of the mouth, pharynx, larynx, and esophagus far more than the additive effect of these exposures separately.[13]

- In 2018, 67% of adults reported current alcohol consumption (12+ drinks in lifetime and ≥1 drink in past year). About 5% reported heavier drinking (12+ drinks in lifetime and [male] >14 drinks/week in past year or [female] >7 drinks/week in past year), ranging from 2% in non-Hispanic Asians to 7% in non-Hispanic whites.[14]
- About 30% of high school students in 2017 reported current (past month) alcohol consumption.[15]

Diet

Approximately 4% to 5% of all cancer cases and deaths can be attributed to dietary factors.[2] Diet patterns high in red and processed meat, starchy foods, refined carbohydrates, and sugary drinks are associated with a higher risk of developing cancer (predominantly colon),[16] whereas those with an emphasis on a variety of fruits and vegetables, whole grains, legumes, and fish or poultry and fewer red and processed meats are associated with lower risk.[17, 18] One study found that individuals who have the healthiest diet have an 11%-24% lower risk of cancer death than those with the least healthy diet.[19] In addition, improving diet quality over time is associated with an overall reduced risk of death.[20]

- Among adults, 33% reported eating two or more servings of fruits per day and 16% consumed vegetables three or more times per day in 2017.[21]
- Among adults, whole grains accounted for 16% of total grain consumption on a given day in 2013-2016, ranging from 11% among Hispanics to 18% among non-Hispanic Asians.[22]
- In 2017, 31% of high school students reported consuming 100% fruit juice or fruit two or more times per day and only 14% reported consuming vegetables three or more times per day.[15]

Physical Activity

An estimated 3% of cancer cases can be attributed to physical inactivity.[2] Physical activity decreases the risk of colon (but not rectal), female breast, and endometrial cancers,[23] as well as kidney, bladder, esophageal (adenocarcinoma), and stomach (cardia).[24] Greater time spent in sedentary behavior may increase risk of other cancer types.[23, 24] Furthermore, cancer patients who are physically active are less likely to have adverse effects and to die from their cancer than those who are inactive.[25] Even low amounts of physical activity appear to reduce cancer mortality.[26, 27] Extended leisure-time sitting has also been associated with increased risk of cancer death,[28] although 60-75 minutes per day of moderate-intensity activity may offset this excess risk.[29]

- In 2018, 26% of adults reported no leisure-time activity (men: 23%, women: 28%), with a higher proportion of blacks (34%) and Hispanics (34%) reporting inactivity than whites (22%) and non-Hispanic Asians (21%).[14]
- From 1998 to 2018, the proportion of adults who met recommended levels of aerobic activity increased from 40% to 54%.[14, 30]
- In 2017, only 26% of high school students (boys: 35%, girls: 18%) engaged in at least 60 minutes of physical activity per day in the previous week.[15]

Type 2 Diabetes

Type 2 diabetes, a chronic condition in which the body loses its ability to respond to insulin, shares several modifiable risk factors with cancer, including excess body weight, poor diet, and physical inactivity. Evidence suggests that type 2 diabetes independently increases risk for several cancers, including liver, endometrium, pancreas, colorectum, kidney, bladder, breast, and perhaps ovary.[31-33] The biology underlying the association between type 2 diabetes and cancer is not yet completely understood, but may involve abnormal glucose control and related factors, including inflammation.

- In 2015, an estimated 27 to 29 million Americans had type 2 diabetes, which represents 90% to 95% of all diabetes cases in the US.[34]

- In 2013-2015, the prevalence of diabetes was higher among American Indians/Alaska Natives (15%), non-Hispanic blacks (13%), and Hispanics (12%) than among Asians (8%) and non-Hispanic whites (7%).[34]
- However, 1 in 2 Asians with diabetes is unaware of their disease, compared to 1 in 4 people nationwide, partly because Asians are more likely to develop the disease at a normal body weight.[35]

Conclusion

Almost 1 in 5 cancers is caused by excess body fat, alcohol consumption, poor nutrition, and a sedentary lifestyle. Many Americans encounter substantial barriers to consuming a healthy diet and engaging in regular physical activity. The tobacco control experience has shown that policy and environmental interventions across national, state, and local levels are critical to achieving changes in individual behavior. Similar purposeful efforts in public policy and community environments, as well as creative new strategies, are needed to facilitate healthier lifestyles to curtail the future cancer burden.

Visit cancer.org/healthy/eat-healthy-get-active/acs-guidelines-nutrition-physical-activity-cancer-prevention.html for more information on the American Cancer Society's nutrition and physical activity guidelines, and review *Cancer Prevention & Early Detection Facts & Figures* at cancer.org/statistics for additional information about how healthy behaviors influence cancer risk.

References

1. 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.

2. Islami F, Goding Sauer A, Miller KD, et al. Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States. *CA Cancer J Clin*. 2018;68: 31-54.

3. Kabat GC, Matthews CE, Kamensky V, Hollenbeck AR, Rohan TE. Adherence to cancer prevention guidelines and cancer incidence, cancer mortality, and total mortality: a prospective cohort study. *Am J Clin Nutr*. 2015;101: 558-569.

4. Lauby-Secretan B, Scoccianti C, Loomis D, Grosse Y, Bianchini F, Straif K. Body Fatness and Cancer – Viewpoint of the IARC Working Group. *N Engl J Med*. 2016;375: 794-798.

5. Demark-Wahnefried W, Platz EA, Ligibel JA, et al. The role of obesity in cancer survival and recurrence. *Cancer Epidemiol Biomarkers Prev*. 2012;21: 1244-1259.

6. Lee JM, Pilli S, Gebremariam A, et al. Getting heavier, younger: trajectories of obesity over the life course. *Int J Obes* (Lond). 2010;34: 614-623.

7. Song M, Willett WC, Hu FB, et al. Trajectory of body shape across the lifespan and cancer risk. *Int J Cancer*. 2016;138: 2383-2395.

8. Fryar CD, Carroll MD, Ogden CL. Prevalence of Overweight, Obesity, and Severe Obesity Among Adults Aged 20 and Over: United States, 1960-1962 Through 2015-2016. *National Center for Health Statistics Health E-Stats*. 2018.

9. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of Obesity Among Adults and Youth: United States, 2015–2016. *NCHS Data Brief*. 2017.

10. Fryar CD, Carroll MD, Ogden CL. Prevalence of Overweight, Obesity, and Severe Obesity Among Children and Adolescents Aged 2–19 Years: United States, 1963–1965 Through 2015-2016. *National Center for Health Statistics Health E-Stats*. 2018.

11. National Center for Health Statistics. National Health and Nutrition Examination Survey Data. Available from URL: https://wwwn.cdc.gov/nchs/nhanes/Default.aspx Accessed October 25, 2017.

12. World Cancer Research Fund/American Institute for Cancer Research. *Continuous Update Project Expert Report 2018. Alcoholic drinks and the risk of cancer*. London, UK: World Cancer Research Fund/American Institute for Cancer Research, 2018.

13. International Agency for Research on Cancer. *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Alcohol Consumption and Ethyl Carbamate*. Lyon, France: International Agency for Research on Cancer, 2010.

14. National Center for Health Statistics. National Health Interview Survey, 2018. Public-use data file and documentation. Available from URL: http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm Accessed June 25, 2019.

15. Kann L, McManus T, Harris WA, et al. Youth Risk Behavior Surveillance – United States, 2017. *MMWR Surveill Summ*. 2018;67: 1-114.

16. Grosso G, Bella F, Godos J, et al. Possible role of diet in cancer: systematic review and multiple meta-analyses of dietary patterns, lifestyle factors, and cancer risk. *Nutr Rev*. 2017;75: 405-419.

