Cancer Facts & Figures
2018

WA
36,170

MT
6,080

ND
4,110

MN
31,270

VT
3,840

NH
8,080

ME
8,600

OR
21,520

ID
8,450

SD
5,100

WI
33,340

NY
110,800

MA
37,130

WY
2,780

MI
56,590

RI 5,920

CT 21,240

NV
14,060

NE
10,320

IA
17,630

PA
80,960

NJ 53,260

CA
178,130

UT
10,950

CO
25,570

IL
66,330

IN
37,250

OH
68,470

DE 6,110

MD 33,810

KS
15,400

MO
35,520

WV
12,110

VA
42,420

DC 3,260

AZ
34,740

NM
9,730

OK
19,030

AR
16,130

KY
25,990

TN
36,760

NC
55,130

SC
30,450

MS
18,130

AL
27,830

GA
56,920

TX
121,860

LA
25,080

AK
3,550

FL
135,170

**US
1,735,350**

HI
6,280

PR
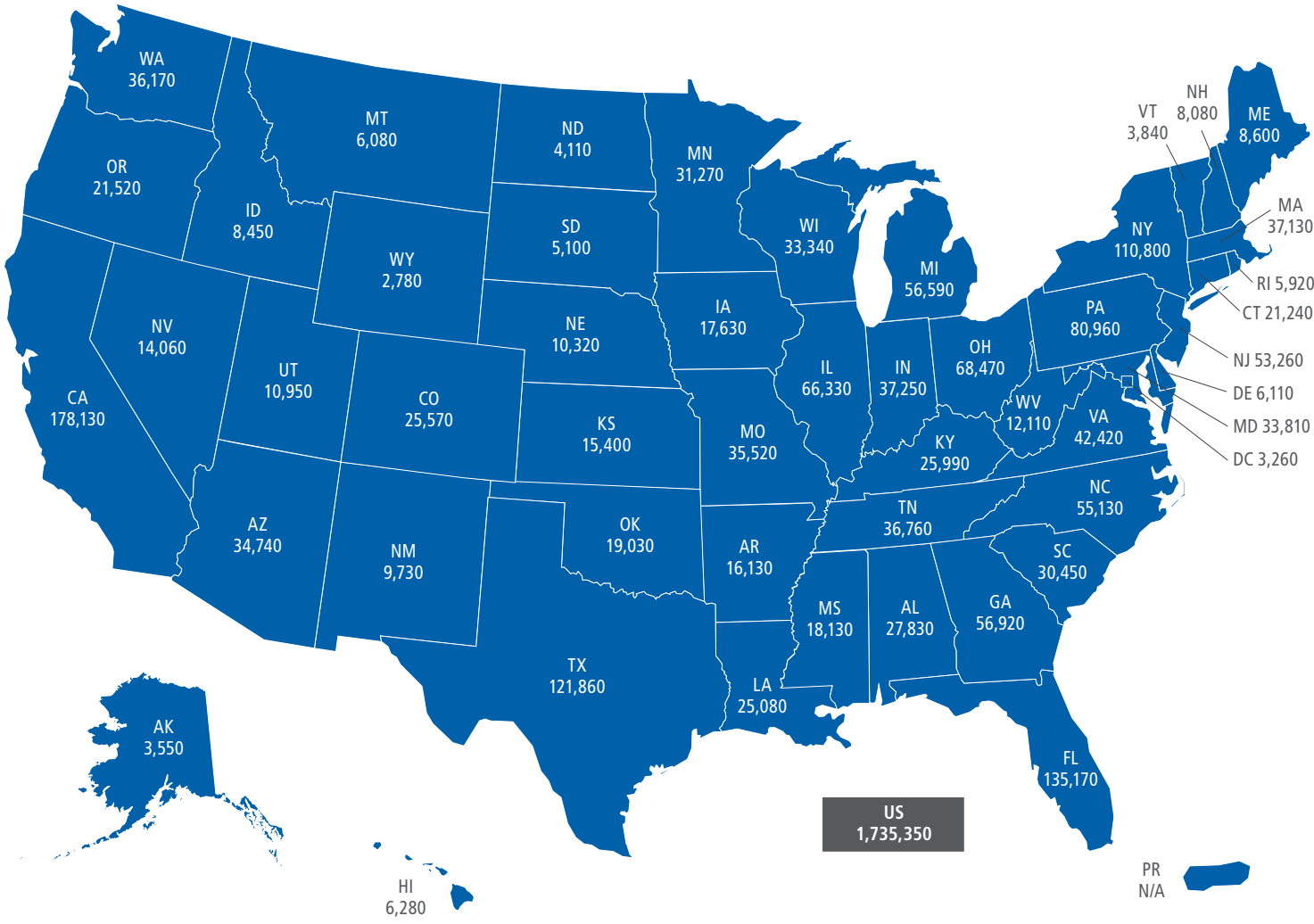N/A

Estimated numbers of new cancer cases for 2018, 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: Ovarian Cancer
see page 28

Contents

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

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Basic Cancer Facts

What Is Cancer?

Cancer is a group of diseases characterized by the uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death. Although the reason why the disease develops remains unknown for many cancers, particularly those that occur during childhood, there are many known cancer causes, including lifestyle factors, such as tobacco use and excess body weight, and non-modifiable factors, such as inherited genetic mutations, hormones, and immune conditions. These risk factors may act simultaneously or in sequence to initiate and/or promote cancer growth.

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 epidemiologists, at least 42% of newly diagnosed cancers in the US – about 729,000 cases in 2018 – are potentially avoidable, including 19% that are caused by smoking and 18% that are caused by a combination of excess body weight, physical inactivity, excess alcohol consumption, and poor nutrition. 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, vaccination, or treatment of the infection. Many of the more than 5 million skin cancer cases that are diagnosed annually could be prevented by protecting skin from excessive sun exposure and not using indoor tanning devices.

Screening can help prevent colorectal and cervical cancers by allowing for the detection and removal of precancerous lesions. Screening also offers the opportunity to detect some cancers early, when treatment is more likely to be successful. Screening is known to help reduce mortality for cancers of the breast, colon, rectum, cervix, and lung (among long-term current or former heavy smokers). In addition, a heightened awareness of changes in certain parts of the body, such as the breast, skin, mouth, eyes, or genitalia, may also result in the early detection of cancer. For complete cancer screening guidelines, see page 71.

How Many People Alive Today Have Ever Had Cancer?

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

How Many New Cases and Deaths Are Expected to Occur in 2018?

About 1.7 million new cancer cases are expected to be diagnosed in 2018 (Table 1, page 4). This estimate does not include carcinoma in situ (noninvasive cancer) of any site except urinary bladder, nor does it include basal cell or squamous cell skin cancers because these are not required to be reported to cancer registries. Table 2 (page 5) provides estimated new cancer cases in 2018 by state.

About 609,640 Americans are expected to die of cancer in 2018 (Table 1, page 4), which translates to about 1,670 deaths per day. Cancer is the second most common cause of death in the US, exceeded only by heart disease. Table 3 (page 6) provides estimated cancer deaths by state in 2018.

How Much Progress Has Been Made against Cancer?

Cancer death rates are the best measure of progress against cancer because they are less affected by detection practices than incidence and survival. The overall age-adjusted cancer death rate rose during most of the 20th century mainly because of the tobacco epidemic, peaking in 1991 at 215 cancer deaths per 100,000 people. As of 2015, the rate had dropped to 159 per 100,000 (a decline of 26%) because of reductions in smoking, as well as improvements in early detection and treatment. This decline translates into more than 2.3 million fewer cancer deaths from 1991 to 2015, progress that has been driven by rapid declines in death rates for the four most common cancer types – lung, colorectal, breast, and prostate (Figure 1, page 2 and Figure 2, page 3).

## Do Cancer Incidence and Death Rates Vary by State?

Tables 4 (page 7) and 5 (page 8) provide average annual incidence (new diagnoses) and death rates for selected cancer types by state. The variation by state is largest for lung cancer, reflecting historical and recent differences in smoking prevalence.

Who Is at Risk of Developing Cancer?

Cancer usually develops in older people; 87% of all cancers in the United States are diagnosed in people 50 years of age or older. Certain behaviors also increase risk, such as smoking, eating an unhealthy diet, or not being physically active. In the US, approximately 40 out of 100 men and 38 out of 100 women will develop cancer during their lifetime (Table 6, page 14). These probabilities are estimated based on cancer occurrence in the general population and may overestimate or underestimate individual risk because of differences in exposures (e.g., smoking), family history, and/or genetic susceptibility.

Relative risk is the strength of the relationship between exposure to a given risk factor and cancer. It is measured by comparing cancer occurrence in people with a certain exposure or trait to cancer occurrence in people without this characteristic. For example, men and women who smoke are about 25 times more likely to develop lung cancer than nonsmokers, so their relative risk of lung cancer is 25. Most relative risks are not this large. For example, women who have a mother, sister, or daughter with a history of breast cancer are about twice as likely to develop breast cancer as women who do not have this family history; in other words, their relative risk is about 2. For most types of cancer, risk is higher with a family history of the disease, which is thought to result from the inheritance of genetic variations that confer low or moderate risk and/or similar exposures to lifestyle/ environmental risk factors among family members. Only a small proportion of cancers are strongly hereditary, meaning they are caused by an inherited genetic alteration that confers a very high risk.

Figure 1. Trends in Age-adjusted Cancer Death Rates* by Site, Males, US, 1930-2015
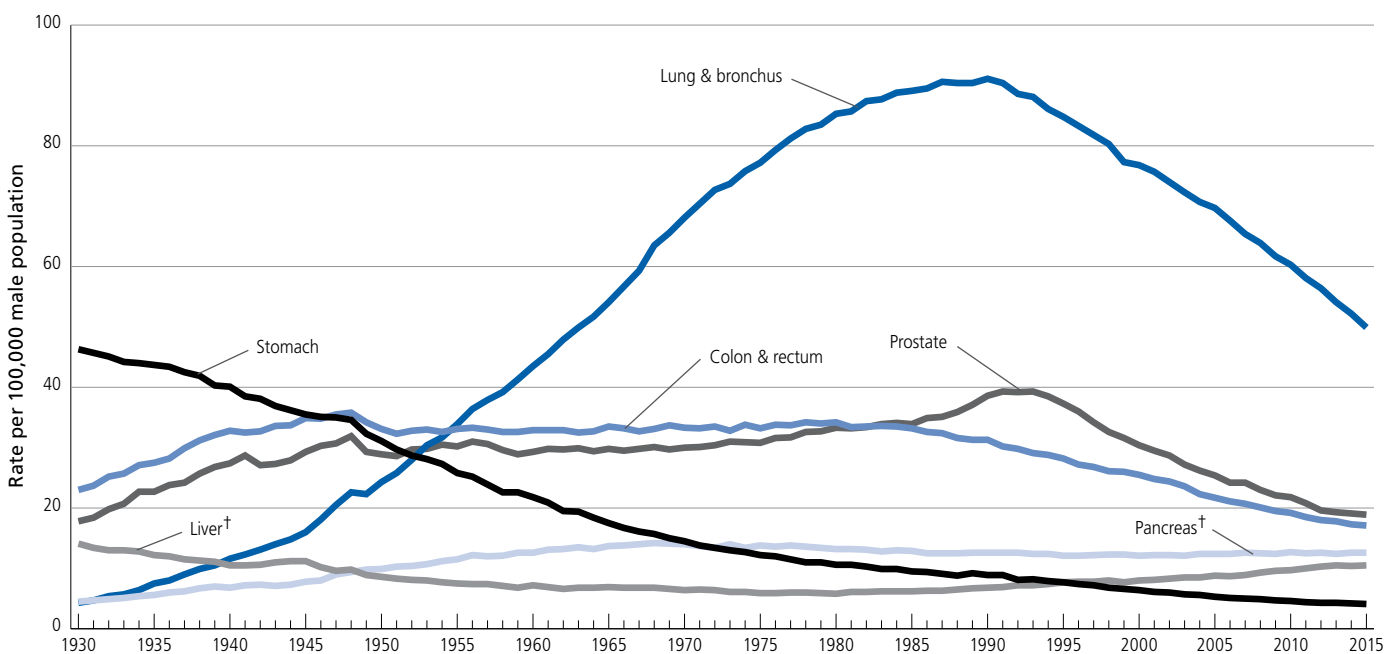
*Age adjusted to the 2000 US standard population. †Mortality rates for pancreatic and liver cancers are increasing.

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

Source: US Mortality Volumes 1930 to 1959, US Mortality Data 1960 to 2015, National Center for Health Statistics, Centers for Disease Control and Prevention.

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What Percentage of People Survive Cancer?

Over the past three decades, the 5-year relative survival rate for all cancers combined increased 20 percentage points among whites and 24 percentage points among blacks, yet it remains substantially lower for blacks (70% versus 63%, respectively). Improvements in survival (Table 7, page 18) reflect improvements in treatment, as well as earlier diagnosis for some cancers. Survival varies greatly by cancer type and stage at diagnosis (Table 8, page 21).

Relative survival, the survival statistic used throughout this report, is the proportion of people with cancer who are alive for a designated time (usually 5 years) after 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 68.

Although relative survival rates provide some indication about the average experience of cancer patients in a given population, 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 several years in the past. Second, they do not account for many factors that affect individual survival, such as treatment, other illnesses, and biological or behavioral differences. Third, 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) and early diagnosis that does not increase lifespan.

Figure 2. Trends in Age-adjusted Cancer Death Rates* by Site, Females, US, 1930-2015
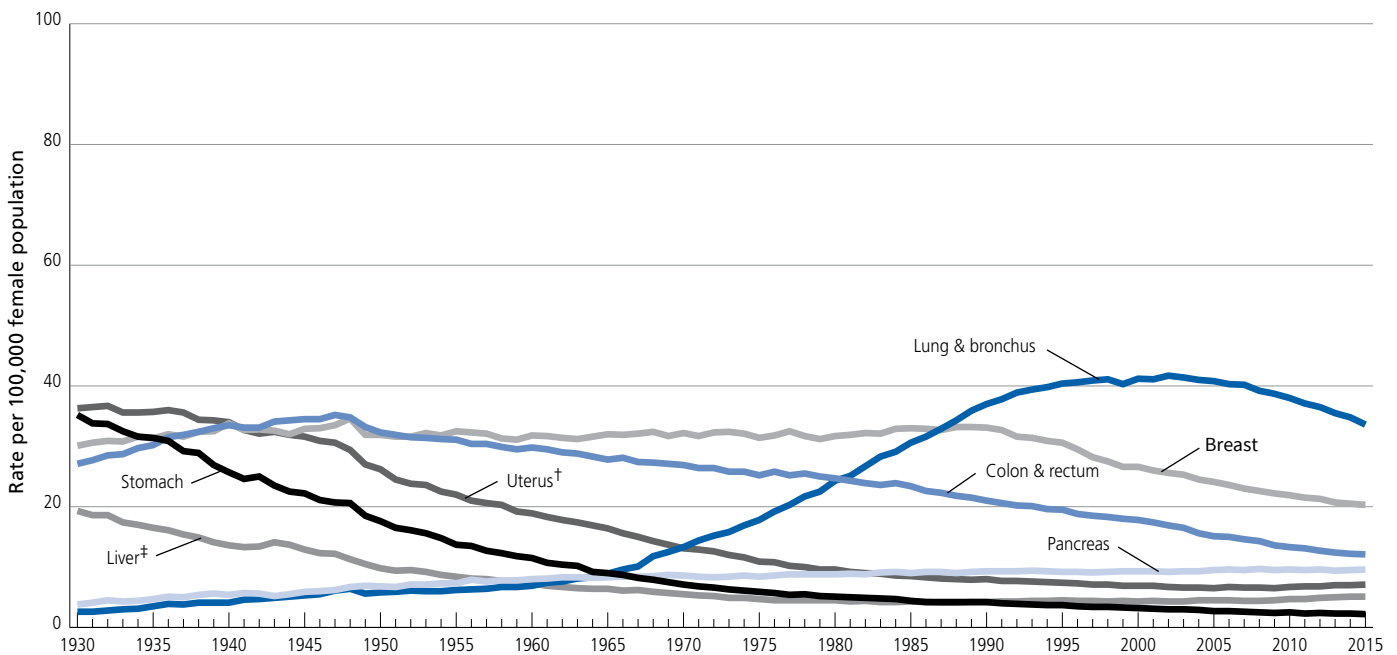
*Age adjusted to the 2000 US standard population. †Uterus refers to uterine cervix and uterine corpus combined. ‡The mortality rate for liver cancer is increasing.