17. Schwingshackl L, Hoffmann G. Adherence to Mediterranean diet and risk of cancer: an updated systematic review and meta-analysis of observational studies. *Cancer Med*. 2015;4: 1933-1947.

18. Schwingshackl L, Hoffmann G. Diet quality as assessed by the Healthy Eating Index, the Alternate Healthy Eating Index, the Dietary Approaches to Stop Hypertension score, and health outcomes: a systematic review and meta-analysis of cohort studies. *J Acad Nutr Diet*. 2015;115: 780-800 e785.

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. Sotos-Prieto M, Bhupathiraju SN, Mattei J, et al. Association of Changes in Diet Quality with Total and Cause-Specific Mortality. *N Engl J Med*. 2017;377: 143-153.

21. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System Survey Data, 2017. Available from URL: https://www.cdc.gov/brfss/data_documentation/index.htm Accessed September 6, 2018.

22. Ahluwalia N, Herrick KA, Terry AL, Hughes JP. Contribution of Whole Grains to Total Grains Intake Among Adults Aged 20 and Over: United States, 2013-2016. *NCHS Data Brief*. 2019;341.

23. World Cancer Research Fund/American Institute for Cancer Research. *Continuous Update Project Expert Report 2018. Physical activity and the risk of cancer*. London, UK: World Cancer Research Fund/American Institute for Cancer Research, 2018.

24. 2018 Physical Activity Guidelines Advisory Committee. *2018 Physical Activity Guidelines Advisory Committee Scientific Report*. Washington, DC: U.S. Department of Health and Human Services, 2018.

25. Cormie P, Zopf EM, Zhang X, Schmitz KH. The Impact of Exercise on Cancer Mortality, Recurrence, and Treatment-Related Adverse Effects. *Epidemiol Rev*. 2017;39: 71-92.

26. O'Donovan G, Lee IM, Hamer M, Stamatakis ED. Association of "Weekend Warrior" and Other Leisure Time Physical Activity Patterns With Risks for All-Cause, Cardiovascular Disease, and Cancer Mortality. *JAMA Intern Med*. 2017;177: 335-342.

27. Patel AV, Hildebrand JS, Leach CR, et al. Walking in Relation to Mortality in a Large Prospective Cohort of Older U.S. Adults. *Am J Prev Med*. 2018;54: 10-19.

28. Patel AV, Maliniak ML, Rees-Punia E, Matthews CE, Gapstur SM. Prolonged Leisure-Time Spent Sitting in Relation to Cause-specific Mortality in a Large U.S. Cohort. *Am J Epidemiol*. 2018.

29. 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;388: 1302-1310.

30. National Center for Health Statistics. *Health, United States, 2016: With Chartbook on Long-term Trends in Health*. Hyattsville, MD, 2017.

31. Giovannucci E, Harlan DM, Archer MC, et al. Diabetes and cancer: a consensus report. *CA Cancer J Clin*. 2010;60: 207-221.

32. Bao C, Yang X, Xu W, et al. Diabetes mellitus and incidence and mortality of kidney cancer: a meta-analysis. *J Diabetes Complications*. 2013;27: 357-364.

33. Wang L, Wang L, Zhang J, Wang B, Liu HD. Association between diabetes mellitus and subsequent ovarian cancer in women: A systematic review and meta-analysis of cohort studies. *Medicine*. 2017;96: e6396.

34. Centers for Disease Control and Prevention. *National Diabetes Statistics Report 2017*. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services, 2017.

35. National Center for Chronic Disease Prevention and Health Promotion, Division of Diabetes Translation. Diabetes and Asian Americans. Available from URL: https://www.cdc.gov/diabetes/library/spotlights/diabetes-asian-americans.html Accessed August 22, 2018.

Cancer Disparities

Eliminating disparities in the cancer burden, 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 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 (NHW) men with 12 or fewer years of education are almost 3 times higher than those of college graduates for all cancers combined. This is partly because incidence rates are higher in people with lower SES for many cancers because many factors that increase cancer risk are more prevalent. For example, people with lower SES are more likely to smoke and to be obese, partly because of targeted marketing to this population by tobacco companies and fast food chains. Moreover, community factors often limit opportunities for physical activity and access to fresh fruits and vegetables. Additional factors include a higher prevalence of cancer-causing infections and harmful exposures in the workplace and other environments.

Disparities in cancer mortality among impoverished individuals also stem from lower survival rates because of a higher likelihood of advanced-stage cancer diagnosis and a lower likelihood of receiving standard treatment. Barriers to preventive care, early detection, and optimal treatment in underserved populations include inadequate health insurance; financial, structural, and personal obstacles to health care; low health literacy rates; and delays in the dissemination of advances in early detection and treatment.

Racial and Ethnic Minorities

Racial and ethnic disparities in the cancer burden largely reflect disproportionate poverty. According to the US Census Bureau, in 2018, 21% of blacks and 18% of Hispanics/Latinos lived below the poverty line, compared to 8% of NHWs and 10% of Asians. In addition, 10% of blacks and 18% of Hispanics/Latinos were uninsured, compared to 5% of NHWs and 7% of Asians. Discrimination also contributes to cancer disparities, as racial and ethnic minorities tend to receive lower-quality health care than NHWs 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.

Cancer occurrence in racial/ethnic minorities is also influenced by cultural factors that affect risk factor behaviors. For example, Hispanics and Asians overall have lower rates of lung cancer than NHWs (Table 9) because they have a history of lower smoking prevalence. Conversely, because a relatively large proportion of Hispanics and Asians are recent immigrants, they have higher rates of certain cancers related to infectious agents (e.g., stomach), reflecting higher infection prevalence in their native countries. Inherited genetic factors contribute minimally to overall cancer disparities but explain some differences in cancer incidence for certain high-risk groups. For example, women of Ashkenazi Jewish descent have higher breast cancer incidence because of a higher frequency of mutations in the breast cancer susceptibility genes *BRCA1* and *BRCA2*.

Following is a brief overview of the cancer burden for four major racial and ethnic minority groups in the US. However, it is important to note that these populations are very heterogeneous, with substantial variation in the cancer burden within each group. In addition, cancer rates for several racial and ethnic groups, especially American Indians and Alaska Natives (AIANs), are known to be underestimated due to misclassification on medical and death records.

Non-Hispanic Blacks: Although there is substantial variation within the non-Hispanic black (henceforth black) population, black males overall have the highest cancer incidence (540 per 100,000) and death (233) rates of the major racial/ethnic groups, 8% and 20% higher, respectively, than NHW males (501 and 194) (Table 9). Cancer mortality in black males is twice that in Asians and Pacific Islanders (APIs, 116), who have the lowest rates. Prostate cancer death rates in blacks are more than double those of every other group in Table 9. Notably, black females have 40% higher breast cancer death rates than NHW females despite similar incidence rates. See *Cancer Facts & Figures for African Americans*, available online at cancer.org/statistics, for more information.

Hispanics/Latinos: As an aggregate group, US Hispanics have lower rates for the most common cancers (female breast, colorectum, lung, and prostate), but among the highest rates for cancers associated with infectious agents, reflecting the risk profile in immigrant countries of origin. For example, Hispanics have cervical cancer incidence rates that are about 35% higher than those in NHWs, and liver and stomach cancer incidence rates that are about double (Table 9). However, incidence rates vary substantially by country of origin, generation, and duration of residence due to acculturation and other factors. For example, colorectal cancer incidence rates in men are about 7% lower in Hispanics than in NHWs overall (Table 9), but are 18% higher in those residing in the US territory of Puerto Rico, which is 99% Hispanic (Table 4). See *Cancer Facts & Figures for Hispanics/Latinos*, available online at cancer.org/statistics, for more information.