Note: Due to changes in ICD coding, numerator information has changed over time. Rates for 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 2015, National Center for Health Statistics, Centers for Disease Control and Prevention.

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Table 1. Estimated Number* of New Cancer Cases and Deaths by Sex, US, 2018

	Estimated New Cases			Estimated Deaths		
	Both sexes	Male	Female	Both sexes	Male	Female
All sites	1,735,350	856,370	878,980	609,640	323,630	286,010
Oral cavity & pharynx	51,540	37,160	14,380	10,030	7,280	2,750
Tongue	17,110	12,490	4,620	2,510	1,750	760
Mouth	13,580	7,980	5,600	2,650	1,770	880
Pharynx	17,590	14,250	3,340	3,230	2,480	750
Other oral cavity	3,260	2,440	820	1,640	1,280	360
Digestive system	319,160	181,960	137,200	160,820	94,230	66,590
Esophagus	17,290	13,480	3,810	15,850	12,850	3,000
Stomach	26,240	16,520	9,720	10,800	6,510	4,290
Small intestine	10,470	5,430	5,040	1,450	810	640
Colon†	97,220	49,690	47,530	50,630	27,390	23,240
Rectum	43,030	25,920	17,110			
Anus, anal canal, & anorectum	8,580	2,960	5,620	1,160	480	680
Liver & intrahepatic bile duct	42,220	30,610	11,610	30,200	20,540	9,660
Gallbladder & other biliary	12,190	5,450	6,740	3,790	1,530	2,260
Pancreas	55,440	29,200	26,240	44,330	23,020	21,310
Other digestive organs	6,480	2,700	3,780	2,610	1,100	1,510
Respiratory system	253,290	136,400	116,890	158,770	87,200	71,570
Larynx	13,150	10,490	2,660	3,710	2,970	740
Lung & bronchus	234,030	121,680	112,350	154,050	83,550	70,500
Other respiratory organs	6,110	4,230	1,880	1,010	680	330
Bones & joints	3,450	1,940	1,510	1,590	930	660
Soft tissue (including heart)	13,040	7,370	5,670	5,150	2,770	2,380
Skin (excluding basal & squamous)	99,550	60,350	39,200	13,460	9,070	4,390
Melanoma of the skin	91,270	55,150	36,120	9,320	5,990	3,330
Other nonepithelial skin	8,280	5,200	3,080	4,140	3,080	1,060
Breast	268,670	2,550	266,120	41,400	480	40,920
Genital system	286,390	176,320	110,070	62,330	30,210	32,120
Uterine cervix	13,240		13,240	4,170		4,170
Uterine corpus	63,230		63,230	11,350		11,350
Ovary	22,240		22,240	14,070		14,070
Vulva	6,190		6,190	1,200		1,200
Vagina & other genital, female	5,170		5,170	1,330		1,330
Prostate	164,690	164,690		29,430	29,430	
Testis	9,310	9,310		400	400	
Penis & other genital, male	2,320	2,320		380	380	
Urinary system	150,350	107,600	42,750	33,170	23,110	10,060
Urinary bladder	81,190	62,380	18,810	17,240	12,520	4,720
Kidney & renal pelvis	65,340	42,680	22,660	14,970	10,010	4,960
Ureter & other urinary organs	3,820	2,540	1,280	960	580	380
Eye & orbit	3,540	2,130	1,410	350	190	160
Brain & other nervous system	23,880	13,720	10,160	16,830	9,490	7,340
Endocrine system	56,430	14,350	42,080	3,080	1,490	1,590
Thyroid	53,990	13,090	40,900	2,060	960	1,100
Other endocrine	2,440	1,260	1,180	1,020	530	490
Lymphoma	83,180	46,570	36,610	20,960	12,130	8,830
Hodgkin lymphoma	8,500	4,840	3,660	1,050	620	430
Non-Hodgkin lymphoma	74,680	41,730	32,950	19,910	11,510	8,400
Myeloma	30,770	16,400	14,370	12,770	6,830	5,940
Leukemia	60,300	35,030	25,270	24,370	14,270	10,100
Acute lymphocytic leukemia	5,960	3,290	2,670	1,470	830	640
Chronic lymphocytic leukemia	20,940	12,990	7,950	4,510	2,790	1,720
Acute myeloid leukemia	19,520	10,380	9,140	10,670	6,180	4,490
Chronic myeloid leukemia	8,430	4,980	3,450	1,090	620	470
Other leukemia‡	5,450	3,390	2,060	6,630	3,850	2,780
Other & unspecified primary sites‡	31,810	16,520	15,290	44,560	23,950	20,610

*Rounded to the nearest 10; cases exclude basal cell and squamous cell skin cancer and in situ carcinoma except urinary bladder. About 63,960 cases of carcinoma in situ of the female breast and 87,290 cases of melanoma in situ will be diagnosed in 2018. †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 2000-2014 incidence data reported by the North American Association of Central Cancer Registries (NAACCR). Estimated deaths are based on 2001-2015 US mortality data, National Center for Health Statistics, Centers for Disease Control and Prevention.

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Table 2. Estimated Number* of New Cases for Selected Cancers by State, US, 2018

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	27,830	3,760	220	2,230	770	830	4,190	1,380	990	2,460	1,110
Alaska	3,550	510	†	270	120	110	460	130	140	360	160
Arizona	34,740	5,700	270	2,840	1,210	1,150	4,460	1,880	1,480	3,180	1,810
Arkansas	16,130	2,160	150	1,370	480	510	2,720	670	650	1,260	720
California	178,130	29,360	1,540	14,400	6,610	6,220	18,760	9,830	8,190	15,190	7,800
Colorado	25,570	3,630	180	1,850	870	910	2,560	1,640	1,100	3,190	1,180
Connecticut	21,240	3,540	120	1,520	890	760	2,700	970	970	2,220	1,210
Delaware	6,110	780	†	450	210	180	890	380	250	640	290
Dist. of Columbia	3,260	520	†	240	120	70	310	120	120	420	80
Florida	135,170	19,860	1,100	11,670	4,450	4,770	18,710	7,940	5,990	13,630	6,600
Georgia	56,920	7,490	430	4,120	1,600	1,590	7,160	3,040	1,970	5,340	1,960
Hawaii	6,280	1,150	50	650	280	200	830	490	270	510	260
Idaho	8,450	1,070	50	630	290	310	1,060	590	390	900	490
Illinois	66,330	9,960	570	5,340	2,800	2,170	9,220	2,980	2,830	6,300	3,190
Indiana	37,250	5,630	290	3,190	1,400	1,210	5,840	1,900	1,600	3,460	1,740
Iowa	17,630	2,560	110	1,510	710	700	2,480	1,050	810	1,580	880
Kansas	15,400	2,290	110	1,220	530	590	2,050	850	640	1,360	660
Kentucky	25,990	3,720	210	2,370	850	960	5,150	1,440	1,060	2,210	1,200
Louisiana	25,080	3,570	210	2,310	670	740	3,660	1,000	1,040	2,600	1,000
Maine	8,600	1,350	50	660	380	320	1,450	470	400	710	580
Maryland	33,810	5,940	220	2,950	1,270	910	4,270	1,690	1,290	3,470	1,500
Massachusetts	37,130	6,490	210	2,630	1,590	1,150	5,140	2,090	1,650	4,060	2,040
Michigan	56,590	8,730	370	4,510	2,330	1,820	8,780	2,890	2,590	5,400	3,070
Minnesota	31,270	4,500	140	2,270	1,120	1,270	3,980	1,420	1,420	2,920	1,380
Mississippi	18,130	2,240	150	1,550	430	560	2,690	590	560	1,370	620
Missouri	35,520	5,160	250	2,890	1,240	1,240	5,750	1,800	1,480	3,000	1,640
Montana	6,080	1,020	†	520	220	230	830	440	280	810	350
Nebraska	10,320	1,560	70	900	380	410	1,310	540	460	960	490
Nevada	14,060	2,180	130	1,130	410	500	2,090	790	580	1,190	770
New Hampshire	8,080	1,360	†	590	360	280	1,230	460	370	840	520
New Jersey	53,260	8,550	380	4,100	2,180	1,990	5,870	2,830	2,370	5,430	2,590
New Mexico	9,730	1,470	80	800	340	360	1,090	500	410	960	390
New York	110,800	17,890	870	9,080	4,580	4,410	13,190	4,920	4,890	9,880	5,440
North Carolina	55,130	7,760	410	4,440	1,910	2,050	8,490	3,310	2,240	5,580	2,530
North Dakota	4,110	570	†	350	140	150	500	220	170	380	200
Ohio	68,470	10,610	480	5,550	2,740	2,060	10,760	3,400	2,880	5,810	3,350
Oklahoma	19,030	2,870	170	1,670	590	710	3,210	860	860	1,670	890
Oregon	21,520	3,400	140	1,510	890	650	3,140	1,570	1,010	2,040	1,130
Pennsylvania	80,960	12,140	500	6,440	3,320	2,930	10,470	4,320	3,430	7,360	4,240
Rhode Island	5,920	1,010	†	460	260	190	880	280	270	740	360
South Carolina	30,450	4,540	220	2,410	920	960	4,630	1,820	1,150	3,080	1,310
South Dakota	5,100	740	†	440	170	190	650	270	220	510	260
Tennessee	36,760	5,590	310	3,110	1,130	1,370	6,030	1,900	1,540	2,750	1,660
Texas	121,860	18,260	1,360	10,080	4,000	4,580	15,460	4,440	5,460	12,600	4,530
Utah	10,950	1,720	70	780	400	480	900	1,010	520	1,250	440
Vermont	3,840	600	†	270	160	120	560	230	170	390	250
Virginia	42,420	7,510	290	3,380	1,570	1,250	5,860	2,620	1,760	4,200	1,900
Washington	36,170	5,580	240	2,710	1,390	1,330	4,810	2,650	1,770	3,730	1,940
West Virginia	12,110	1,700	90	1,030	450	390	2,060	720	480	820	620
Wisconsin	33,340	5,420	190	2,650	1,410	1,350	4,400	1,740	1,410	3,660	1,710
Wyoming	2,780	450	†	210	100	100	330	200	120	330	160
United States	**1,735,350**	**266,120**	**13,240**	**140,250**	**63,230**	**60,300**	**234,030**	**91,270**	**74,680**	**164,690**	**81,190**

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

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

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Table 3. Estimated Number* of Deaths for Selected Cancers by State, US, 2018

State	All sites	Brain/ nervous system	Female breast	Colon & rectum	Leukemia	Liver‡	Lung & bronchus	Non-Hodgkin lymphoma	Ovary	Pancreas	Prostate
Alabama	10,720	330	670	950	400	500	3,140	300	240	740	490
Alaska	1,120	†	70	100	†	60	290	†	†	80	50
Arizona	12,390	380	850	1,040	540	680	2,850	410	310	970	680
Arkansas	6,910	190	410	600	260	290	2,130	200	150	430	280
California	60,650	1,860	4,500	5,300	2,580	3,900	11,830	2,140	1,570	4,570	3,490
Colorado	8,000	270	580	660	340	410	1,600	250	230	580	510
Connecticut	6,590	200	410	460	290	320	1,570	220	160	520	320
Delaware	2,080	50	140	140	80	110	580	70	50	160	90
Dist. of Columbia	1,030	†	110	90	†	80	200	†	†	90	70
Florida	45,030	1,290	2,940	3,640	1,820	2,150	11,760	1,510	970	3,300	2,260
Georgia	17,730	500	1,320	1,580	620	890	4,650	530	420	1,210	870
Hawaii	2,580	50	160	230	90	180	590	100	†	230	120
Idaho	3,020	100	210	240	120	140	680	110	80	240	200
Illinois	24,670	620	1,720	2,080	980	1,100	6,410	790	560	1,680	1,160
Indiana	13,820	350	860	1,110	550	550	3,960	450	290	910	600
Iowa	6,570	190	370	570	250	260	1,740	250	150	460	300
Kansas	5,600	170	350	470	260	240	1,490	180	120	420	260
Kentucky	10,590	260	580	830	380	440	3,530	320	190	660	390
Louisiana	9,370	220	610	830	330	550	2,580	290	170	730	400
Maine	3,360	100	180	230	130	120	970	110	60	230	150
Maryland	10,780	290	810	870	420	580	2,560	340	260	850	530
Massachusetts	12,610	370	750	890	520	650	3,180	380	320	960	600
Michigan	21,380	570	1,400	1,670	840	880	5,860	750	500	1,610	940
Minnesota	10,080	300	630	770	460	410	2,420	380	230	750	520
Mississippi	6,750	220	420	640	230	310	1,930	170	110	490	310
Missouri	13,280	320	850	1,050	520	580	3,950	370	250	920	550
Montana	2,110	70	140	180	80	90	510	70	50	150	130
Nebraska	3,550	110	230	320	150	130	890	130	70	250	190
Nevada	5,330	150	390	520	210	240	1,380	150	120	380	280
New Hampshire	2,810	80	170	190	110	100	760	80	70	210	130
New Jersey	16,040	430	1,250	1,400	650	720	3,670	510	400	1,300	750
New Mexico	3,750	100	260	340	140	240	760	120	110	270	220
New York	35,350	900	2,390	2,970	1,460	1,710	8,490	1,200	910	2,760	1,680
North Carolina	20,380	540	1,370	1,570	760	1,010	5,770	610	430	1,390	940
North Dakota	1,290	†	80	110	60	†	310	50	†	90	70
Ohio	25,740	640	1,700	2,100	1,000	1,040	7,200	860	550	1,860	1,110
Oklahoma	8,470	210	530	750	350	400	2,460	270	190	540	390
Oregon	8,310	260	530	650	310	480	2,000	280	240	620	450
Pennsylvania	28,620	710	1,880	2,380	1,180	1,270	7,280	970	670	2,160	1,300
Rhode Island	2,180	50	130	160	90	120	610	60	50	150	100
South Carolina	10,630	270	710	860	400	470	2,900	300	230	730	520
South Dakota	1,680	60	110	160	80	60	440	50	†	110	80
Tennessee	14,900	350	920	1,220	540	700	4,480	460	310	960	600
Texas	41,030	1,130	2,880	3,740	1,660	2,700	9,310	1,330	920	2,880	1,830
Utah	3,270	130	280	280	170	150	470	130	110	270	220
Vermont	1,450	50	80	110	50	50	390	50	†	110	60
Virginia	15,260	400	1,090	1,210	550	720	3,780	490	370	1,120	700
Washington	13,030	400	860	970	520	710	3,080	450	340	950	690
West Virginia	4,900	110	280	430	200	190	1,470	150	90	300	180
Wisconsin	11,840	360	720	890	520	450	3,000	420	230	890	620
Wyoming	980	†	70	80	60	†	220	†	†	70	†
United States	**609,640**	**16,830**	**40,920**	**50,630**	**24,370**	**30,200**	**154,050**	**19,910**	**14,070**	**44,330**	**29,430**

*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.

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

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Table 4. Incidence Rates* for Selected Cancers by State, US, 2010-2014

State	All sites Male	All sites Female	Breast Female	Colon & rectum Male	Colon & rectum Female	Lung & bronchus Male	Lung & bronchus Female	Non-Hodgkin lymphoma Male	Non-Hodgkin lymphoma Female	Prostate Male	Urinary bladder Male	Urinary bladder Female
Alabama	533.2	394.9	119.6	52.2	36.9	92.5	52.1	19.6	14.0	129.3	34.0	7.6
Alaska	447.7	411.9	125.4	46.6	40.2	67.5	53.3	20.9	13.5	91.4	33.8	9.6
Arizona	413.8	375.0	112.4	39.2	29.8	56.0	45.4	18.4	13.4	80.8	32.2	8.0
Arkansas	528.0	398.1	112.7	50.1	37.1	99.0	60.7	20.4	14.8	120.7	36.0	7.4
California	459.3	388.5	120.7	42.5	32.6	51.0	39.9	22.8	15.3	109.3	31.4	7.4
Colorado	445.4	390.2	123.7	37.9	30.8	48.3	41.6	21.1	14.5	110.9	32.7	8.1
Connecticut	526.7	458.4	139.2	44.4	34.3	69.7	56.8	25.6	17.2	118.8	46.9	12.4
Delaware	570.7	456.4	133.1	43.5	32.9	81.3	62.9	25.4	17.3	141.6	42.2	10.9
Dist. of Columbia	534.4	446.1	143.5	48.7	40.3	67.4	49.5	22.5	13.1	159.7	23.3	9.0
Florida	479.4	396.9	115.5	42.5	32.3	71.4	53.1	21.0	14.5	103.6	33.2	8.2
Georgia	534.1	410.9	123.5	48.9	35.6	84.6	52.2	21.9	14.7	129.3	33.3	7.8
Hawaii	444.1	407.4	136.0	51.3	36.5	56.9	38.1	22.1	14.6	90.1	23.7	5.7
Idaho	477.5	410.5	120.5	39.8	32.5	55.7	46.8	21.9	15.4	119.7	37.9	8.7
Illinois	520.1	437.9	130.0	52.5	38.1	79.2	57.8	23.5	16.3	119.4	37.5	9.4
Indiana	494.3	425.6	120.1	48.8	38.5	88.9	60.8	22.8	16.1	95.7	36.7	9.1
Iowa	529.6	439.5	122.8	51.7	39.8	78.3	53.0	26.9	18.1	112.2	38.4	9.0
Kansas†	521.8	430.0	123.5	47.4	36.1	73.1	52.8	24.0	16.8	124.1	38.8	9.3
Kentucky	590.8	472.7	123.3	59.3	42.4	116.3	79.7	25.2	16.7	113.0	40.2	10.1
Louisiana	576.5	420.8	123.2	56.0	41.4	90.8	54.9	23.9	16.7	144.4	33.5	7.7
Maine	517.6	454.0	125.5	42.7	34.3	83.9	65.3	22.8	18.2	99.8	47.5	12.4
Maryland	502.5	421.0	131.0	42.6	33.3	66.6	52.0	20.7	15.1	131.5	37.0	9.4
Massachusetts	504.1	449.3	136.1	42.9	33.7	70.3	60.5	23.4	16.6	114.2	40.5	11.3
Michigan	516.4	426.3	122.2	44.0	34.0	77.2	58.8	24.4	16.9	126.3	39.1	10.2
Minnesota†	510.9	434.6	130.2	43.8	34.7	61.8	50.2	27.1	18.1	119.4	38.5	9.6
Mississippi	558.7	407.4	115.5	58.2	41.8	101.4	56.3	20.9	14.3	135.5	30.9	7.4
Missouri	502.0	427.6	125.9	49.7	36.6	89.0	64.3	22.6	15.4	101.0	33.8	8.7
Montana	485.9	424.7	123.1	44.2	34.1	60.9	53.8	22.6	16.3	116.6	36.0	10.1
Nebraska	507.5	416.0	121.8	49.9	38.2	71.8	50.2	24.8	16.9	119.6	37.1	8.2
Nevada†‡	504.8	403.2	114.3	50.7	36.4	71.9	60.5	20.4	14.9	136.8	39.0	10.8
New Hampshire	527.5	463.1	140.4	40.9	34.2	71.2	63.3	25.3	17.4	123.5	48.1	12.1
New Jersey	543.0	452.9	132.0	47.9	37.8	65.6	52.5	25.5	17.9	139.4	41.5	10.6
New Mexico†§	417.1	363.8	112.6	40.2	30.5	49.1	36.3	17.6	13.2	99.4	26.1	6.0
New York	546.4	451.0	129.0	46.9	35.7	69.9	54.2	26.3	17.8	136.8	41.0	10.5
North Carolina	527.9	421.4	129.4	43.7	33.0	88.5	56.1	21.4	14.5	125.0	35.5	8.8
North Dakota	510.4	414.5	121.4	53.8	40.0	70.8	48.9	22.8	18.2	123.2	37.0	8.7
Ohio	504.6	424.4	122.9	47.9	35.8	83.7	59.0	22.9	15.3	111.8	38.6	9.2
Oklahoma	502.0	412.3	117.8	48.6	36.9	86.6	58.7	22.1	15.0	108.3	33.6	7.9
Oregon	467.9	419.2	126.0	40.8	31.2	63.1	53.4	22.4	15.8	101.1	38.0	8.9
Pennsylvania	543.9	461.3	129.8	49.9	37.5	78.3	56.1	26.0	17.9	117.5	43.9	11.1
Rhode Island	518.5	457.9	130.3	41.2	34.7	77.7	63.7	26.5	18.1	108.5	45.1	12.8
South Carolina	521.3	411.9	127.2	44.7	33.8	85.7	53.7	20.0	14.0	121.4	34.7	8.6
South Dakota	498.4	428.1	130.7	51.6	38.8	69.7	50.8	24.6	16.1	116.8	35.1	8.9
Tennessee	529.2	418.7	121.1	46.8	36.4	95.7	61.0	21.5	14.9	119.1	34.5	8.0
Texas	465.1	380.2	111.5	46.3	32.2	68.0	44.7	21.5	15.0	99.4	27.4	6.4
Utah	457.4	373.9	114.7	35.5	27.7	32.7	24.1	23.2	15.1	130.6	29.8	6.0
Vermont	493.3	437.4	130.1	39.3	33.0	71.8	59.7	26.5	17.5	98.4	38.9	10.6
Virginia	460.8	398.7	126.9	41.1	33.1	73.1	50.8	20.9	14.1	107.6	31.1	8.2
Washington	502.1	437.9	134.9	40.9	32.9	65.5	53.7	25.3	16.7	116.3	37.6	9.3
West Virginia	523.7	443.8	114.8	53.1	40.9	98.7	66.2	21.8	16.0	99.6	39.9	10.5
Wisconsin	515.8	437.3	127.9	43.6	33.6	69.5	54.8	25.5	17.3	116.0	39.9	10.0
Wyoming	447.2	382.5	113.5	41.7	30.5	49.4	44.1	19.7	13.3	108.5	36.0	9.3
United States	**501.9**	**417.9**	**123.6**	**45.9**	**34.8**	**73.0**	**52.8**	**22.9**	**15.8**	**114.9**	**35.8**	**8.8**

*Per 100,000, age adjusted to the 2000 US standard population. †This state's data are not included in US combined rates because they did not provide consent or did not meet high-quality standards for one or more years during 2010-2014 according to the North American Association of Central Cancer Registries (NAACCR). ‡Rates are based on incidence data for 2008-2010. §Rates are based on incidence data for 2010-2012.

Source: NAACCR, 2017. 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.

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Table 5. Death Rates* for Selected Cancers by State, US, 2011-2015

State	All sites Male	All sites Female	Breast Female	Colon & rectum Male	Colon & rectum Female	Lung & bronchus Male	Lung & bronchus Female	Non-Hodgkin lymphoma Male	Non-Hodgkin lymphoma Female	Pancreas Male	Pancreas Female	Prostate Male
Alabama	231.6	145.7	21.8	20.1	13.4	73.7	38.2	7.3	4.5	13.4	9.8	22.7
Alaska	196.1	146.5	19.7	17.4	13.6	53.1	40.0	7.3	4.1	11.1	10.8	18.5
Arizona	170.6	124.9	19.4	15.2	10.9	41.5	30.1	6.5	4.2	11.5	8.9	17.8
Arkansas	234.2	152.5	21.6	21.2	14.1	78.5	43.7	7.4	4.6	12.6	9.2	20.0
California	173.8	128.2	20.2	15.6	11.4	38.2	27.4	7.0	4.3	11.8	9.1	19.7
Colorado	163.7	122.2	19.0	14.3	10.7	34.0	27.3	6.5	3.8	10.7	8.4	21.4
Connecticut	178.4	130.8	18.3	13.5	10.4	43.9	32.9	7.1	4.2	12.1	9.8	17.9
Delaware	201.6	149.2	21.6	16.1	11.1	59.4	40.9	7.7	4.4	13.8	10.3	18.1
Dist. of Columbia	205.0	159.1	28.9	18.3	14.7	47.2	32.7	6.1	3.2	15.6	11.5	32.3
Florida	185.8	130.4	19.8	15.9	11.1	52.1	34.5	7.0	4.1	12.0	8.9	17.2
Georgia	209.2	138.9	22.1	19.3	12.4	62.2	34.5	7.1	4.2	12.3	9.1	22.5
Hawaii	164.9	114.9	15.9	16.7	10.3	40.0	25.1	6.7	3.8	12.8	9.9	13.7
Idaho	183.5	132.4	20.5	15.7	10.9	41.9	31.3	8.0	5.0	12.9	9.5	23.6
Illinois	205.9	148.4	22.3	18.9	13.1	57.3	38.3	7.7	4.5	12.8	9.6	20.5
Indiana	221.4	152.1	21.4	19.0	13.4	68.4	42.2	8.3	5.1	13.0	9.6	20.4
Iowa	204.1	141.6	19.2	18.2	13.6	58.0	36.0	8.7	5.1	12.7	9.3	19.5
Kansas	198.1	143.1	20.0	17.9	12.6	55.9	38.3	7.4	4.8	12.9	10.2	18.8
Kentucky	245.7	165.9	21.7	20.7	14.1	86.6	53.5	8.7	4.9	13.1	9.7	19.5
Louisiana	233.4	154.5	23.6	21.3	14.6	70.6	40.7	8.7	4.7	15.2	11.3	21.5
Maine	211.8	150.1	18.0	15.4	11.7	63.3	42.4	7.8	5.3	11.9	10.8	19.6
Maryland	193.9	141.0	22.4	17.1	11.9	50.0	35.4	7.1	4.2	13.8	10.0	20.1
Massachusetts	191.3	138.1	18.5	15.1	10.9	49.5	36.9	6.9	4.3	12.7	10.0	18.8
Michigan	205.3	149.5	21.7	17.3	12.3	58.6	40.9	8.7	5.0	13.3	10.3	19.0
Minnesota	184.7	134.3	18.6	14.7	11.3	45.8	33.6	8.4	5.0	12.4	9.0	19.9
Mississippi	249.9	156.0	23.3	23.4	15.5	80.3	40.5	7.3	4.0	15.1	11.2	25.2
Missouri	213.9	152.4	22.2	18.7	12.9	67.3	44.0	7.3	4.4	12.9	9.8	18.0
Montana	181.1	138.3	20.2	16.3	11.1	45.7	37.4	7.0	4.2	10.8	9.5	20.2
Nebraska	194.8	137.1	20.0	18.3	13.6	52.5	34.4	7.4	4.7	12.4	8.8	20.2
Nevada	188.8	143.8	22.2	19.6	13.6	51.2	40.6	6.5	3.8	12.1	8.8	20.5
New Hampshire	196.4	142.1	19.6	13.6	12.5	52.6	40.5	7.0	4.3	13.1	9.2	19.8
New Jersey	186.2	139.0	22.4	17.9	12.4	45.9	32.9	7.3	4.3	13.1	10.2	18.5
New Mexico	173.0	123.6	18.9	16.8	11.5	36.3	26.2	6.1	4.1	10.9	8.4	20.3
New York	183.5	135.9	20.2	16.4	11.8	47.5	32.9	7.2	4.3	12.9	9.9	18.7
North Carolina	210.7	140.4	21.3	17.0	11.7	65.0	37.1	7.3	4.4	12.7	9.4	20.7
North Dakota	186.9	128.7	17.5	17.0	12.0	50.6	31.3	6.7	4.7	12.3	8.7	19.4
Ohio	215.9	153.5	22.9	19.1	13.4	64.6	42.1	8.3	4.9	13.3	10.2	19.5
Oklahoma	225.3	156.5	23.0	20.9	14.1	70.0	44.6	8.2	4.8	12.3	9.7	20.5
Oregon	193.1	143.9	20.2	16.1	12.0	48.3	37.8	7.7	4.7	13.0	9.7	21.1
Pennsylvania	207.1	147.1	21.9	18.4	13.2	57.1	36.5	8.1	4.7	13.7	10.1	19.2
Rhode Island	206.8	140.6	18.5	16.2	11.9	58.8	41.2	6.6	4.5	12.9	9.1	19.2
South Carolina	218.7	143.2	22.3	18.0	12.6	65.0	36.6	7.0	4.3	13.1	9.7	22.5
South Dakota	192.3	136.5	19.9	19.3	13.0	52.8	35.6	7.3	4.0	11.6	9.1	18.7
Tennessee	230.7	152.7	22.0	19.7	13.6	75.1	43.2	8.2	4.8	12.6	9.8	19.9
Texas	190.4	131.2	20.2	17.9	11.6	49.8	30.6	7.1	4.3	11.6	8.9	18.1
Utah	148.8	110.3	20.3	13.0	9.7	23.9	15.9	6.7	4.6	11.2	8.6	20.4
Vermont	197.7	144.7	19.0	15.6	12.4	51.3	39.6	8.5	4.2	12.9	9.8	19.4
Virginia	198.0	139.7	21.8	16.7	11.8	55.4	35.4	7.3	4.4	12.9	9.5	20.2
Washington	187.9	138.3	19.9	14.8	11.0	47.5	35.3	7.9	4.7	12.3	9.5	20.1
West Virginia	233.4	163.2	22.2	21.7	15.6	75.7	45.7	7.8	5.0	12.4	9.1	17.6
Wisconsin	198.3	141.6	20.0	16.1	11.7	51.8	36.4	8.0	4.7	13.3	10.1	21.2
Wyoming	170.7	130.0	18.5	16.9	10.1	39.8	31.8	6.8	4.6	10.3	8.6	16.3
United States	**196.7**	**139.5**	**20.9**	**17.3**	**12.2**	**53.8**	**35.4**	**7.4**	**4.5**	**12.6**	**9.5**	**19.5**

*Per 100,000, age adjusted to the 2000 US standard population.
Source: US Mortality Data, National Center for Health Statistics, Centers for Disease Control and Prevention.

How Is Cancer Staged?

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

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

What Are the Costs of Cancer?

The Agency for Healthcare Research and Quality estimates that the direct medical costs (total of all health care expenditures) for cancer in the US in 2015 were $80.2 billion. Fifty-two percent of those costs were for hospital outpatient or office-based provider visits, and 38% were for inpatient hospital stays. These estimates are based on a set of large-scale surveys of individuals and their medical providers called the Medical Expenditure Panel Survey (MEPS), the most complete, nationally representative data on health care and expenditures. Visit meps.ahrq.gov/mepsweb/ for more information.
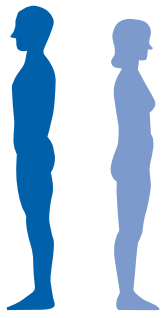
Lack of health insurance and other barriers prevents many Americans from receiving optimal cancer prevention, early detection, and treatment. According to the US Census Bureau, 28 million Americans (9%) were uninsured during the entire 2016 calendar year, down almost 14 million from 2013 because of the implementation in January 2014 of several new provisions of the Affordable Care Act. The largest increase in health insurance coverage was among those with the lowest education and income. Hispanics and blacks continue to be the most likely to be uninsured, 16% and 11%, respectively, compared to 6% of non-Hispanic whites. The percentage of uninsured ranged from 3% in Massachusetts to 17% in Texas. Uninsured patients and those from many ethnic minority groups are substantially more likely to be diagnosed with cancer at a later stage, when treatment is often more extensive, costlier, and less successful. To learn more about how the Affordable Care Act helps save lives from cancer, see Advocacy on page 66.