Asians and Pacific Islanders (APIs): As a group, APIs have the lowest overall cancer incidence and mortality, but among the highest liver and stomach cancer rates, about double those among NHWs (Table 9). Like Hispanics, lung cancer rates in APIs are about half those in NHWs because of historically low smoking prevalence. However, some API populations with higher historical smoking prevalence, such as Native Hawaiians, have lung cancer rates that approach those of NHWs. The variation in cancer occurrence within the API population reflects its diversity in terms of geographic origin, language, acculturation, and socioeconomic status. Unfortunately,

Table 9. Incidence and Mortality Rates* for Selected Cancers by Race and Ethnicity, US, 2012-2017

Incidence, 2012-2016	All races	Non-Hispanic white	Non-Hispanic black	Asian/ Pacific Islander	American Indian/ Alaska Native†	Hispanic/ Latino
All sites	448.4	464.6	460.4	288.4	380.7	346.4
Male	489.4	501.2	540.0	292.3	399.2	372.9
Female	421.1	440.7	407.2	289.5	370.9	333.4
Breast (female)	125.2	130.8	126.7	93.3	94.7	93.9
Colon & rectum	38.7	38.6	45.7	30.0	43.3	34.1
Male	44.4	44.0	53.8	35.3	48.5	40.8
Female	33.9	33.9	39.9	25.7	39.1	28.7
Kidney & renal pelvis	16.6	16.8	18.7	7.7	23.1	16.4
Male	22.5	22.8	25.9	11.0	29.7	21.6
Female	11.5	11.5	13.2	5.1	17.5	12.2
Liver & intrahepatic bile duct	8.3	6.9	10.9	12.7	15.1	13.4
Male	12.7	10.5	17.9	19.4	21.6	20.0
Female	4.4	3.7	5.4	7.3	9.4	7.8
Lung & bronchus	59.3	63.5	62.4	34.4	53.6	30.2
Male	69.3	72.4	82.7	43.5	60.1	37.9
Female	51.7	56.7	48.6	27.6	48.8	24.6
Prostate	104.1	97.1	173.0	52.9	68.0	86.8
Stomach	6.6	5.4	10.1	10.3	8.8	9.6
Male	9.0	7.6	13.9	13.3	11.6	12.1
Female	4.6	3.5	7.5	7.9	6.7	7.7
Uterine cervix	7.6	7.1	9.1	6.0	8.7	9.6
Mortality, 2013-2017						
All sites	158.2	162.9	186.4	98.1	144.0	111.8
Male	189.3	193.8	233.2	116.4	172.6	135.6
Female	135.5	139.9	157.5	85.0	122.9	95.1
Breast (female)	20.3	20.3	28.4	11.4	14.6	14.0
Colon & rectum	13.9	13.8	19.0	9.5	15.8	11.1
Male	16.6	16.3	23.8	11.4	19.4	14.1
Female	11.7	11.7	15.6	8.1	13.0	8.7
Kidney & renal pelvis	3.7	3.8	3.7	1.7	5.5	3.4
Male	5.4	5.6	5.6	2.6	8.2	5.0
Female	2.3	2.4	2.3	1.1	3.4	2.2
Liver & intrahepatic bile duct	6.6	5.8	8.6	9.0	10.6	9.3
Male	9.6	8.4	13.5	13.4	14.8	13.2
Female	4.0	3.5	4.9	5.6	7.1	6.0
Lung & bronchus	40.2	43.4	43.5	22.0	33.3	17.5
Male	49.3	51.8	60.4	29.0	40.0	24.1
Female	33.2	36.8	31.9	16.8	28.3	12.6
Prostate	19.1	18.0	38.7	8.6	18.7	15.7
Stomach	3.1	2.3	5.4	5.1	4.8	5.0
Male	4.1	3.2	8.0	6.6	6.3	6.4
Female	2.2	1.6	3.7	4.0	3.6	4.0
Uterine cervix	2.3	2.1	3.6	1.7	2.5	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 and exclude data from Puerto Rico. †Data based on Purchased/Referred Care Delivery Area (PRCDA) counties.

Source: Incidence – North American Association of Central Cancer Registries, 2019. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2019.

contemporary cancer data are largely unavailable for minority subpopulations. 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 Indians and Alaska Natives (AIANs): AIANs have the highest kidney cancer incidence and death rates of any racial or ethnic population in the US – nearly 3 times those among APIs, who have the lowest rates (Table 9). 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, excess body weight, and hypertension. Likewise, variations in smoking patterns among AIAN men contribute to large differences in lung cancer rates, which are about 50% higher than NHWs for those living in the Northern Plains or Alaska, but less than half those in NHWs for AIAN men living in the Southwest. Notably, Alaska Natives have the highest colorectal cancer incidence in the US (89 per 100,000 during 2012-2016), more than double those in NHWs and American Indians (39 and 41, respectively) and about 90% higher than in blacks (46).

For information about American Cancer Society advocacy efforts dedicated to reducing the cancer burden among minority and medically underserved populations, see Advocacy on page 64.

The Global Cancer Burden

The ultimate mission of the American Cancer Society is to lead the fight for a world without cancer. Today, cancer accounts for about 1 in every 6 deaths worldwide – more than HIV/AIDS, tuberculosis, and malaria combined.[1] In 2018, there were an estimated 17.0 million cases of cancer diagnosed around the world and 9.5 million cancer deaths.[2] About 20% of cancer cases occurred in low- and medium-Human Development Index countries, many of which lack the medical resources and health systems to support the disease burden. By 2040, the global burden is expected to reach 27.5 million new cancer cases and 16.2 million cancer deaths solely due to the growth and aging of the population. However, these projections may be underestimates given 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 economically transitioning countries.

Worldwide Tobacco Use

Tobacco use is a major contributor to the global burden of disease, responsible for about 25% of cancer deaths worldwide[3] and more than half of all deaths among long-term tobacco users.[4-6]

- Tobacco was responsible for more than 8 million deaths in 2017, including 1.2 million deaths from secondhand smoke exposure among nonsmokers.[3] More than 75% of tobacco-attributable deaths are in low- and middle-income countries (LMICs).[3]
- Between 1990 and 2017, annual tobacco-attributable deaths increased from 1.6 to 1.7 million in high-income countries, and increased from 4.3 million to 6.4 million in LMICs.[3]

The first global public health treaty under the auspices of the World Health Organization, the Framework Convention on Tobacco Control (WHO FCTC), was unanimously adopted by the World Health Assembly in 2003 and subsequently became 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. Several major tobacco-producing nations, including Argentina, Indonesia, Malawi, and the United States, are among the few nations that have not yet ratified the treaty.

- About 65% of the world's population was covered by at least one comprehensive tobacco control measure in 2018, up from about 15% in 2008.
- The WHO estimates that 22% of the world's population lives in smoke-free environments and only 14% is covered by tobacco tax policy that is effective for tobacco control purposes.

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 antitobacco advocates in promoting evidence-based cancer and tobacco control programs with a 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.[1] Although 77% of these deaths occur in LMICs,[3] only 2% of private and public health funding is allocated to prevent and control NCDs in these areas.[7] The American Cancer Society helps make cancer and other NCDs a global public health priority by collaborating with key partners. An example of recent progress in this effort occurred in 2017 when the World Health Assembly passed a resolution reaffirming cancer control as a critical health and development priority. In 2018, the WHO director general made a global call for action toward the elimination of cervical cancer.