Selected Cancers

This section provides information on 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* on cancer.org/statistics.) Trends in cancer incidence are described based on cancer cases recorded by the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program from 1975 to 2014 that have been adjusted for delays in reporting; mortality trends are based on deaths reported by the National Center for Health Statistics from 1975 to 2015. See Sources of Statistics on page 68 for more information.

Figure 3. Leading Sites of New Cancer Cases and Deaths – 2018 Estimates

Estimated New Cases

Male				Female		
Prostate	164,690	19%		Breast	266,120	30%
Lung & bronchus	121,680	14%		Lung & bronchus	112,350	13%
Colon & rectum	75,610	9%		Colon & rectum	64,640	7%
Urinary bladder	62,380	7%		Uterine corpus	63,230	7%
Melanoma of the skin	55,150	6%		Thyroid	40,900	5%
Kidney & renal pelvis	42,680	5%		Melanoma of the skin	36,120	4%
Non-Hodgkin lymphoma	41,730	5%		Non-Hodgkin lymphoma	32,950	4%
Oral cavity & pharynx	37,160	4%		Pancreas	26,240	3%
Leukemia	35,030	4%		Leukemia	25,270	3%
Liver & intrahepatic bile duct	30,610	4%		Kidney & renal pelvis	22,660	3%
All sites	**856,370**	**100%**		**All sites**	**878,980**	**100%**

Estimated Deaths

Male				Female		
Lung & bronchus	83,550	26%		Lung & bronchus	70,500	25%
Prostate	29,430	9%		Breast	40,920	14%
Colon & rectum	27,390	8%		Colon & rectum	23,240	8%
Pancreas	23,020	7%		Pancreas	21,310	7%
Liver & intrahepatic bile duct	20,540	6%		Ovary	14,070	5%
Leukemia	14,270	4%		Uterine corpus	11,350	4%
Esophagus	12,850	4%		Leukemia	10,100	4%
Urinary bladder	12,520	4%		Liver & intrahepatic bile duct	9,660	3%
Non-Hodgkin lymphoma	11,510	4%		Non-Hodgkin lymphoma	8,400	3%
Kidney & renal pelvis	10,010	3%		Brain & other nervous system	7,340	3%
All sites	**323,630**	**100%**		**All sites**	**286,010**	**100%**

Estimates are rounded to the nearest 10, and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder. Ranking is based on modeled projections and may differ from the most recent observed data.

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Breast

New cases: In the US in 2018, there will be an estimated 266,120 new cases of invasive breast cancer diagnosed in women (Figure 3); 2,550 cases diagnosed in men; and an additional 63,960 cases of in situ breast lesions diagnosed in women (Table 1, page 4).

Incidence trends: From 2005 to 2014, the most recent 10 years for which data are available, invasive breast cancer incidence rates were stable in white women and increased slightly (by 0.3% per year) in black women.

Deaths: An estimated 41,400 breast cancer deaths (40,920 women, 480 men) will occur in 2018.

Mortality trends: The female breast cancer death rate peaked at 33.2 (per 100,000) in 1989, then declined by 39% to 20.3 in 2015. This progress, which is attributed to improvements in early detection (through screening, as well as increased awareness) and treatment, translates to an estimated 322,600 fewer breast cancer deaths than would have been expected if the death rate had remained at its peak. The annual percent decline from 2006 to 2015 was slightly larger for white women (1.8%) than for black women (1.5%).

Signs and symptoms: The most common sign is a lump or mass in the breast. Other symptoms include persistent changes to the breast, such as thickening, swelling, distortion, tenderness, skin irritation, redness, scaliness, and nipple abnormalities or spontaneous nipple discharge. Early breast cancer usually has no symptoms and is most often diagnosed through mammography screening.

Risk factors: Like most cancers, older age is the strongest risk factor for breast cancer. Many other factors that influence risk modify exposure of breast tissue to reproductive hormones. Some of these are potentially modifiable, such as weight gain after the age of 18 and/or being overweight or obese (for postmenopausal breast cancer), postmenopausal hormone use (combined estrogen and progestin), physical inactivity, and alcohol consumption; breastfeeding for at least one year

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

Two medications – tamoxifen and raloxifene – have been approved to reduce breast cancer risk in women at high risk. Raloxifene appears to have a lower risk of certain side effects, but is only approved for use in postmenopausal women. Aromatase inhibitors are another type of medication that help prevent breast cancer in women without functioning ovaries, but currently are only approved to prevent cancer recurrence.

Early detection: Mammography is a low-dose x-ray procedure used to detect breast cancer at an early stage. Early detection with mammography can allow for less extensive treatment and has been shown to reduce breast cancer mortality. However, like any screening tool, mammography is not perfect; it can miss cancer (false negative) and can also appear abnormal in the absence of cancer (false positive). About 1 in 10 women who are screened have an abnormal mammogram, and only about 5% of these women have cancer. Mammography also detects cancers and in situ lesions (e.g., ductal carcinoma in situ [DCIS]) that would never have progressed and caused harm (i.e., overdiagnoses), with estimates ranging from <5% to >30%. For women at average risk of breast cancer, recently updated American Cancer Society screening guidelines recommend that those 40 to 44 years of age have the option to begin annual mammography; those 45 to 54 should undergo annual mammography; and those 55 years of age and older may transition to biennial mammography or

continue annual mammography. Women should continue mammography as long as overall health is good and life expectancy is 10 or more years. For some women at high risk of breast cancer, annual magnetic resonance imaging (MRI) is recommended in addition to mammography, typically starting at age 30. For more information on breast cancer screening, see the American Cancer Society's screening guidelines on page 71.

Treatment: Treatment usually involves either breast-conserving surgery (surgical removal of the tumor and surrounding tissue, sometimes called a lumpectomy) or mastectomy (surgical removal of the breast), depending on tumor characteristics (e.g., size, hormone receptor status, and extent of spread) and patient preference. Radiation to the breast 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 outcomes equivalent to, and possibly even better than, mastectomy. Radiation is sometimes recommended after mastectomy in the case of larger tumors or node-involved breast cancers. One or more underarm lymph nodes are usually evaluated during surgery to determine whether the tumor has spread beyond the breast. Women undergoing mastectomy who elect breast reconstruction have several options, including the type of tissue or implant used to restore breast shape. Reconstruction may be performed at the time of mastectomy (also called immediate reconstruction) or as a second procedure (delayed reconstruction), but often requires more than one surgery.

Treatment may also involve chemotherapy (before or after surgery), hormone (anti-estrogen) therapy, and/or targeted therapy. Women with early-stage breast cancers who test positive for hormone receptors benefit from treatment with hormone therapy for 5 or more years. Several targeted therapies are available to treat the approximately 14% of women who have breast tumors that overexpress the growth-promoting protein HER2.

Survival: The 5- and 10-year relative survival rates for invasive breast cancer are 90% and 83%, respectively. Most cases (62%) are diagnosed at a localized stage (no spread to lymph nodes, nearby structures, or other locations outside

the breast), for which the 5-year survival is 99% (Table 8, page 21). Survival rates have improved over time for both white and black women, but remain about 10% lower (in absolute terms) for black women (Table 7, page 18).

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

Childhood Cancer (Ages 0-14 years)

New cases: An estimated 10,590 new cancer cases will be diagnosed among children 0 to 14 years of age in the US in 2018.

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

Deaths: An estimated 1,180 cancer deaths will occur among children in 2018. Cancer is the second-leading cause of death among children ages 1-14 years (after accidents), accounting for 13% of deaths in 2015.

Mortality trends: The childhood cancer death rate declined by more than two-thirds from 1969 (6.5 per 100,000) to 2015 (2.1 per 100,000), largely due to improvements in treatment and high rates of participation in clinical trials.

Signs and symptoms: The early diagnosis of childhood cancer is often hampered by nonspecific symptoms 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 in parentheses is among all childhood cancers, including benign and borderline malignant brain tumors and cancers not classified by the ICCC.

- Leukemia (29% 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%), which is 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%), a kidney cancer also called nephroblastoma, may appear as swelling or a lump in the abdomen.

- Non-Hodgkin lymphoma, including Burkitt lymphoma, (5%) and Hodgkin lymphoma (3%), often causes lymph nodes to swell, appearing as a lump in the neck, armpit, or groin, as well as fatigue, weight loss, and fever.

- Rhabdomyosarcoma (3%), a soft tissue sarcoma that can occur in the head and neck, genitourinary area, trunk, and extremities, may cause pain and/or a mass or swelling.

- Retinoblastoma (2%) is an eye cancer that usually occurs in children younger than 5 years of age and is typically recognized because the pupil appears white or pink instead of the normal red color in flash photographs or during an eye examination.

- 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 type of cancer usually arising in the bone in adolescents, typically appears as pain at the tumor site.

Risk factors: There are few known risk factors for childhood cancer. Exposure to ionizing radiation increases the risk of childhood leukemia and possibly other cancers. Solid organ transplant recipients are at increased risk for non-Hodgkin lymphoma, largely

because of drugs used to prevent organ rejection that suppress the immune system. Children with certain genetic syndromes, such as Down syndrome, are at increased risk for leukemia.

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

Survival: Survival for all invasive childhood cancers combined has improved markedly over the past 30 years due to new and improved treatments. The 5-year relative survival for the most recent time period (2007-2013) is 83%, although rates vary considerably depending on cancer type, patient age, and other characteristics. For example, the 5-year survival for Hodgkin lymphoma is 98%; for retinoblastoma it is 95%; Wilms tumor, 93%; non-Hodgkin lymphoma, 91%; leukemia, 86% (91% for acute lymphoid leukemia and 65% for acute myeloid leukemia); neuroblastoma, 79%; Ewing sarcoma, 78%; brain and other central nervous system tumors (excluding benign brain tumors), 73%; osteosarcoma, 70%; and rhabdomyosarcoma, 70%. Pediatric cancer survivors may experience treatment-related side effects long after active treatment, including impairment in the function of specific organs (e.g., cognitive defects) and secondary cancers. The Children's Oncology Group (COG) has developed guidelines for screening for and 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: An estimated 97,220 cases of colon cancer and 43,030 cases of rectal cancer will be diagnosed in the US in 2018.

Incidence trends: Colorectal cancer incidence overall has been declining for several decades due to changing patterns in risk factors and the uptake of screening, although this reflects the higher rates in older adults and masks trends in young age groups. During the most recent 10 years for which data are available (2005 to 2014), incidence rates declined by 3.8% annually for colon cancer and by 3.5% annually for rectal cancer among adults 55 years of age and older, but increased by 1.4% and 2.4%, respectively, among those younger than age 55.

Deaths: An estimated 50,630 deaths from colorectal cancer will occur in 2018. Unfortunately, accurate statistics on deaths from colon and rectal cancers separately are not available because many deaths from rectal cancer are misclassified as colon cancer on death certificates. The substantial misclassification is thought to largely be caused by the widespread use of the term "colon cancer" to refer to both colon and rectal cancers in educational messaging.

Mortality trends: Overall, the colorectal cancer death rate in 2015 (14 per 100,000) was half of what it was in 1975 (28 per 100,000) because of increased screening, declines in incidence, and improvements in treatment. From 2006 to 2015, the death rate declined by 2.9% per year among individuals ages 55 and older, but increased by 1% per year among adults younger than age 55.

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. Timely evaluation of persistent symptoms is essential for adults of any age. Early-stage colorectal cancer typically does not have symptoms, which is why screening is usually necessary to detect this cancer early.

Table 6. Probability (%) of Developing Invasive Cancer during Selected Age Intervals by Sex, US, 2012-2014*

		Birth to 49	50 to 59	60 to 69	70 and older	Birth to death
All sites†	Male	3.4 (1 in 30)	6.1 (1 in 16)	13.4 (1 in 7)	32.2 (1 in 3)	39.7 (1 in 3)
	Female	5.5 (1 in 18)	6.1 (1 in 16)	9.9 (1 in 10)	26.0 (1 in 4)	37.6 (1 in 3)
Breast	Female	1.9 (1 in 52)	2.3 (1 in 43)	3.4 (1 in 29)	6.8 (1 in 15)	12.4 (1 in 8)
Colon & rectum	Male	0.3 (1 in 287)	0.7 (1 in 145)	1.2 (1 in 85)	3.4 (1 in 29)	4.5 (1 in 22)
	Female	0.3 (1 in 306)	0.5 (1 in 194)	0.8 (1 in 122)	3.1 (1 in 32)	4.2 (1 in 24)
Kidney & renal pelvis	Male	0.2 (1 in 456)	0.4 (1 in 284)	0.6 (1 in 155)	1.3 (1 in 74)	2.1 (1 in 48)
	Female	0.1 (1 in 706)	0.2 (1 in 579)	0.3 (1 in 320)	0.7 (1 in 136)	1.2 (1 in 83)
Leukemia	Male	0.2 (1 in 400)	0.2 (1 in 573)	0.4 (1 in 260)	1.4 (1 in 71)	1.8 (1 in 56)
	Female	0.2 (1 in 515)	0.1 (1 in 887)	0.2 (1 in 446)	0.9 (1 in 111)	1.3 (1 in 80)
Lung & bronchus	Male	0.1 (1 in 682)	0.7 (1 in 154)	1.9 (1 in 54)	6.1 (1 in 16)	6.9 (1 in 15)
	Female	0.2 (1 in 635)	0.6 (1 in 178)	1.4 (1 in 70)	4.8 (1 in 21)	5.9 (1 in 17)
Melanoma of the skin‡	Male	0.5 (1 in 218)	0.5 (1 in 191)	0.9 (1 in 106)	2.6 (1 in 38)	3.6 (1 in 27)
	Female	0.7 (1 in 152)	0.4 (1 in 254)	0.5 (1 in 202)	1.1 (1 in 91)	2.4 (1 in 42)
Non-Hodgkin lymphoma	Male	0.3 (1 in 382)	0.3 (1 in 349)	0.6 (1 in 174)	1.8 (1 in 54)	2.4 (1 in 42)
	Female	0.2 (1 in 545)	0.2 (1 in 480)	0.4 (1 in 248)	1.3 (1 in 74)	1.9 (1 in 54)
Prostate	Male	0.2 (1 in 403)	1.7 (1 in 58)	4.8 (1 in 21)	8.2 (1 in 12)	11.6 (1 in 9)
Thyroid	Male	0.2 (1 in 517)	0.1 (1 in 791)	0.2 (1 in 606)	0.2 (1 in 425)	0.6 (1 in 160)
	Female	0.8 (1 in 124)	0.4 (1 in 271)	0.3 (1 in 289)	0.4 (1 in 256)	1.8 (1 in 56)
Uterine cervix	Female	0.3 (1 in 368)	0.1 (1 in 845)	0.1 (1 in 942)	0.2 (1 in 605)	0.6 (1 in 162)
Uterine corpus	Female	0.3 (1 in 342)	0.6 (1 in 166)	1.0 (1 in 103)	1.3 (1 in 75)	2.8 (1 in 35)

*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 6.7.5. Statistical Research and Applications Branch, National Cancer Institute, 2017. srab.cancer.gov/devcan.

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

Risk factors: Modifiable factors that increase risk include obesity, physical inactivity, long-term smoking, high consumption of red or processed meat, low calcium intake, moderate to heavy alcohol consumption, and very low intake of fruits and vegetables and whole-grain fiber. Hereditary and medical factors that increase risk include a personal or family history of colorectal cancer and/or polyps (adenomatous), certain inherited genetic conditions (e.g., Lynch syndrome and familial adenomatous polyposis), 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. Decisions about aspirin use should be discussed with a health care provider.

Early detection: Men and women who are at average risk for colorectal cancer should begin screening at the age of 50. 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. While the various recommended screening options provide a similar reduction in colorectal cancer mortality, they differ in terms of how well they detect cancer and precancerous lesions; how often they should be performed; whether bowel preparation is required; potential harms; and cost to patients. For the American Cancer Society's recommendations for colorectal cancer screening, see page 71.

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. Chemotherapy, alone for colon cancer or in combination with radiation for rectal cancer, is given before (neoadjuvant) or after (adjuvant) surgery to most patients

whose cancer has penetrated the bowel wall deeply or spread to lymph nodes. For colorectal cancer that has spread to other parts of the body (metastatic colorectal cancer), treatments typically include chemotherapy and/ or targeted therapy. Immunotherapy is a newer option for some advanced cancers.

Survival: The 5-year relative survival rate is 64% for colon cancer and 67% for rectal cancer. Only 39% of colorectal cancer patients are diagnosed with localized disease, for which 5-year survival is 90% (Table 8, page 21).

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

Kidney & Renal Pelvis

New cases: An estimated 65,340 new cases of kidney (renal) cancer will be diagnosed in the US in 2018. These are primarily renal cell carcinomas, which occur in the body of the kidney, but also include cancers of the renal pelvis (5%), which behave more like bladder cancer, and Wilms tumor (1%), a childhood cancer that usually develops before the age of 5 (see Childhood Cancer [Ages 0-14 years] on page 12). Men are twice as likely as women to be diagnosed with kidney cancer.

Incidence trends: Kidney cancer incidence rates appear to have stabilized since the mid-2000s following decades of increase, in part due to a rise in incidental detection because of the increased use of medical imaging.

Deaths: An estimated 14,970 deaths from kidney cancer will occur in 2018.

Mortality trends: The kidney cancer death rate decreased by almost 1% per year from 1995 to 2015.

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

Risk factors: Obesity and tobacco smoking are strong risk factors for kidney cancer. High blood pressure; chronic renal failure; and occupational exposure to certain chemicals, such as trichloroethylene, also

increase risk. Radiation exposure (e.g., for cancer treatment) slightly increases risk. A small proportion of renal cell cancers are the result of rare hereditary conditions (e.g., von Hippel-Lindau disease and hereditary papillary renal cell carcinoma).

Treatment: Surgery is the primary treatment for most kidney cancers, although active surveillance (observation) may be an option for some patients with small tumors. Patients who are not surgical candidates may be offered ablation therapy, a procedure that uses heat or cold to destroy the tumor. So far, adjuvant treatment has not been shown to be helpful after surgery, although several targeted therapies are being studied. For metastatic disease, targeted therapies are typically the main treatment, sometimes along with removal of the kidney. Immunotherapy may also be another option.

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

Leukemia

New cases: An estimated 60,300 new cases of leukemia will be diagnosed in the US in 2018. 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 (ALL), acute myeloid (AML), chronic myeloid (CML), and chronic lymphocytic (CLL). (CLL is included with leukemia in this report in order to describe temporal trends, but it is now classified as a type of lymphoma.) Although leukemia is often thought of as a childhood cancer, the majority (92%) of cases are diagnosed in adults 20 years of age and older. Among adults, the most common types are CLL (37%) and AML (32%), while in those 0 to 19 years, ALL is most common, accounting for 74% of cases. (See page 12 for information about childhood leukemia and other cancers.)

Incidence trends: From 2005 to 2014, the overall leukemia incidence rate increased by 1.6% per year, ranging from 0.5% per year for CLL to 3.9% per year for AML, which rose from 3.6 (per 100,000) in 2005 to 4.8 in 2014.

Deaths: An estimated 24,370 leukemia deaths will occur in 2018.

Mortality trends: Death rates from 2006 to 2015 decreased by about 1% per year for ALL and CML and by almost 3% per year for CLL, but remained stable for AML.

Signs and symptoms: Symptoms of leukemia may include fatigue, paleness, weight loss, repeated infections, fever, bleeding or bruising easily, bone or joint pain, and swelling in the lymph nodes or abdomen. These signs can appear suddenly in acute leukemia, whereas chronic leukemia typically progresses slowly with few symptoms and is often diagnosed incidentally during routine blood tests.

Risk factors: Exposure to ionizing radiation increases the risk of most types of leukemia. Medical radiation, such as that used in cancer treatment, is one of the most common sources of radiation exposure. The risk of leukemia is also increased in patients treated with chemotherapy; in children with Down syndrome and certain other genetic abnormalities; and in workers exposed to benzene (e.g., during oil refining or rubber-manufacturing) or ethylene oxide (e.g., health care workers during sterilization of medical equipment).

Some risk factors are most strongly associated with specific types of leukemia. For example, family history is a strong risk factor for CLL. Cigarette smoking is a risk factor for AML in adults, and there is accumulating evidence that parental smoking before and after childbirth may also increase AML and ALL risk in children. Exposure to certain chemicals, such as formaldehyde, increases the risk of AML. Some infections have been linked to leukemia. For example, an uncommon virus called human T-cell leukemia virus type I (HTLV-I), which is endemic in southern Japan and the Caribbean, can cause a rare type of leukemia called adult T-cell leukemia/lymphoma. Studies suggest that obesity may increase risk of some leukemia subtypes.

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

Treatment: Chemotherapy is used to treat most acute leukemias. Various anticancer drugs are used, either in combination or as single agents. Several targeted drugs are effective for treating CML because they attack cells with the Philadelphia chromosome, a genetic abnormality that is the hallmark of CML. Some of these drugs are also used to treat a type of ALL involving a similar genetic defect. People diagnosed with CLL that is not progressing or causing symptoms may not require treatment. For patients who do require treatment, promising new targeted drugs have changed how CLL is treated in recent years. Certain types of leukemia may be treated with high-dose chemotherapy, followed by stem cell transplantation under appropriate conditions. Newer experimental treatments that boost the body's immune system have recently shown much promise, even against some hard-to-treat leukemias.

Survival: Survival rates vary substantially by age and leukemia subtype, ranging from a current (2007-2013) 5-year relative survival of 24% for adult patients diagnosed with AML to 83% for those with CLL. For patients 0-19 years, 5-year survival is 64% for AML and 88% for ALL based on International Classification of Childhood Cancer groupings. Advances in treatment have resulted in a dramatic improvement in survival over the past three decades for most types of leukemia (Table 7, page 18). For example, from 1975-1977 to 2007-2013, the overall 5-year relative survival for ALL increased from 41% to 71%. In large part due to the discovery of targeted drugs, the 5-year survival rate for CML has more than doubled over the past two decades, from 31% for patients diagnosed in the early 1990s to 68% for those diagnosed from 2007 to 2013.

Liver

New cases: An estimated 42,220 new cases of liver cancer (including intrahepatic bile duct cancers) will be diagnosed in the US during 2018, approximately three-fourths of which will be hepatocellular carcinoma (HCC). Liver cancer is about 3 times more common in men than in women.

Incidence trends: Liver cancer incidence has more than tripled since 1980; from 2005 to 2014, the rate increased by about 3% per year.

Deaths: An estimated 30,200 liver cancer deaths will occur in 2018.

Mortality trends: The death rate for liver cancer has more than doubled, from 2.8 (per 100,000) in 1980 to 6.6 in 2015, with an increase of 2.5% per year from 2006 to 2015.

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

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

Prevention: A vaccine that protects against HBV has been available since 1982. There is no vaccine available to prevent HCV infection, although new combination antiviral therapies can often clear the infection and substantially reduce cancer risk among those already infected. The Centers for Disease Control and Prevention (CDC) recommends one-time HCV testing for everyone born from 1945 to 1965 (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. 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 practicing safe sex. Visit the CDC website at cdc.gov/hepatitis/ for more information on viral hepatitis.

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

Treatment: Early-stage liver cancer can sometimes be treated successfully with surgery to remove part of the liver (few patients have sufficient healthy liver tissue for this option) or liver transplantation. Other treatment options include tumor ablation (destruction) or embolization (blocking blood flow). Fewer treatment options exist for patients diagnosed at an advanced stage. Targeted therapies and chemotherapy may be options.

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

Lung and Bronchus

New cases: An estimated 234,030 new cases of lung cancer will be diagnosed in the US in 2018.

Incidence trends: The incidence rate has been declining since the mid-1980s in men, but only since the mid-2000s in women, because of gender differences in historical patterns of smoking uptake and cessation. From 2005 to 2014, lung cancer incidence rates decreased by 2.5% per year in men and 1.2% per year in women.

Deaths: An estimated 154,050 deaths from lung cancer will occur in 2018.

Mortality trends: The lung cancer death rate has declined by 45% since 1990 in men and by 19% since 2002 in women due to reductions in smoking, with the pace of decline quickening over the past decade; from 2011 to 2015, the rate decreased by 3.8% per year in men and by 2.3% per year in women.

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

Risk factors: Cigarette smoking is by far the most important risk factor for lung cancer; 80% of lung cancer deaths in the US are still caused by smoking. Risk increases with both quantity and duration of smoking. Cigar and pipe smoking also increase risk. Exposure to radon gas released from soil and building materials is thought to be the second-leading cause of lung cancer in the US. Other risk factors include occupational or

Table 7. Trends in 5-year Relative Survival Rates* (%) by Race, US, 1975-2013

	All races			White			Black		
	1975-77	1987-89	2007-13	1975-77	1987-89	2007-13	1975-77	1987-89	2007-13
All sites	49	55	69	50	57	70	39	43	63
Brain & other nervous system	23	29	35	22	28	33	25	32	42
Breast (female)	75	84	91	76	85	92	62	71	83
Colon & rectum	50	60	66	50	60	67	45	52	59
Colon	51	60	65	51	61	67	45	52	56
Rectum	48	58	69	48	59	69	44	52	66
Esophagus	5	9	21	6	11	22	4	7	12
Hodgkin lymphoma	72	79	88	72	80	89	70	72	85
Kidney & renal pelvis	50	57	75	50	57	75	49	55	76
Larynx	66	66	63	67	67	65	58	56	50
Leukemia	34	43	64	35	44	65	33	35	58
Liver & intrahepatic bile duct	3	5	19	3	6	18	2	3	14
Lung & bronchus	12	13	20	12	13	20	11	11	17
Melanoma of the skin	82	88	94	82	88	94	57†	79†	69
Myeloma	25	27	51	24	27	51	29	30	52
Non-Hodgkin lymphoma	47	51	73	47	51	74	49	46	67
Oral cavity & pharynx	53	54	68	54	56	69	36	34	49
Ovary	36	38	47	35	38	46	41	34	39
Pancreas	3	4	9	3	3	9	2	6	8
Prostate	68	83	99	69	84	>99	61	71	97
Stomach	15	20	31	14	18	30	16	19	31
Testis	83	95	97	83	96	97	73†‡	88†	92
Thyroid	92	94	98	92	94	98	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	85	60	57	65

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 9 areas from 1975 to 77, 1987 to 89, and 2007 to 2013, all followed through 2014. †The standard error is between 5 and 10 percentage points. ‡Survival rate is for cases diagnosed from 1978 to 1980.

NOTE: This table provides historical trends based on the 9 oldest SEER registries. Contemporary survival rates presented throughout this report and in Table 8 (page 21) may differ because they are based on more complete population coverage.

Source: Howlader N, Noone AM, Krapcho M, et al. (eds). *SEER Cancer Statistics Review, 1975-2014*, National Cancer Institute, Bethesda, MD, www.seer.cancer.gov/csr/1975_2014/, based on November 2016 SEER data submission, posted to the SEER website April 2017.

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environmental exposure to secondhand smoke, asbestos (particularly among smokers), certain metals (chromium, cadmium, arsenic), some organic chemicals, radiation, air pollution, and diesel exhaust. Some specific occupational exposures that increase risk include rubber manufacturing, paving, roofing, painting, and chimney sweeping. Risk is also probably increased among people with a history of tuberculosis. Genetic susceptibility (e.g., family history) plays a role in the development of lung cancer, especially in those who develop the disease at a young age.

Early detection: Screening with low-dose spiral computed tomography (LDCT) has been shown to reduce lung cancer mortality by about 20% compared to standard chest x-ray among current or former (quit within 15 years) heavy smokers 55 to 74 years of age with at least a

30 pack-year smoking history. The American Cancer Society guidelines for the early detection of lung cancer recommend shared decision making between clinicians who have access to high-volume, high-quality lung cancer screening programs and current or former heavy smokers who are in good health. The decision-making discussion should include a description of the benefits, uncertainties, and harms associated with lung cancer screening, which should occur annually. Lung cancer screening prevalence remains low (at 4% in 2015). For more information on lung cancer screening, see the American Cancer Society's screening guidelines on page 71.

Treatment: Appropriate treatment for lung cancer is based on whether the tumor is small cell (13%) or non-small cell (84%), as well as the stage and molecular

characteristics of the cancer. For early-stage non-small cell lung cancers, 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, targeted drugs (or a combination of the two), or immunotherapy. Small cell lung cancer is usually treated with chemotherapy, alone or combined with radiation; a large percentage of patients on this regimen experience remission, although the cancer often returns.

Survival: The 5-year relative survival rate for lung cancer is 18% (15% for men and 21% for women). Only 16% of lung cancers are diagnosed at a localized stage, for which the 5-year survival rate is 56% (Table 8, page 21).

Lymphoma

New cases: An estimated 83,180 new cases of lymphoma will be diagnosed in the US in 2018. This cancer begins in certain immune system cells, such as those in lymph nodes, and can occur almost anywhere in the body. Lymphomas are broadly classified as either Hodgkin lymphoma (8,500 cases) or non-Hodgkin lymphoma (NHL, 74,680 cases). Hodgkin lymphoma and NHL are further classified into subtypes based on the type of cell in which the cancer starts, as well as many other characteristics, with the most common being classical Hodgkin lymphoma and diffuse large B-cell lymphoma, respectively. (Statistics for NHL herein are based on historical classification for the purposes of describing trends and thus do not include chronic lymphocytic leukemia or multiple myeloma.)

Incidence trends: Overall, incidence rates for both Hodgkin lymphoma and NHL were stable from 2005 to 2014, although patterns vary by subtype. (See onlinelibrary.wiley.com/doi/10.3322/caac.21357/abstract for trends by subtype.)

Deaths: In 2018, there will be an estimated 1,050 deaths from Hodgkin lymphoma and 19,910 deaths from NHL.

Mortality trends: Due to improvements in treatment, the death rate has been declining since at least 1975 for Hodgkin lymphoma and since the mid-1990s for NHL. For NHL, reductions in incidence and improvements in survival for human immunodeficiency virus (HIV)-associated subtypes has also contributed to the mortality decline. From 2006 to 2015, death rates decreased by about 3% per year for Hodgkin lymphoma and 2% per year for NHL.

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

Risk factors: As with most cancers, the risk of NHL increases with age. In contrast, the risk of Hodgkin lymphoma increases during adolescence and early adulthood, decreases during middle age, and then increases again later in life. Most of the known risk factors are associated with severely altered immune function. For example, risk is elevated in people who receive immune suppressants to prevent organ transplant rejection. Certain infectious agents (e.g., Epstein Barr virus) increase the risk of lymphoma 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. Some autoimmune disorders (e.g., Sjogren syndrome, lupus, and rheumatoid arthritis) are also associated with increased risk for lymphoma. A family history of lymphoma increases risk for all Hodgkin lymphoma and NHL subtypes. Studies also suggest a role for certain behavioral risk factors (e.g., body weight) and environmental exposures for some subtypes.