Develop civil society capacity in cancer control 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 or coordinated in their cancer control efforts. The American Cancer Society Strengthening Organizations for a United Response to the Cancer Epidemic (SOURCE) Program is designed to strengthen the civil society response to cancer across the continuum from prevention through end-of-life care in focus countries around the world. The program also facilitates the establishment of national cancer umbrella organizations to coordinate the civil society response and elevate the voice of all organizations, big and small, in the cancer fight.

Improve tobacco control worldwide. The American Cancer Society Global Cancer Control department and the Economic and Health Policy Research (EHPR) program in the Intramural Research department are working to end the worldwide tobacco epidemic through research and programs. In 2016, the two teams launched a global initiative that promotes the Sustainable Development target of a 30% reduction in smoking prevalence by 2025 through tobacco taxation. This program actively seeks to engage cancer organizations, most of which have not been previously involved in this area, particularly in LMICs. The EHPR also provides sound, scientific evidence on the issues that are of concern to the governments – including illicit trade in tobacco products and the economic livelihoods of tobacco farmers – and that are obstacles to the implementation of lifesaving tobacco control policies like increasing tobacco excise taxes. Currently, the EHPR is leading multicountry, multiyear programs – partly with support from the US National Institutes of Health and the Bloomberg Philanthropies – to examine these issues in more than 16 countries in Africa, Asia, and Latin America. Governments use this research for policy making that engenders improved public health.

Improve patient support programs. With little knowledge about what to expect in the complex cancer care process, many patients experience delays in diagnosis or treatment. The American Cancer Society has partnered with the Kenyatta National Hospital (KNH) in Nairobi, Kenya, to provide a patient navigation program that enables trained professionals to guide patients through the cancer care journey and ensure they receive a timely diagnosis and proper treatment. Additionally, the American Cancer Society and KNH broke ground in 2019 on a 156-bed Hope Hostel located on the grounds of the hospital that will provide free accommodation to cancer patients receiving treatment, eliminating the cost of lodging and transportation that often keeps those patients from seeking and completing treatment.

Make effective treatment available to all in need. The American Cancer Society Global Cancer Treatment team works to reduce mortality from cancer worldwide by addressing disparities in access to affordable, high-quality cancer treatment, including chemotherapy, radiotherapy, surgery, and pain relief. Along with collaborators such as IBM, the National Comprehensive

Cancer Network, the Clinton Health Access Initiative (CHAI), and the African Cancer Coalition, the American Cancer Society is working to develop standard cancer treatment guidelines to achieve the highest standard of care with available resources in sub-Saharan Africa. The American Cancer Society and the CHAI have also negotiated successfully with pharmaceutical companies Pfizer and Cipla to reduce the cost of 16 of the most commonly used cancer medicines by about 50%. Additionally, the ChemoSafe project supports African Health Ministries and cancer treatment centers to improve the safe handling and administration of chemotherapy through the implementation of safety standards, training of workers, and access to personal protective equipment.

Moderate to severe pain, which is experienced by about 80% of people with advanced cancer, is commonly untreated in resource-limited settings. Improved access to essential pain medicines is arguably the easiest and least expensive need to meet in LMICs. The American Cancer Society leads projects in Nigeria, Ethiopia, Kenya, Uganda, Rwanda, and Swaziland to improve access to essential pain medicines and also supports national morphine production programs that have dramatically reduced the cost of and increased access to pain relief. We are also training health workers in teaching and referral hospitals across the six countries through the Pain-Free Hospital Initiative, a one-year hospital-wide quality improvement initiative designed to change clinical practice by integrating effective, high-quality pain treatment into hospital-based services. The initiative has been implemented in more than 75 hospitals and has trained 25,000 health workers, resulting in a reduction of more than 50% in average pain scores reported by patients.

Increase awareness about the global cancer burden. The American Cancer Society works with global collaborators to increase awareness about the growing cancer and tobacco burdens and their disproportionate impact on LMICs. For example, we collaborated with the International Agency for Research on Cancer and the Union for International Cancer Control to produce *The Cancer Atlas, Third Edition* and its interactive website (canceratlas.cancer.org). The *Atlas* highlights the complex nature of the global cancer landscape while pointing to strategies governments can use to reduce their cancer burden. Similarly, *The Tobacco Atlas, Sixth Edition* (tobaccoatlas.org), a collaboration with Vital Strategies, is the most comprehensive resource on the evolving worldwide tobacco epidemic. Tobaccoatlas.org, an accompanying interactive website, receives more than 40,000 visitors each month, about two-thirds of whom are outside the US. The American Cancer Society Intramural Research department also publishes *Global Cancer Facts & Figures* (cancer.org/statistics), which along with an accompanying statistics article in *CA: A Cancer Journal for Clinicians*, provides up-to-date data on cancer incidence, mortality, and survival worldwide. In addition to our print publications, the American Cancer Society's website, cancer.org, provides cancer information to millions of individuals throughout the world. In 2018, approximately 51% of visitors to the website were outside the US. Information is currently available in English, Spanish, Chinese, Bengali, Hindi, Korean, Urdu, and Vietnamese.

References

1. Roth GA, Abate D, Abate KH, et al. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*. 2018;392(10159):1736-1788.

2. Ferlay J. *GLOBOCAN 2018*. Lyon: World Health Organization International Agency for Research on Cancer, 2018.

3. Institute for Health Metrics and Evaluation (IHME). GBD Compare Data Visualization. Seattle, WA: IHME, University of Washington, 2018. Available from http://vizhub.healthdata.org/gbd-compare. (Accessed July 15, 2019).

4. Thun MJ, Carter BD, Feskanich D, et al. 50-year trends in smoking-related mortality in the United States. *N Engl J Med*. 2013;368(4):351-364.

5. Banks E, Joshy G, Weber MF, et al. Tobacco smoking and all-cause mortality in a large Australian cohort study: findings from a mature epidemic with current low smoking prevalence. *BMC Med*. 2015;13:38.

6. Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. *BMJ*. 2004;328(7455):1519.

7. Institute for Health Metrics and Evaluation (IHME). Financing Global Health Visualization. Seattle, WA: IHME, University of Washington, 2019. Available from http://vizhub.healthdata.org/fgh/. (Accessed July 15, 2019).

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. More than 100 years later, the American Cancer Society works with 1.5 million volunteers to lead the fight for a world without cancer.

We are *activists* – convening powerful leaders who work tirelessly to create awareness and impact. We deliver *breakthroughs* – launching innovative research and developing game-changing approaches. We build *communities* – coming together to support those affected by cancer and to help ensure access to treatment. We provide *direction* – empowering people with information and answers.

Thanks in part to our contributions, more than 2.9 million cancer deaths have been averted in the US in the past two decades.

How the American Cancer Society Is Leading the Fight

The American Cancer Society relies on the strength of our dedicated volunteers to drive every part of our mission. With the support of our professional staff, volunteers raise funds to support innovative research, provide cancer patients rides to treatment, and offer peer-to-peer support to those facing a cancer diagnosis – and that's just the beginning.

Prevention and Early Detection

Cancer prevention and early detection are core components of the American Cancer Society's mission to save lives, celebrate lives, and lead the fight for a world without cancer. An estimated 42% of cancer cases and 45% of cancer deaths in the US are attributed to potentially modifiable risk factors, and cancer prevention and early detection through screening can reduce the cancer burden even further.