Treatment: NHL patients are usually treated with chemotherapy; radiation, alone or in combination with chemotherapy, is also sometimes used. Targeted or immunotherapy drugs directed at lymphoma cells are used for some NHL subtypes. If NHL persists or recurs after standard treatment, stem cell transplantation may be an option. New experimental therapies that boost the body's immune system have shown promising results for some hard-to-treat lymphomas.

Hodgkin lymphoma is usually treated with chemotherapy, radiation therapy, or a combination of the two, depending on disease stage and cell type. If these treatments are 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 86% for Hodgkin lymphoma and 71% for NHL.

Oral Cavity and Pharynx

New cases: An estimated 51,540 new cases of cancer of the oral cavity and pharynx (throat) will be diagnosed in the US in 2018. Incidence rates are more than twice as high in men as in women.

Incidence trends: From 2005 to 2014, incidence rates decreased by more than 2% per year among blacks, but increased by about 1% per year among whites, 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).

Deaths: An estimated 10,030 deaths from cancers of the oral cavity and pharynx will occur in 2018.

Mortality trends: The long-term decline in death rates for cancers of the oral cavity and pharynx has stalled in recent years, with rates stable from 2006 to 2015.

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

Risk factors: Known risk factors include any form of tobacco use and excessive 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 some HPV-associated oral cancers as well. Unfortunately, immunization rates are much lower than for other disease-preventing vaccines, with only 38% of boys and 50% of girls ages 13-17 years up to date with the HPV vaccination series in 2016.

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

Survival: The 5-year relative survival rate for cancers of the oral cavity and pharynx combined is 65%, but is much lower in blacks (48%) than in whites (66%). Studies indicate that survival is better for patients with cancer who test positive for HPV. Less than one-third (30%) of cases are diagnosed at a local stage, for which 5-year survival is 84%.

Ovary

Please see the Special Section on page 28.

Pancreas

New cases: An estimated 55,440 new cases of pancreatic cancer will be diagnosed in the US in 2018. Most (94%) will develop in the exocrine tissue of the pancreas, which makes up the majority of the pancreas and produces enzymes to digest food. Endocrine tumors (6%), commonly referred to as pancreatic neuroendocrine tumors, develop in hormone-producing cells and have a younger median age at diagnosis and better prognosis.

Incidence trends: From 2005 to 2014, pancreatic cancer incidence rates increased by about 1% per year in whites, but were stable in blacks, although rates remain about 25% higher in blacks than in whites.

Table 8. Five-year Relative Survival Rates* (%) by Stage at Diagnosis, US, 2007-2013

	All stages	Local	Regional	Distant		All stages	Local	Regional	Distant
Breast (female)	90	99	85	27	Oral cavity & pharynx	65	84	64	39
Colon & rectum	65	90	71	14	Ovary	47	93	73	29
Colon	64	91	72	14	Pancreas	8	32	12	3
Rectum	67	88	70	15	Prostate	99	>99	>99	30
Esophagus	19	43	23	5	Stomach	31	67	31	5
Kidney†	74	93	67	12	Testis	95	99	96	73
Larynx	61	77	45	34	Thyroid	98	>99	98	56
Liver‡	18	31	11	3	Urinary bladder§	77	70	35	5
Lung & bronchus	18	56	29	5	Uterine cervix	67	92	57	17
Melanoma of the skin	92	99	63	20	Uterine corpus	81	95	69	16

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 18 areas from 2007-2013, all followed through 2014. †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: Howlader N, Noone AM, Krapcho M, et al. (eds). SEER Cancer Statistics Review, 1975-2014, National Cancer Institute, Bethesda, MD, http://seer.cancer.gov/csr/1975_2014/, based on November 2016 SEER data submission, posted to the SEER website April 2017.

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Deaths: An estimated 44,330 deaths from pancreatic cancer will occur in 2018.

Mortality trends: From 2006 to 2015, the death rate for pancreatic cancer increased slightly in whites (by 0.2% per year), but decreased in blacks by 0.5% per year.

Signs and symptoms: Symptoms for pancreatic cancer, which usually do not appear until the disease has progressed, include weight loss, abdominal discomfort that may radiate to the back, and occasionally the development of diabetes. Tumors 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.

Risk factors: The risk of pancreatic cancer in cigarette smokers is about twice that in never smokers. Use of smokeless tobacco also increases risk. Other risk factors include a family history of pancreatic cancer, a personal history of chronic pancreatitis or diabetes, and obesity. 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.

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

Survival: For all stages combined, the 5-year relative survival rate is 8%. Even for the small percentage of people diagnosed with local disease (10%), the 5-year survival is only 32%. About half (52%) of patients are diagnosed at a distant stage, for which 5-year survival is 3%.

Prostate

New cases: An estimated 164,690 new cases of prostate cancer will be diagnosed in the US during 2018. The risk of prostate cancer is 74% higher in blacks than in whites for reasons that remain unclear.

Incidence trends: In the late 1980s and early 1990s, incidence rates for prostate cancer spiked dramatically, in large part because of widespread screening with the prostate-specific antigen (PSA) blood test. The decline in

rates since around 2000 has accelerated in recent years, likely due to recommendations against routine PSA screening beginning in 2008. From 2010 to 2014, the rate decreased by about 10% per year.

Deaths: An estimated 29,430 deaths from prostate cancer will occur in 2018.

Mortality trends: Prostate cancer death rates have been decreasing since the early 1990s, although rates appear to have stabilized from 2013 to 2015.

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

Risk factors: The only well-established risk factors for prostate cancer are increasing age, African ancestry, a family history of the disease, and certain inherited genetic conditions. Black men in the US and Caribbean have the highest documented prostate cancer incidence rates in the world. Genetic studies suggest that strong familial predisposition may be responsible for 5%-10% of prostate cancers. Inherited conditions associated with increased risk include Lynch syndrome and *BRCA1* and *BRCA2* mutations. Smoking may increase the risk of fatal prostate cancer.

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

Treatment: Treatment decisions should be based on clinician recommendations and patient values and preferences. 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 or have less aggressive tumors or are older. Treatment options include surgery, external beam radiation, or radioactive seed implants (brachytherapy). Hormonal therapy may be used along with surgery or radiation in more advanced cases. Treatment often impacts a man's quality of life due to side effects or complications, such as urinary and erectile difficulties, which may be temporary or long term. Current research is exploring new biologic markers for prostate cancer to minimize unnecessary treatment by improving the distinction between indolent and aggressive disease.

Prostate cancer that has spread to distant sites is treated with hormonal therapy, chemotherapy, radiation therapy, and/or other treatments. Hormone treatment may control advanced prostate cancer for long periods of time by shrinking the size or limiting the growth of the cancer, thus helping to relieve pain and other symptoms. Chemotherapy may be given along with hormone therapy, or it may be used if hormone treatments are no longer effective. 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. Newer forms of hormone therapy have been shown to be beneficial for treating advanced disease. Other types of drugs can be used to treat prostate cancer that has spread to the bones.

Survival: The majority (91%) 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 30%. The 10-year survival rate for all stages combined is 98%.

Skin

New cases: Skin cancer is the most commonly diagnosed cancer in the US. However, the actual number of the most common types – basal cell and squamous cell (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. An estimated 91,270 new cases of melanoma will be diagnosed in the US in 2018. It is most commonly diagnosed in non-Hispanic whites, with an annual incidence rate of 26 (per 100,000), compared to 4 in Hispanics and 1 in blacks. Overall, incidence rates are higher in women than in men before age 50, but by age 65, rates in men are double those in women, and by age 80 they are triple. This pattern reflects age and sex differences in occupational and recreational exposure to ultraviolet radiation (including the use of indoor tanning), and perhaps early detection practices and use of health care.

Incidence trends: The incidence of melanoma of the skin has risen rapidly over the past 30 years, although current trends differ by age. From 2005 to 2014, the rate increased by 3% per year among men and women ages 50 and older, but had stabilized among those younger than age 50.

Deaths: In 2018, an estimated 9,320 deaths from melanoma will occur.

Mortality trends: From 2006 to 2015, the death rate for melanoma declined by 1% per year in adults 50 years of age and older and by 2.6% per year in those younger than 50.

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

Risk factors: For melanoma, major risk factors include a personal or family history of melanoma and the presence of atypical, large, or numerous (more than 50) moles. Heavy exposure to ultraviolet (UV) radiation, from sunlight or use of indoor tanning, is a risk factor for all types of skin cancer. Indoor tanning devices are classified as "carcinogenic to humans" by the International Agency for Research on Cancer based on an extensive review of scientific evidence. 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. Additional risk factors for KC include a weakened immune system and past exposure to radiation (e.g., for cancer treatment) or arsenic.

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

Early detection: The best way to detect skin cancer early is to be aware of new or changing skin growths, particularly those that look unusual. Any new lesions, or a progressive change in a lesion's appearance (size, shape, or color, etc.), should be evaluated promptly by a physician. The ABCDE rule outlines warning signs of the most common type of melanoma: A is for asymmetry (one half of the mole does not match the other half); B is for border irregularity (the edges are ragged, notched, or blurred); C is for color (the pigmentation is not uniform, with variable degrees of tan, brown, or black); D is for diameter greater than 6 millimeters (about the size of a pencil eraser); and E is for evolution, meaning a change in the mole's appearance over time. Not all melanomas have these signs, so be alert for any new or changing skin growths or spots.

Treatment: Most early skin cancers are diagnosed and treated by removal and microscopic examination of the cells. Most cases of KC are cured by removing the lesion through minor surgery or other techniques (e.g., destruction by freezing). Radiation therapy and certain topical medications may be used. For melanoma, the primary growth and surrounding normal tissue are removed and sometimes a sentinel lymph node is biopsied to determine stage. More extensive lymph node surgery may be needed if the sentinel lymph nodes contain cancer. Melanomas with deep invasion or that have spread to lymph nodes may be treated with surgery, immunotherapy, chemotherapy, and/or radiation therapy. The treatment of advanced melanoma has changed greatly in recent years with FDA approval of several new immunotherapy and targeted drugs. 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 is 99% for localized stage, 63% for regional stage, and 20% for distant-stage disease.

Thyroid

New cases: An estimated 53,990 new cases of thyroid cancer will be diagnosed in the US in 2018, with 3 out of 4 cases occurring in women.

Incidence trends: Thyroid cancer is the most rapidly increasing cancer in the US, largely due to increased detection (probably including some overdiagnosis) because of more sensitive diagnostic procedures. From 2005 to 2014, the incidence rate rose by about 4% per year in both men and women, although the pace of increase appears to be slowing in recent years, likely because of more conservative diagnostic criteria.

Deaths: An estimated 2,060 deaths from thyroid cancer will occur in 2018.

Mortality trends: The death rate for thyroid cancer has increased slightly over the past 10 data years, from 0.49 (per 100,000) in 2006 to 0.51 in 2015.

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

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

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 body from making 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%. However, survival varies by stage (Table 8, page 21), age at diagnosis, and disease subtype.

Urinary Bladder

New cases: An estimated 81,190 new cases of bladder cancer will be diagnosed in the US in 2018. Bladder cancer incidence is about 4 times higher in men than in women and almost 2 times higher in white men than in black men.

Incidence trends: After decades of slowly increasing, bladder cancer incidence rates declined from 2005 to 2014 by 0.8% per year in both men and women.

Deaths: An estimated 17,240 deaths from bladder cancer will occur in 2018.

Mortality trends: The death rate for urinary bladder cancer from 2006 to 2015 was stable in men and decreased by 0.4% per year in women.

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

Risk factors: Smoking is the most well-established risk factor for bladder cancer, accounting for about half of all cases 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.

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.

Treatment: Surgery, alone or in combination with other treatments, is used in more than 90% of cases. Early-stage cancers may be treated by removing the tumor and then administering immunotherapy or chemotherapy drugs directly into the bladder. More advanced cancers may require removal of the entire bladder (cystectomy). Patient outcomes are improved with the use of chemotherapy, alone or with radiation, before cystectomy. Timely follow-up care is extremely important because of the high rate of bladder cancer recurrence. Distant-stage cancers are typically treated with chemotherapy, sometimes along with radiation. Immunotherapy is a newer option if chemotherapy cannot be used or is no longer working.

Survival: Half (51%) of all bladder cancers are diagnosed before the tumor has spread beyond the layer of cells in which it developed (in situ), for which the 5-year relative survival rate is 96%. For disease diagnosed at a localized, regional, or distant stage, 5-year survival declines to 70%, 35%, and 5%, respectively.

Uterine Cervix

New cases: An estimated 13,240 cases of invasive cervical cancer will be diagnosed in the US in 2018.

Incidence trends: Cervical cancer incidence rates declined by half between 1975 (14.8 per 100,000) and 2014 (6.9 per 100,000) due to the widespread uptake of screening,

primarily with the Pap test (described below), but declines have slowed in recent years. Overall incidence from 2005 to 2014 was stable.

Deaths: An estimated 4,170 deaths from cervical cancer will occur in 2018.

Mortality trends: The cervical cancer death rate in 2015 (2.3 per 100,000) was less than half that in 1975 (5.6 per 100,000) due to declines in incidence and the early detection of cancer through screening, but like incidence, the pace of the reduction has slowed. From 2006 to 2015, the death rate decreased by 0.8% per year.

Signs and symptoms: Pre-invasive 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.

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 of cervical cancer, also likely indirectly; risk gradually declines after stopping use.

Prevention: Vaccines that protect against the types of HPV that cause 90% of cervical cancers, as well as several other diseases and cancers, are recommended to be given at ages 11 to 12 years and available for use in ages 9 to 26. In October 2016, the CDC reduced the recommended number of vaccine doses from three to two for ages 9 to 14, while ages 15 to 26 still require a 3-dose series for full protection. Unfortunately, the immunization rate remains low in the US; in 2016, 50% of girls 13-17 years – and only 36% at age 13 – were up to date with the HPV vaccination series.

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

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

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

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

Survival: The 5-year relative survival rate for cervical cancer is 69% for white women and 56% for black women. Five-year survival is 92% for the 46% of patients diagnosed when the cancer is localized, but falls to 57% and 17% for women diagnosed with regional and distant-stage disease, respectively (Table 8, page 21).

Uterine Corpus (Endometrium)

New cases: An estimated 63,230 cases of cancer of the uterine corpus (body of the uterus) will be diagnosed in the US in 2018. Cancer of the uterine corpus is often referred to as endometrial cancer because most cases (92%) occur in the endometrium (lining of the uterus).

Incidence trends: From 2005 to 2014, the incidence rate increased by 1% per year among white women and by 2.5% per year among black women.

Deaths: An estimated 11,350 deaths from uterine corpus cancer will occur in 2018.

Mortality trends: From 2006 to 2015, the death rate for cancer of the uterine corpus increased by 1.5% per year among white women and 2.1% per year among black women.

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 can also be a symptom.

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

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

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

Survival: The 5-year relative survival rate for uterine cancer is 84% for white women and 62% for black women, partly because white women are more likely than black women to be diagnosed with early-stage disease (69% versus 53%); however, survival is substantially lower for black women for every stage of diagnosis.

Special Section: Ovarian Cancer

Introduction

In 2018, there will be approximately 22,240 new cases of ovarian cancer diagnosed and 14,070 ovarian cancer deaths in the US. Ovarian cancer accounts for just 2.5% of all female cancer cases, but 5% of cancer deaths because of the disease's low survival. This is largely because 4 out of 5 ovarian cancer patients are diagnosed with advanced disease that has spread throughout the abdominal cavity. Improving the ability to detect ovarian cancer early is a research priority, given that women diagnosed with localized-stage disease have more than a 90% five-year survival rate. Although advancing knowledge about ovarian cancer has been hindered by substantial disease heterogeneity and uncertainties about tumor tissues of origin, understanding of the disease has evolved rapidly in recent years, especially for epithelial tumors, the most common subtype. This special section provides information about ovarian cancer risk factors, incidence and mortality rates and trends, early detection, and treatment that is primarily related to epithelial tumors.

Figure S1. Female Reproductive Anatomy

What is ovarian cancer?

The ovaries are a pair of reproductive glands, each about the size of a grape, located on either side of the uterus (Figure S1). They produce eggs that travel through the fallopian tubes into the uterus, where they are fertilized for reproduction. In premenopausal women, the ovaries

are the primary source of the hormones estrogen and progesterone, which maintain the health of the female reproductive system.

The three major types of ovarian cancer are epithelial, accounting for 90% of cases, germ cell (3%), and sex cord-stromal (2%) (Figure S2).[1] Epithelial cancers are further subdivided into serous (52%), endometrioid (10%), mucinous (6%), and clear cell (6%) tumors.[1] (See sidebar on opposite page for more information about non-epithelial cancers.) The process of epithelial ovarian tumor development has long perplexed researchers. As biological understanding has evolved, epithelial subtypes are increasingly characterized as distinct diseases with different molecular pathways, risk factors, and treatment.[2-5] Serous tumors are mostly high-grade serous carcinomas, which are characterized by involvement of both ovaries, aggressive behavior, late-stage diagnosis, and low survival.[2] Accumulating evidence suggests that these tumors actually originate in the epithelial cells of the fallopian tube as microscopic preliminary lesions that subsequently migrate to the ovaries and/or

Borderline malignant ovarian cancer

Borderline malignant tumors, which most often affect younger women, are epithelial tumors with behavior characteristics in between benign and malignant tumors. They are also called tumors of low malignant potential because they do not usually grow into the stroma (the supportive tissue around the ovary), with 5-year survival rates greater than 98%.[8] Although they are not included in ovarian cancer statistics because they are considered noninvasive, understanding and classification of these tumors continues to evolve.[8, 9]

Figure S2. Distribution (%) of Major Types of Ovarian Cancer* by Race/Ethnicity, 2010-2014

● Epithelial ● Germ cell ● Sex cord-stromal ● Other or unspecified

Race/Ethnicity	Epithelial	Germ cell	Sex cord-stromal	Other or unspecified
All races	90	3	2	5
Non-Hispanic white	91	2	2	5
Non-Hispanic black	82	5	6	7
Asian/Pacific Islander	90	5	2	4
Hispanic	84	7	3	6

Percent (0 – 100)
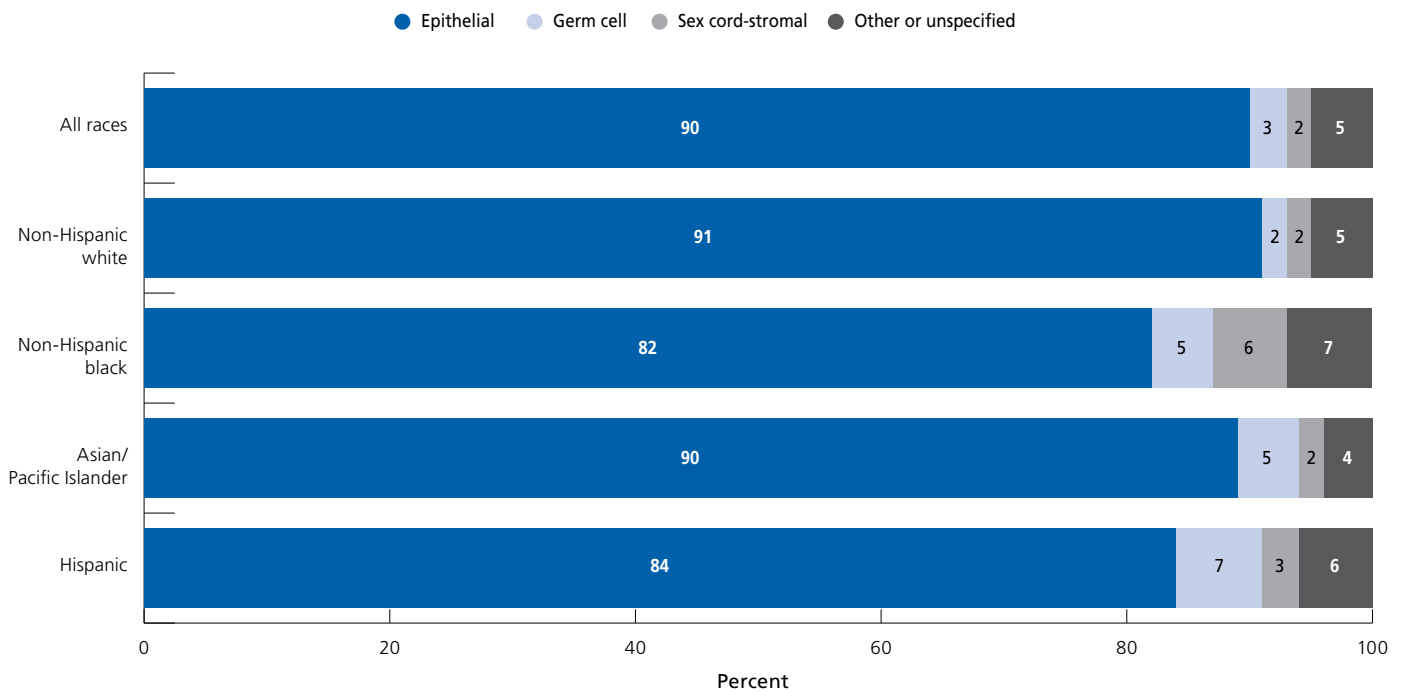
*Data are based on microscopically confirmed cases. Persons of Hispanic origin may be of any race; Asians/Pacific Islanders include those of Hispanic and non-Hispanic origin. American Indians and Alaska Natives are not shown due to <25 cases reported for certain subtypes.

Source: North American Association of Central Cancer Registries (NAACCR), 2017. 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.

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peritoneum (the lining of the pelvis and abdominal cavity), where they are diagnosed.[2, 6, 7] In addition to their common origins, tumors of the fallopian tube and peritoneum are very similar to epithelial ovarian cancer in appearance and behavior, and are now often studied jointly. In contrast, endometrioid and clear cell tumors are thought to originate in the endometrium (lining of the uterus), while mucinous tumors may originate in the ovaries or fallopian tube-peritoneal junction; these subtypes typically affect only one ovary.[2]

Non-epithelial ovarian cancer

The two main types of non-epithelial ovarian cancer, germ cell tumors and sex cord-stromal tumors, collectively account for only about 5% of ovarian cancer (Figure S2). Germ cell tumors arise from the germ (egg) cells of the ovary and primarily occur in adolescents and young women. Sex cord-stromal tumors form in the supportive tissue of the ovaries and can arise from different cells, including granulosa, Sertoli, and Leydig cells. Sex cord-stromal tumors generally occur most often in women in their 50s, although certain types are more common in adolescents and young women.[1, 10] Due to their rarity, risk factors for non-epithelial tumors are poorly understood, but may include hormone exposure[11-13] and genetic mutations.[14-16]

Germ cell tumors are not easy to detect early, but symptoms include abdominal swelling and irregular vaginal bleeding.[17] Sex cord-stromal tumors often produce sex hormones, which may affect menstruation and/or cause male physical characteristics, such as a deep voice or body hair.[10] Treatment for both germ cell and sex cord-stromal tumors typically includes surgery, alone or in combination with chemotherapy and/or radiation.[10, 17, 18]

How does ovarian cancer occurrence vary?

The average lifetime risk of developing ovarian cancer is 1.3% (Table S1). Older women and non-Hispanic white (NHW) women have the highest risk, although the racial variation for ovarian cancer is smaller than for many other cancers. Similarly, rates vary only slightly among states due, in part, to the lack of advances in early detection, which often exacerbate disparities. Some of the variation in ovarian cancer risk is explained by differences in the prevalence of reproductive risk factors, such as number of childbirths, use of oral contraceptives, and tubal ligation, but the source of most of the variation remains unknown.[19]

Race/Ethnicity

During 2010-2014, overall ovarian cancer incidence rates in NHW women (12.0 per 100,000 women) were 30% higher than those in non-Hispanic black (hereafter black; 9.4) and Asian American/Pacific Islander (API) women (9.2), who have the lowest rates (Figure S3). Despite this, black women have the second-highest mortality rates, likely due in part to later stage at diagnosis, a lower likelihood of receiving optimal treatment, and more comorbidities.[20, 21] The distribution of ovarian cancer subtypes varies by race/ethnicity (Figure S2, page 29), although serous epithelial tumors are most common for all women.

Age

The median age of diagnosis for ovarian cancer is 63 years, meaning that half of women are age 63 or younger at diagnosis. The age distribution of ovarian cancer varies by tumor type and race/ethnicity. For all women combined, incidence peaks in the late 70s for epithelial tumors, in the 50s for sex cord-stromal tumors, and in ages 15-19 years for germ cell tumors.[1] Incidence of epithelial tumors is highest in NHW and API women until ages 50-54 years; however, from age 70, rates in NHWs are double those in APIs (Figure S4). In contrast, incidence of sex cord-stromal tumors is highest in black women from around age 30.[1]

Figure S3. Ovarian Cancer Incidence and Mortality Rates* by Race and Ethnicity[†], US, 2010-2014
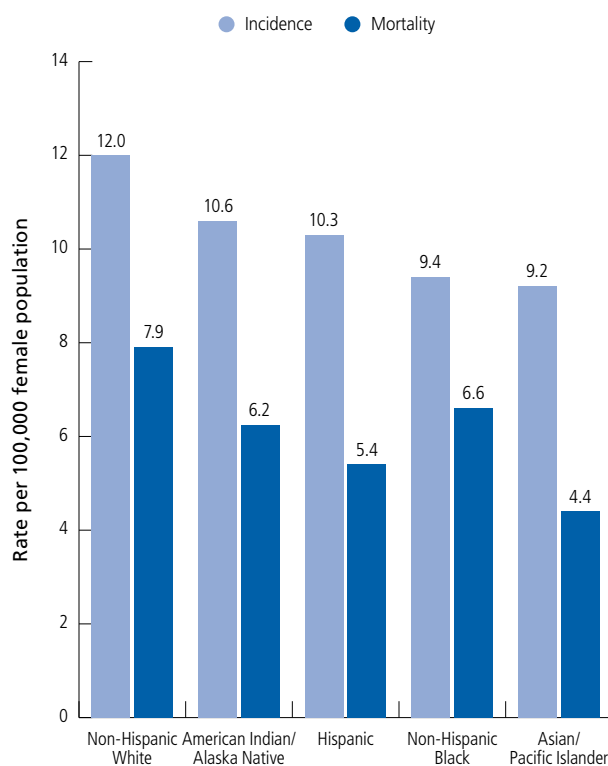
*Age adjusted to the 2000 US standard population. †Persons of Hispanic origin may be of any race; American Indians/Alaska Natives and Asians/Pacific Islanders include those of Hispanic and non-Hispanic origin.

Sources: Incidence: NAACCR, 2017. Mortality: US mortality data, National Center for Health Statistics, Centers for Disease Control and Prevention, 2017. Data for American Indians/Alaska Natives are based on Contract Health Service Delivery Area (CHSDA) counties.

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Figure S4. Epithelial Ovarian Cancer Incidence Rates* by Age and Race, US, 2010-2014
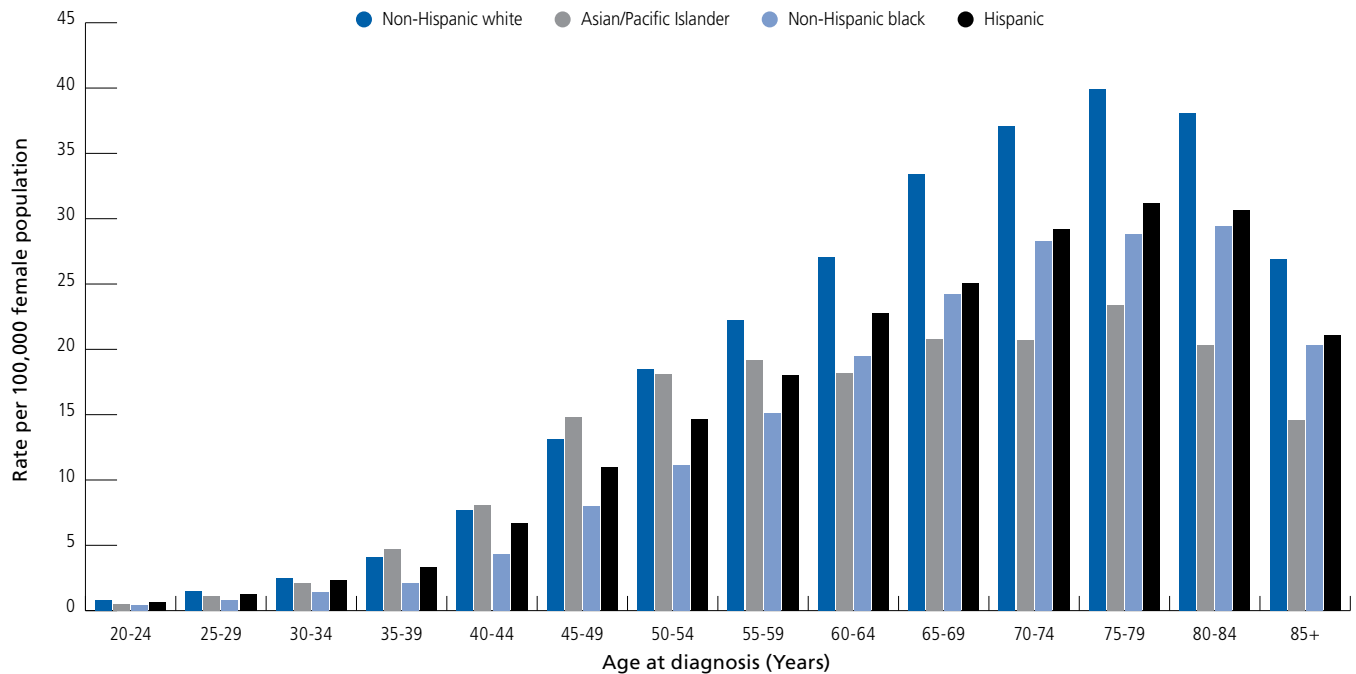
*Age adjusted to the 2000 US standard population. Persons of Hispanic origin may be of any race; Asians/Pacific Islanders include those of Hispanic and non-Hispanic origin. American Indians and Alaska Natives are not shown due to <25 cases reported for several age groups.

Source: NAACCR, 2017.

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How has the occurrence of ovarian cancer changed over time?