Tobacco use remains the most preventable cause of cancer death in the US. Cigarette smoking increases the risk of at least 12 different cancers; almost 30% of all cancer deaths in the US, and 80% of lung cancer deaths, are attributed to smoking. The American Cancer Society continues our long history of work to reduce tobacco use through research (see page 61), education, and advocacy (see page 64). Our Center for Tobacco Control continues to work toward the adoption and implementation of smoke- and tobacco-free policies in all workplaces, public places, and other important venues such as multiunit residential settings. In addition, we're taking steps to reduce tobacco-related health disparities, including among the disproportionately high percentage of smokers who also have mental health or substance use disorders. We are also addressing the evolving tobacco product marketplace and rapid increase in the use of electronic tobacco products, or e-cigarettes, by youth.

Aside from avoiding tobacco use, maintaining a healthy, active lifestyle is one of the most effective ways to reduce cancer risk. The American Cancer Society regularly performs a formal review of the current scientific evidence on diet and cancer and synthesizes it into clear, informative recommendations for the general public to promote healthy individual behaviors and environments that support healthy eating and physical activity to reduce cancer risk. These nutrition and physical activity guidelines form the foundation for our communication, worksite, school, and community strategies designed to encourage and support people in making healthy choices.

Finding cancer at its earliest stage, when it may be easier to treat, gives patients the greatest chance of survival. Moreover, screening tests for cervical and colorectal cancer can detect precancers, allowing for cancer prevention. To help health care providers and the public make informed decisions about cancer screening, the American Cancer Society publishes early-detection guidelines based on the most current scientific evidence for cancers of the breast, cervix, colorectum, endometrium, lung, and prostate. In addition, we have a history of implementing campaigns among the public and with health care professionals to

increase awareness of the value of screening. For example, campaigns to increase the use of Pap testing and mammography have contributed to a 71% decrease in cervical cancer mortality since 1969 and a 40% decline in breast cancer mortality since 1989. In 2019, the American Cancer Society and the National Colorectal Cancer Roundtable (NCCRT) built on the success of an earlier initiative to increase colorectal cancer screening rates in adults 50 and older, signed onto by more than 1,750 organizations, with a goal to reach 80% screening prevalence in every community.

Similarly, we provide guidelines for HPV vaccination and established the National HPV Vaccination Roundtable, which is working with health care professionals nationwide to increase HPV vaccination rates in adolescents, to take advantage of the enormous opportunity to reduce incidence and mortality of human papillomavirus (HPV)-associated cancers. Through our Vaccinate Adolescent Programs, Cancer Control staff have implemented structured HPV vaccination interventions and Maintenance of Certification intervention projects in 91 federally qualified health care centers. Our staff have trained over 10,000 providers on HPV vaccination as cancer prevention. Clinics have seen an average HPV series initiation rate increase of 16% over the course of our year-long intervention projects.

In addition, we work with community health partners and corporations across the nation to increase access to preventive care and improve health equity with programs such as the NCCRT, the National HPV Vaccination Roundtable, and the Community Health Advocates implementing Nationwide Grants for Empowerment and Equity (CHANGE) program. Together in 2019, we contributed to nearly 137,000 low- or no-cost screening exams in underserved communities. By helping local facilities provide cancer education and screening for more underserved patients, we are helping to reduce death rates from breast, cervical, and colorectal cancers.

More than 5 million new cases of skin cancer are diagnosed each year in the US. 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. We promote skin cancer prevention and awareness educational messages in support of Don't Fry Day and year-round.

Cancer is the leading cause of premature death in the US working-age population (ages 20-65 years). Therefore, the American Cancer Society is working with business leaders across the country to establish a workplace culture of health. Through our Health Index for Employers, we work with companies to implement evidence-based solutions to improve health outcomes across the cancer continuum. Our health index focuses on five domains: tobacco prevention and cessation, healthy eating, physical activity, cancer screening and prevention, and cancer support. A suite of tools and resources are available for each of the domains. Examples of prevention and screening products we offer are:

- The **Freshstart**® program: This group-based tobacco cessation program is designed to help employees and students plan a successful quit attempt by providing essential information, skills for coping with cravings, and social support. The program is delivered through hospital systems, employers, military bases, universities/colleges, community health organizations, and other systems.
- The **80% Pledge for Colorectal Cancer – Employers** guide: This detailed guide includes steps to increase colorectal cancer screening in the workplace, including making the commitment; working with health plans and wellness staff to ensure coverage is understood, promoted, and designed effectively; capturing data to show progress; and sharing effective strategies with the public.
- The **Content Subscription Service**: This electronic toolkit subscription is offered by the American Cancer Society to employers who support the health and wellness needs of employees with information about cancer prevention and early detection.

Patient and Caregiver Services

The American Cancer Society provides patients and caregivers with resources that can help improve – and even save – lives. From free rides to treatment and other cancer-related appointments, places to stay when

treatment is far from home, and our 24/7 cancer helpline, we're here for everyone with cancer questions and concerns, when and where they need us.

Cancer Information

Caring, trained American Cancer Society staff connect people to answers about a cancer diagnosis, health insurance assistance, American Cancer Society programs and services, print materials, and referrals to other services at our cancer helpline at 1-800-227-2345. Our website, cancer.org, offers evidence-based, easy-to-understand, and accurate cancer information and news. Patients and their caregivers can find reliable information about treatments and side effects for every major cancer type, and where to access programs and services nearby. We also help people living in the US who speak languages other than English find the assistance they need at cancer.org/easyreading or cancer.org/cancer-information-in-other-languages.

The American Cancer Society also publishes books for patients and caregivers that cover a wide range of topics, from patient education, quality of life, and caregiving issues to healthy living. Visit cancer.org/bookstore to order a book or learn more. You may also order a book by contacting our book distributor at 1-800-888-4741 or by emailing orders@ipgbook.com. Our books also are available through all major book retailers, including Amazon and Barnes & Noble. The American Cancer Society also publishes three peer-reviewed scientific journals for health care professionals and researchers: *Cancer*, *Cancer Cytopathology*, and *CA: A Cancer Journal for Clinicians*. Visit cancer.org/health-care-professionals/resources-for-professionals.html to learn about the journals.

Programs and Services

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 posttreatment survivorship care guidelines are designed to promote survivor health and quality of life by facilitating the delivery of high-quality, comprehensive, coordinated clinical follow-up care. Our survivorship research efforts focus on understanding the impact of cancer on 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. Through the National Cancer Survivorship Resource Center, a collaboration between the American Cancer Society and the George Washington University Cancer Institute funded by the Centers for Disease Control and Prevention, we created the Cancer Survivorship E-Learning Series for Primary Care Providers. The free e-learning program is designed to teach clinicians how to care for survivors of adult-onset cancers.

Support for caregivers: Cancer is not isolated only to the individual diagnosed, but also impacts an entire family unit and network of close friends. One of the informational tools we offer caregivers is our *Caregiver Resource Guide* (cancer.org/treatment/caregivers/caregiver-resource-guide.html), which can help them learn to care for themselves as a caregiver; better understand what their loved one is going through; develop skills for coping and caring; and take steps to help protect their own health and well-being. Another helpful resource is our *Caregiver Support Video Series* (cancer.org/caregivervideos), which provides educational support to caregivers as they assist with everyday needs of loved ones and self-care techniques to improve their quality of life.

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. It has specially trained patient navigators across the country who can help find transportation to treatment and other 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 2018, more than 34,000 people relied on the program to help them through their diagnosis and treatment.

Transportation to treatment: When transportation to treatment is a concern, the American Cancer Society may be able to help provide the rides. Our Road To Recovery® program offers free rides to cancer patients who would otherwise have difficulty getting to their cancer-related appointments, thanks to volunteer drivers, transportation partners, or community organizations. In 2018, we provided approximately 480,000 rides to nearly 29,000 cancer patients.

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 that helps patients access the care they need. In 2018, more than 30 Hope Lodge locations provided over 477,000 nights of free lodging to more than 27,000 patients and caregivers – saving them approximately $49 million in hotel expenses. Through our Hotel Partners Program, we partner with local hotels to provide free or discounted lodging for patients. In 2018, nearly 66,000 nights were provided to more than 8,500 patients, saving them more than $9.6 million in hotel expenses.

Breast cancer support: Through the American Cancer Society Reach To Recovery® program, breast cancer patients are connected with trained volunteers to receive peer-to-peer support on everything from practical and emotional issues to helping them cope with their disease, treatment, and long-term survivorship issues. In 2018, the program provided information and support to more than 6,700 patients.

Hair-loss and mastectomy products: Cancer and cancer treatment can have profound effects, including some that alter a patient's appearance, such as hair loss. The American Cancer Society *"tlc" Tender Loving Care*® program helps women with appearance-related side effects by offering them a variety of affordable wigs, hats, and scarves, as well as a full range of mastectomy products. These items can be purchased in the privacy of their own home by calling **1-800-850-9445** or visiting the *"tlc"*™ website at tlcdirect.org. In 2018, more than 70,000 customers were served.

Finding hope and inspiration: The American Cancer Society Cancer Survivors Network® provides a safe online connection where cancer patients and caregivers can find others with similar experiences and interests. At csn.cancer.org, members can participate on discussion boards or join chat rooms and build their own support network from among the members. Other online resources, including Springboard Beyond Cancer and Belong, provide additional support for patients, survivors, and caregivers and allow them to better communicate to receive the help they need during and after cancer.

Intramural Research

In 1946, under the direction of E. Cuyler Hammond, ScD, a small research group was created at the American Cancer Society that focused on investigating the causes of cancer and improving the quality and availability of cancer data. Since then, our Intramural Research program has grown into five programs that conduct and publish high-quality research to advance the understanding of cancer, monitor trends in cancer risk factors and occurrence, improve the lives of cancer survivors, and evaluate American Cancer Society programs to ensure that they are effective and reach cancer patients most in need.

Behavioral and Epidemiology Research Group: The Behavioral and Epidemiology Research Group (BERG) conducts studies that increase knowledge of the factors associated with cancer incidence, mortality, survival, and survivorship. The overarching goals of this research are to reduce the burden imposed by cancer, improve cancer outcomes and quality of life, and reduce cancer disparities.

This work began in 1952, when Hammond engaged the American Cancer Society's nationwide network of volunteers to initiate a large cohort of study participants to provide insights into the causes of cancer. The first cohort, the Hammond-Horn Study (followed from 1952 to 1955), included only men and provided the first US prospective evidence confirming the association between cigarette smoking and premature death from lung cancer and other diseases. This work established the foundation for a series of subsequent, large cohort studies of men and women called the Cancer Prevention Studies (CPS). For nearly 67 years, results from these studies have contributed extensively to the science on cancer risk

associated with modifiable and non-modifiable factors, and have informed the American Cancer Society's and international guidelines for cancer prevention.

In 1994, American Cancer Society leadership recognized the need for more research directed at understanding and improving the social, emotional, and economic impact of cancer and its treatment, and a Blue Ribbon Advisory Committee recommended that the American Cancer Society "should increase its emphasis on psychosocial and behavioral research to fulfill unmet needs." Thus, in 1995, the Behavioral Research Center was formed with a focus on outcomes and quality of life among cancer patients and survivors and was subsequently expanded to include issues faced by caregivers, cancer risk behaviors such as tobacco use, and cancer disparities. Behavioral research findings, including those from the landmark Studies of Cancer Survivors, have improved understanding of how people adjust to life after cancer and helped to inform the development of clinical interventions and American Cancer Society recommendations for cancer survivors.

In 2017, the Behavioral and Epidemiology Research programs were merged to form the BERG, creating new opportunities for innovative, interdisciplinary research. Contributions from the BERG ultimately inform our evidence-based programs and recommendations, which are focused on enhancing cancer prevention, improving outcomes, and reducing disparities. Today, BERG staff focus their efforts on questions that leverage the strength of existing resources to address the following broad research objectives:

- **Epidemiology of modifiable risk factors:** Fill in gaps in knowledge about factors related to cancer etiology, survival and long-term survivorship, including genetic and other predictors of smoking prevalence and health consequences; physical and sedentary activity, diet, alcohol, and excess body weight; medical conditions and common medications; and environmental exposures (e.g., circadian rhythm disruption, radon, pollutants).
- **Molecular epidemiology:** Improve understanding of the molecular epidemiology of cancer, with a focus on breast, gastrointestinal, hematologic and prostate cancers, through studies of circulating biomarkers; genetic factors and gene-environmental interactions; and tumor heterogeneity.
- **Survivorship and quality of life:** Identify factors associated with optimal physical, emotional, and social well-being among cancer patients, survivors, and caregivers to improve their quality of life; assist American Cancer Society program staff in the design and enhancement of interventions and services for cancer survivors and their loved ones; and support the addition of patient-reported outcomes to population health reporting systems.
- **Health behaviors:** Identify behaviors and related predictors associated with cancer prevention, with a primary focus on tobacco control, healthy eating, and active living, as well as their effects on cancer survivors' psychological adjustment and quality of life, in order enhance the efficacy of behavioral interventions and inform American Cancer Society programs, practices, and policies.
- Cancer disparities and health equity: Develop approaches and methods for cancer disparities/health equity research, examine exposures and outcomes in medically vulnerable populations, and identify effective strategies to help eliminate cancer disparities from prevention to survivorship.

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. Information is disseminated via educational publications for a lay audience and peer-reviewed journal articles for a scientific audience. The SHSR program has produced *Cancer Facts & Figures* annually since 1951, and the accompanying Cancer Statistics article, published in *CA: A Cancer Journal for Clinicians* (cacancerjournal.com), since 1967. These two publications are the most widely cited sources for cancer statistics in the world and are available on our website at cancer.org/statistics and in hard copy from American Cancer Society offices and through our National Cancer Information Center (1-800-227-

2345). Seven supplemental *Cancer Facts & Figures* publications focus on a specific topic (e.g., breast cancer, cancer risk factors) or subpopulation (e.g., Hispanics), including *Global Cancer Facts & Figures*, which is a collaboration with the International Agency for Research on Cancer (IARC). The IARC, along with the Union for International Cancer Control (UICC), also collaborates on the production of *The Cancer Atlas*, a one-stop resource for global cancer data and in-depth insights into the cancer burden, major risk factors, and ways leaders worldwide can facilitate cancer control. *The Cancer Atlas* is translated into multiple languages and accompanied by an award-winning interactive website (canceratlas.cancer.org). SHSR staff also provide customizable cancer statistics specifically for the US on a mobile-friendly interactive website, the Cancer Statistics Center (cancerstatisticscenter.cancer.org), that provides national and state-level data on cancer occurrence and risk factors to approximately 14,000 users each month.

Surveillance research staff also conduct and publish high-quality epidemiologic studies to help advance the understanding of cancer. Major research topics include sociodemographic disparities in progress against cancer and the prevalence of risk factors and screening to identify opportunities for targeted interventions and generate scientific evidence to support American Cancer Society priority areas for cancer prevention and control. For example, the American Cancer Society's 2018 colorectal cancer screening guidelines, which lowered the age for screening initiation from 50 to 45 years of age for those at average risk, were strongly influenced by a series of high-profile studies published by SHSR staff that demonstrated increasing rates of colorectal cancer incidence and mortality in individuals under 55 years of age. In addition, since 1998, surveillance staff 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.

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, including barriers to care (e.g., financial hardship) in support of the American Cancer Society's mission to reduce health care inequalities. Researchers in the HSR program use secondary data sources such as the National Cancer Data Base, a hospital-based registry jointly sponsored by the American Cancer Society and the American College of Surgeons; the SEER-Medicare database, a linkage of population-based cancer registry data with Medicare claims data; and the Medical Expenditure Panel Survey, which is linked with the National Health Interview Survey. Findings from HSR researchers have been instrumental in the American Cancer Society's and the American Cancer Society Cancer Action Network's[SM] (ACS CAN) support of the Affordable Care Act (ACA) and its effect on public health. For example, HSR researchers found that racial/ethnic, socioeconomic, and geographic disparities in the percentage of uninsured patients were diminished or eliminated in states that had expanded Medicaid, but remained high in non-expansion states, highlighting the promising role of access to care in reducing disparities. The importance of health care coverage was further reinforced in another study that reported that nearly one-third of the black-white survival disparity for early-stage breast cancer in nonelderly women was due to differences in insurance status.

Economic and Health Policy Research: The Economic and Health Policy Research (EHPR) program focuses on the economic and policy aspects of most major cancer risk factors – including tobacco use, poor nutrition, physical inactivity, and alcohol misuse – as well as other major cancer-related challenges, including patient access to potentially lifesaving treatments and the direct and indirect costs of cancer risk factors, 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.

For more than a decade, a key emphasis of the EHPR program has been vigorous collaboration on tobacco control efforts, particularly in low- and middle-income countries, with numerous international organizations and academic institutions such as the Secretariat and Parties of the WHO Framework Convention on Tobacco Control, the World Bank, Johns Hopkins University, and the Pan American Health Organization (PAHO), among others. This continues to be an important investment by the American Cancer 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 successful and cost-effective policy interventions. Major global health donors, including the Bloomberg Philanthropies and the US National Institutes of Health, continue to support these efforts through project funding. The team continues to be a leading global voice on tobacco taxation, affordability of tobacco products, and issues around illicit trade in these goods. The team is also one of the principal research institutions examining the economics of tobacco farming globally. Using rigorous empirical research, the American Cancer Society has been working with global partners to counter the tobacco industry's false narrative that tobacco control hurts the economic livelihoods of tobacco farmers. Finally, the EHPR program is actively involved in helping governments to resolve tensions between public health and economic policies. For example, working with partners such as the United Nations Development Programme, the EHPR is working to find viable alternative economic livelihoods for farmers and workers displaced by improved public health policies.

The EHPR team has recently turned more of its attention to taxing other unhealthy goods, particularly sugar-sweetened beverages (SSBs) and alcohol. Increasing excise tax on these goods holds considerable potential as a public health strategy by driving down consumption. The team is currently working with PAHO and other in-country partners to pilot a model for SSB excise taxation, and to examine the feasibility of raising alcohol excise taxes, which are low throughout most of the world.

The flagship service publication of the EHPR program is *The Tobacco Atlas*, a comprehensive, accessible guide to tobacco control, produced in collaboration with the American Cancer Society Global Cancer Control department and Vital Strategies. The sixth edition and its corresponding website, tobaccoatlas.org, were released in March 2018 at the World Conference on Tobacco or Health in South Africa, and are available in English, Spanish, Chinese, and Arabic (with French and Portuguese to follow in late 2019). Each month, the website has tens of thousands of visitors from nearly every country in the world.

Statistics and Evaluation Center: Founded in 2005, the Statistics and Evaluation Center's (SEC) mission is to deliver accurate, reliable, and timely evidence-based information to American Cancer Society leadership and staff to inform decisions at all levels of the organization. Expertise in the social, behavioral, statistical, geospatial, health, and epidemiological sciences allows SEC staff to collaborate effectively with colleagues across the American Cancer Society, as well as with our advocacy affiliate, ACS CAN. SEC staff have implemented innovative and collaborative research approaches that have greatly improved the American Cancer Society's ability to deliver efficient, high-quality programs and services; identify barriers; and provide better access to quality health care to those most in need. The SEC also conducts community- and health systems-based collaborative evaluations for cancer prevention, control, and survivorship programs in order to build the evidence base for these initiatives.

The SEC achieves its mission by: 1) providing leadership and expertise on evaluation of mission and income-delivery programs in all its aspects, including study design, qualitative, and quantitative data collection and analysis, dissemination, and provision of strategic recommendations; 2) developing and implementing web-based surveys for evaluation efforts; and 3) providing leadership, expertise, and operational support related to geospatial science, data, and analysis within research and for decision making across the American Cancer Society.

Advocacy

Saving lives from cancer is as much a matter of public policy as scientific discovery. Lawmakers at the local,

state, and federal level play a critical role in enacting policies that help save lives – from quality, affordable health care for all individuals; increasing funding for cancer research and programs; and improving quality of life for patients and their families, to helping communities prevent cancer and promote good health. The American Cancer Society Cancer Action Network (ACS CAN), the nonprofit, nonpartisan advocacy affiliate of the American Cancer Society, works with federal, state, and local policy makers to achieve these goals and make cancer a top priority for public officials and candidates. ACS CAN also empowers advocates across the country to make their voices heard and influence evidence-based public policy change as well as legislative and regulatory solutions that will reduce the cancer burden.

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 help to defeat cancer, the organization 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 and survivors.

ACS CAN's recent advocacy accomplishments on behalf of cancer patients and their families are outlined in the following sections. **Please note:** Descriptions of the Patient Protection and Affordable Care Act (ACA) provisions and other federal laws and guidance were current as of August 2019 and do not take into account any potential changes to health care being considered by Congress, the administration, or the courts.

Access to Care

ACS CAN continues to advocate to protect key patient protections enacted as part of the ACA, including eliminating insurance coverage exclusions, preventing preexisting condition exclusions, eliminating annual and lifetime benefit caps, and removing copays for key cancer prevention and early-detection services like mammography and colonoscopy. The organization is actively working with states to expand eligibility for Medicaid programs, allowing millions of low-income individuals and families to gain access to comprehensive and affordable health care coverage. Additionally, ACS CAN urges policy makers to advance and support policies that protect and improve low-income Americans' access to health care to improve health outcomes and reduce the burden of cancer.

ACS CAN is also advocating for other important patient protections, including:

- The prohibition of short-term limited-duration plans, association health plans, and other plans that do not cover comprehensive benefits or protect patients against high costs
- Market stabilization measures, including state individual mandates for insurance coverage and reinsurance programs that bring down premiums
- The removal of barriers to patient access to prescription drugs, including capping patient costs in the Medicare Part D program and ensuring that the use of utilization management tools by health care payers do not delay cancer treatments
- Full federal funding for community health centers, which provide community-oriented primary care in underserved areas
- Access to preventive services without cost sharing
- The continuation of the Prevention and Public Health Fund

Research Funding and Drug Development

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 (NCI). Thanks in no small part to ACS CAN's work, Congress has steadily increased funding for NCI over the past several years. Today, the NCI has a budget of more than $6.1 million, with most of that awarded through grants to researchers in cancer

centers, universities, and labs in every state of the country. Federal budget pressures threaten this funding every year, and ACS CAN recognizes 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.

In addition to advocating for cancer research funding, the organization works to enhance cancer patients' access to innovative therapies by improving clinical trial enrollment. Clinical trials are the key step in advancing potential new cancer treatments from the research setting to the cancer clinic, and patient participation in trials is crucial to their success. Approximately 20% of cancer clinical trials fail because of insufficient patient enrollment. To address this problem, ACS CAN, in collaboration with other stakeholders, identified a number of barriers and is working on implementing a set of consensus recommendations to make it easier for patients to enroll in an appropriate clinical trial.

Prevention and Early Detection

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

- Working to expedite and defend the full implementation of the Family Smoking Prevention and Tobacco Control Act, including the regulation of new products
- Leading efforts to pass comprehensive smoke-free laws requiring all workplaces, restaurants, and bars to be smoke-free. In 2019, Atlanta, Georgia, home to the world's busiest airport, passed a comprehensive smoke-free bill that will go into effect January 2, 2020.
- Working to increase the price of tobacco products via federal and state taxes on all tobacco products and defending against tax rollbacks. The average state tax rate for cigarettes rose to $1.81 per pack (as of July 1, 2019).
- Working to increase and protect state funding for tobacco control programs
- Continuing as an intervener in the long-pending tobacco industry appeal of the federal government's lawsuit against the industry, in which specific manufacturers were 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, which provides low-income, uninsured, and medically underserved women access to cancer screenings, as well as diagnostic, patient navigation, and treatment services
- Urging policy makers to invest federal and state funds in colorectal cancer control programs
- 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
- Advocating for evidence-based child nutrition programs and for state and local requirements to increase the quality and quantity of physical education and physical activity in K-12 schools
- 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 those devices

Quality of Life

ACS CAN supports balanced pain policies at the federal and state levels that ensure continued patient and survivor access to pain treatments. The organization also supports the enactment of legislation to assure that

cancer patients have full access to palliative care services, along with curative treatment, from the point of diagnosis through treatment and survivorship or end of life as needed. 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.

Central to ACS CAN's success is the sophisticated and effective volunteer structure. Across the country, volunteers in every congressional district work closely with the organization 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 American Cancer Society Relay For Life®, and Making Strides Against Breast Cancer® signature events, as well as the Coaches vs. Cancer® initiative, a collaboration between the American Cancer Society and the National Association of Basketball Coaches.

Sources of Statistics

Estimated new cancer cases. The number of cancer cases diagnosed in 2020 was estimated using a spatiotemporal model and time series projection based on incidence during 2002-2016 from 49 states and the District of Columbia (DC) that provided consent and met the North American Association of Central Cancer Registries' (NAACCR) high-quality data standard. The NAACCR is an umbrella organization that sets standards and collects and disseminates incidence data from cancer registries in the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) program and/or the Centers for Disease Control and Prevention's National Program of Cancer Registries. The method for estimating incidence prior to projection considers geographic variations in sociodemographic and lifestyle factors, medical settings, and cancer screening behaviors, and also accounts for expected delays in case reporting. (For more information on this method, see "A" in Additional information on the next page.)

The number of in situ cases of female breast ductal carcinoma and melanoma diagnosed in 2020 was estimated by 1) approximating the actual number of cases in the 10 most recent data years (2007-2016) by applying annual age-specific incidence rates (based on 48 states) to corresponding population estimates for the overall US; 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. These estimates were also partially adjusted for expected reporting delays using invasive factors.

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. 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. State-specific incidence rates were previously published in the NAACCR's publication *Cancer Incidence in North America, 2012-2016*. National rates presented herein may differ slightly from those previously published by the NAACCR due to the exclusion of Puerto Rico, which is presented separately herein. (See "B" in Additional information on the next page for full reference.)

Trends in cancer incidence rates provided in Selected Cancers sections of this publication are based on delay-adjusted incidence rates from the 21 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. These trends were originally published in the *SEER Cancer Statistics Review (CSR) 1975-2016*. (See "C" in Additional information on the next page for full reference.) Trends in

adolescent and young adult cancer provided in the special section of this publication are based on incidence rates from the NAACCR.

Estimated cancer deaths. The number of cancer deaths in the US in 2020 was estimated by fitting the number of cancer deaths from 2003 to 2017 to a statistical model and then using the most recent trend (APC) to forecast the number in 2020. 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 this page.)

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. 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 2017.

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 1975-2016*. Trends in 5-year survival are based on data from the 9 oldest SEER registries, which go back to 1975, whereas contemporary 5-year survival rates are based on data from the oldest 18 SEER registries, which provide greater population coverage while also allowing for stratification by stage at diagnosis. In addition to 5-year relative survival rates, 10-year prostate cancer survival is also presented, based on patients diagnosed during 2001-2015, all followed through 2016, and generated using the NCI's SEER 18 database and SEER*Stat software version 8.3.6. (See "E" in Additional information on the next page for full reference.)

Probability of developing cancer. Probabilities of developing cancer were calculated using DevCan (Probability of Developing Cancer) software version 6.7.7, developed by the NCI. (See "F" in Additional information on the next page 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 15 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. Sherman R, Firth R, De P, et al. (eds). Cancer in North America: 2012-2016. Volume Two: Registry-specific Cancer Incidence in the United States and Canada. Springfield, IL: North American Association of Central Cancer Registries, Inc. June 2019. Available at https://www.naaccr.org/cancer-in-north-america-cina-volumes/#Vol2.

C. Howlader N, Noone AM, Krapcho M, et al. (eds). SEER Cancer Statistics Review, 1975-2016. National Cancer Institute. Bethesda, MD, 2019. 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 (seer.cancer.gov) SEER*Stat Database: Incidence – SEER 18 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2018 Sub (1973-2016 varying) – Linked To County Attributes – Total U.S., 1969-2017 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2019, based on the November 2018 submission.

F. DevCan: Probability of Developing or Dying of Cancer Software, Version 6.7.7; Statistical Research and Applications Branch, National Cancer Institute, 2019. https://surveillance.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 have the opportunity to begin annual screening between the ages of 40 and 44. Women should undergo regular screening mammography starting at age 45. Women ages 45 to 54 should be screened annually.
	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 45+	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.
		Multi-target 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
		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. African American men should have this conversation with their provider beginning at age 45.

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.

Acknowledgments

We gratefully acknowledge all cancer registries and their staff for their hard work and diligence in collecting cancer information, without which this report would not exist. We would also like to acknowledge the following subject matter experts for their valuable contributions: Rick Alteri; Kimberly Andrews; Cammie Barnes; Kristen Braun; Durado Brooks; Zachary Cahn; Ellen Chang; Sally Cowal; Keri Daniels; Carol DeSantis; Michelle DelFavero; Jacqui Drope; Jeffrey Drope; Christin Engelhardt; Stacey Fedewa; Miranda Fidler-Benaoudia; Mark Fleury; Ted Gansler; Susan Gapstur; Ann Goding-Sauer; Heather Hipp; Anna Howard; Farhad Islami; Eric Jacobs; Mamta Kalidas; Theresa Keegan; TJ Koerner; J. Leonard Lichtenfeld; Kristie McComb; Marji McCullough; Catherine McMahon; Meg O'Brien; Alpa Patel; Cheri Richard; Liora Sahar; Debbie Saslow; Scott Simpson; Jennifer Singleterry; Kirsten Sloan; Robert Smith; Michal Stoklosa; Lauren Teras; Tawana Thomas-Johnson; Lindsey Torre; Britton Trabert; Dana Wagner; Martin Weinstock; Tanya Wildes; and Joe Zou.

Cancer Facts & Figures is an annual publication of the American Cancer Society, Atlanta, Georgia.

For more information, contact:
Rebecca Siegel; Kimberly Miller; or Ahmedin Jemal
Surveillance and Health Services Research Program

The American Cancer Society's mission
is to **save lives, celebrate lives,**
and **lead the fight** for a world without cancer.

American Cancer Society®

Attacking from every angle.™

cancer.org | 1.800.227.2345

BBB ACCREDITED CHARITY
bbb.org/charity

PUTTING PATIENTS FIRST
National Health Council
Standards of Excellence
Certification Program ®