Incidence trends

Overall ovarian cancer incidence rates have been decreasing since the mid-1980s, with the pace of the decline accelerating in the early 2000s.[22] However, trends differ by age and race/ethnicity. From 2005 to 2014, incidence rates declined by 1.4% per year in NHWs, but were stable in blacks, Hispanics, American Indians and Alaska Natives (AIANs), and APIs, although rates appear to be decreasing modestly in the most recent years for Hispanics, blacks, and APIs. [23] Among women of all races ages 65 years and older, incidence rates increased from the late 1970s through the 1980s before beginning to decline around 1990, whereas rates among younger women have generally declined since at least 1975.[24] The increase among older women prior to 1990 may be related to the decreasing birth rate in the US during the early- to mid-20th century. Subsequent declines in this age group, particularly among NHWs, may be partly due to decreased use of menopausal hormones, which

increases risk, following publication of a landmark report in 2002 linking them to elevated breast cancer risk.[25] Use of oral contraceptives, which confers a substantial risk reduction, has also likely contributed to declines in incidence, especially among younger women.[26]

Mortality trends

Mortality trends closely mirror those of incidence because of the low survival rate for ovarian cancer. Similar to incidence, mortality rates have decreased in women younger than 65 years since at least 1975, but only since the mid-2000s in women 65 years and older (Figure S5, page 32). Contrary to incidence trends by race/ethnicity, death rates declined during the most recent 10 years of data (2006 to 2015) in all racial/ethnic groups except AIANs, among whom rates were stable.[27] Mortality rates decreased more rapidly among Hispanics and NHWs (by about 2% annually) than among blacks and APIs (1% annually).[27] These declines are likely due to improvements in treatment, as well as reductions in incidence among NHWs.[28-30]

Figure S5. Age-adjusted Ovarian Cancer Mortality Rates* by Age Group and Race/Ethnicity, 1975-2015

● White ● Hispanic ● Black ● Asian/Pacific Islander
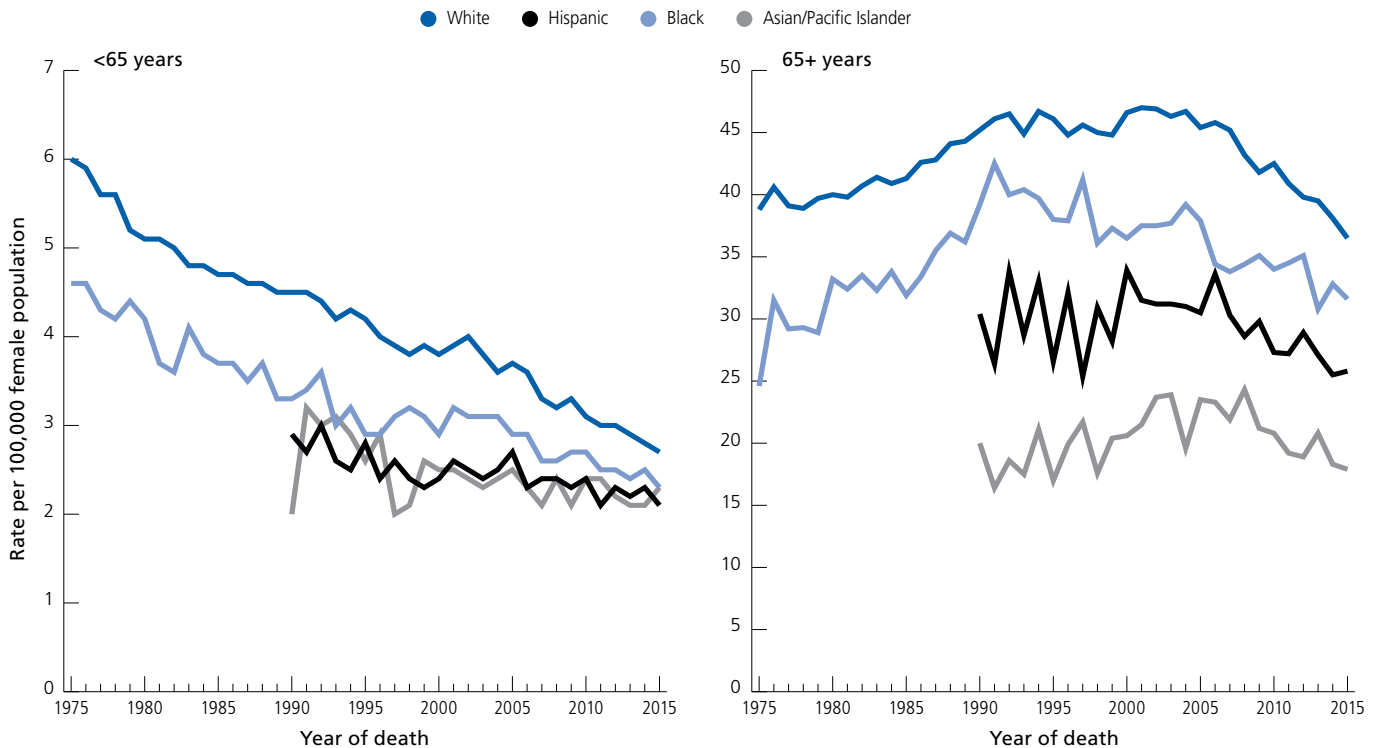
*Per 100,000, age adjusted to the 2000 US standard population. Note: American Indians and Alaska Natives not pictured due to <25 deaths in some years. Rates for Hispanics exclude data from Louisiana, New Hampshire, and Oklahoma due to missing data on Hispanic ethnicity for some years.

Source: US mortality data, National Center for Health Statistics, Centers for Disease Control and Prevention, 2017.

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What factors are associated with ovarian cancer risk?

Most of the current information on factors associated with ovarian cancer risk is from studies of epithelial tumors. The strongest risk factor for ovarian cancer is a family history of breast or ovarian cancer.[31] Modifiable factors associated with increased risk include use of menopausal hormone therapy and excess body weight.[33-35] Several established ovarian cancer risk factors modify a woman's exposure to reproductive hormones, although the mechanism underlying this relationship is not yet understood.[32] There is increasing evidence that risk factors vary by epithelial subtype.

Family and personal history

Family history

Risk of ovarian cancer is increased by about fourfold among women with a first-degree relative with a history of the disease and by about twofold for those with an affected second-degree relative (Table S2, page 34).[36] Risk is increased by about 70% among women with a first-degree relative with a history of breast cancer.[37] Almost 40% of ovarian cancer cases in women with a family history are due to mutations in the cancer susceptibility genes *BRCA1* and *BRCA2*.[38] As a result, the United States Preventive Services Task Force (USPSTF) recommends that women with this family history be referred for genetic counseling and evaluation.[39]

Genetic predisposition

Approximately 20% of ovarian cancer cases, particularly high-grade serous tumors, are estimated to be due to inherited mutations that confer elevated risk, the majority from *BRCA1* and *BRCA2*.[40] Therefore, the National Comprehensive Cancer Network recommends genetic testing for all women affected by ovarian cancer. While *BRCA1* and *BRCA2* mutations are rare (much less than 1%) in the general population, they occur slightly more often in certain ethnic or geographically isolated

groups, such as those of Ashkenazi (Eastern European) Jewish descent (about 2%).[41] These mutations are also a source of excess risk for breast cancer. The risk of developing ovarian cancer by age 80 is estimated to be 44% and 17% in *BRCA1* and *BRCA2* mutation carriers, respectively.[42] Risk-reducing surgery to remove the ovaries and fallopian tubes (salpingo-oophorectomy) in these women decreases the risk of ovarian cancer by about 80%,[43] and is recommended once childbearing is complete.[44] However, it is important to note that not all women with these mutations develop cancer.

In addition to *BRCA1* and *BRCA2*, other gene mutations that affect ovarian cancer risk to varying degrees continue to be identified. Some moderate-risk gene mutations include *BRIP1*, *MSH6*, and *RAD15C*.[45] There are also more common gene mutations that increase risk only slightly, but may account for a substantial number of cancer cases because of their prevalence in the population. Understanding and discovery of these types of gene mutations and their potential utility in a clinical setting for risk prediction and cancer prevention continue to evolve.

Lynch syndrome, also known as hereditary nonpolyposis colorectal cancer syndrome, is a rare hereditary condition associated with an increased risk for several cancers in addition to colorectal, including ovarian. Women with Lynch syndrome have approximately an 8% risk of developing ovarian cancer by age 70.[46] Ovarian cancers linked to Lynch syndrome are usually non-serous epithelial tumors.[47]

Personal medical history
Women with a personal history of breast cancer are about 30% more likely to develop ovarian cancer than a woman without this history, and almost five times more likely if the diagnosis is before age 40.[48] A large portion of the excess risk for ovarian cancer in women with a personal history of breast cancer is accounted for by mutations in *BRCA1* and *BRCA2*.[49]

Pelvic inflammatory disease may slightly increase risk for serous ovarian cancer, although studies remain inconclusive.[50, 51] Likewise, an association with polycystic ovary syndrome has been proposed, but is uncertain.[52-54]

Several studies found an association between endometriosis and certain ovarian cancer subtypes (endometrioid, low-grade serous, and clear cell), but it is unclear whether the relationship is causal or a result of shared risk factors.[5, 55-58]

Reproductive and hormonal factors

Pregnancy
It is well established that women who have had a full-term pregnancy have a lower risk of ovarian cancer than those who have not, with a higher number of pregnancies associated with further reduction.[59] Risk is reduced by about 40% for the first birth and 14% for each additional birth.[59] A recent study suggests that this association may be confined to endometrioid and clear cell carcinoma.[5] Some studies suggest that childbirth at an older age (30 years or more) also reduces risk.[60, 61]

Hormonal birth control
Oral contraceptive use is associated with a substantial reduction in the risk of ovarian cancer, with greater benefit for longer duration. Among women who use oral contraceptives for five to nine years total, risk is reduced by about 35%.[62] The protective effect persists, with diminishing strength, for at least 10 years following discontinuation of use.[62-64] It has been suggested that earlier users of contraceptives in the 1960s experienced a greater protective effect, possibly due to the higher-dose estrogen formulation,[59] although studies are inconsistent.[62, 65]

Surgical birth control
Fallopian tube ligation is associated with a roughly 30% reduced risk of ovarian cancer.[66] It is unclear whether tubal ligation reduces the risk of all epithelial ovarian cancers or only certain subtypes.[5, 67] Fallopian tube removal (salpingectomy) reduces risk by more than 60%,[68] and may be recommended for ovarian cancer prevention in women who have completed childbearing and are undergoing elective pelvic surgery or hysterectomy, or as an alternative to tubal ligation.[44] Hysterectomy has also been associated with reduced risk, although it is not clear if this benefit occurs with simple hysterectomy (without removal of the fallopian tubes and/or ovaries) or in older women.[69]

Breastfeeding

Some studies have found a modest decrease in ovarian cancer risk among women who breastfed, with greater benefit for longer duration.[5, 70-73]

Menopausal hormones

Women who ever used menopausal hormones (estrogen alone and estrogen combined with progesterone) have a 20% higher risk of developing ovarian cancer compared to never-users, with a stronger risk among recent users;[34] among current or former (stopped within 5 years) users, risk of ovarian cancer is about 40% higher. Risk is increased even with short duration of hormone use and remains elevated for at least 10 years after discontinuation. The association appears to be confined to serous and endometrioid carcinoma, the two most common epithelial subtypes.

Fertility drugs

There is much interest in the long-term health effects of fertility drugs given their increasing use. While more studies examining the association between fertility drugs and ovarian cancer risk are needed, thus far there is little evidence of an association.[74-76] This may be because women who have received fertility treatments have only just begun to enter the peak age for ovarian cancer, as well as the relative rarity of the disease.[74]

Excess body weight

The International Agency for Research on Cancer recently concluded that excess body weight modestly increases the risk of developing epithelial ovarian cancer, although the association is limited to women who have not used menopausal hormones.[33, 35] Among women who have not used hormones, risk of ovarian cancer increases by about 10% for every 5 kg/m^2 of body mass index. Results from studies evaluating whether this relationship varies by epithelial subtype are inconsistent.[5, 33, 77]

Height

Height is associated with elevated risk for several cancers, including ovarian; risk increases by about 7% for each additional 5 centimeters of adult height relative to a height of less than 155 centimeters (about 5 feet).[33] This association is unexplained, but may be related to genetic and environmental factors contributing to adult height, including growth hormone exposure during early life.[78, 79]

Smoking

Cigarette smoking increases the risk of mucinous ovarian cancer and decreases risk for endometrioid and clear cell carcinoma.[80] In current smokers, risk of mucinous ovarian cancer is increased by about 80%, mainly for tumors of borderline malignancy.[80]

Diet and personal habits

A number of studies have evaluated the relationship between ovarian cancer risk and various foods and dietary patterns with inconsistent results.[81, 82] Physical inactivity is associated with about a 30% higher risk of epithelial ovarian cancer,[83] and likewise, sedentary behavior appears to increase risk.[84-88] Some studies

suggest that use of analgesics, such as aspirin or other nonsteroidal anti-inflammatory drugs, is associated with a decreased risk of ovarian cancer, although results have been mixed and more studies are needed to confirm this relationship.[89-93]

The International Agency for Research on Cancer has concluded there is limited evidence that perineal use of talc-based body powder increases the risk of ovarian cancer.[94] Most of the current information on this relationship is based on a type of study design (case-control) that is particularly prone to bias. Of the large prospective studies, one found a slightly increased risk of invasive serous carcinoma among ever talc powder users,[95] while the other found no relationship among perineal powder users.[96] The study of this association is hindered by the difficulty in defining and measuring women's exposure to body powder with or without talc and by the rarity of the disease.

Can ovarian cancer be detected early?

Early ovarian cancer usually has no obvious symptoms, which is why the disease is typically diagnosed at an advanced stage. However, studies indicate that 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 prior to diagnosis.[97] 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 from the cancer (ascites).

Currently, there is no recommended screening test for the early detection of ovarian cancer in average-risk women, although studies to identify effective screening strategies are ongoing. The Prostate, Lung, Colorectal, and Ovarian Cancer (PLCO) Screening Trial, which assessed the use of transvaginal ultrasound (TVU) and fixed cutpoints in the tumor marker CA125 for the early detection of ovarian cancer, found no mortality benefit after up to 19 years of follow-up.[98] Based on this study, the USPSTF recommended against screening for ovarian cancer in 2012, concluding that there was adequate evidence that annual screening

does not reduce ovarian cancer mortality and can lead to important harms, mainly surgical interventions in women without ovarian cancer.[99] Another large randomized trial in the United Kingdom that evaluated TVU combined with a risk algorithm incorporating changes in CA125 levels found reduced mortality in average-risk women after 15 years,[100] although the use of secondary analysis to reach these results has been criticized.[101] Identifying an effective screening method is complicated by accumulating evidence that ovarian cancer, particularly aggressive high-grade serous carcinoma, begins as a microscopic lesion in the fallopian tube that is undetectable with current strategies.[2] For women who are at high risk, a thorough pelvic exam in combination with TVU and a blood test for changes in the level of the tumor marker CA125 may be offered, although this strategy has not proven effective in reducing ovarian cancer mortality.[102, 103]

## How is ovarian cancer diagnosed?

When ovarian cancer is suspected, patients will be asked to provide a full medical history and undergo a physical examination focused on the pelvis, checking for an enlarged ovary and/or fluid in the abdomen. Blood tests may help identify some types of ovarian cancer, primarily germ cell tumors. A test for levels of the tumor marker CA125 and imaging, such as TVU, computed tomography (CT) scan, or magnetic resonance imaging (MRI) of the abdominal and pelvic region, may also be ordered, although these tests cannot confirm cancer. If abdominal fluid is detected, a sample may be removed and examined for cancer cells using a procedure called paracentesis, in which a thin needle is inserted into the abdomen. Surgery with a tumor biopsy is usually required to confirm disease and determine histologic subtype and stage.[28] This surgery, which is highly complex and preferably performed by a gynecologic oncologist,[104] also constitutes the first step of treatment, called debulking (see How is ovarian cancer treated? page 37). In patients who are unable to undergo surgery, a tumor specimen may be taken through fine needle biopsy, in which a needle is placed directly into the tumor through the skin using imaging guidance, or during laparoscopy. Imaging of the chest and examination of the colon and rectum using colonoscopy may also be used to assess the spread of disease.

Do ovarian cancer stage at diagnosis and survival vary?

Most ovarian cancer patients (60%) are diagnosed with distant-stage disease, for which 5-year survival is 29% (Figure S6; Table S3). As a result, the overall 5-year relative survival rate for ovarian cancer is low (47%; Table S3).[22] Stage at diagnosis varies by cancer subtype; most serous carcinomas are diagnosed at a distant stage (79%), which reflects the aggressive nature of high-grade serous carcinomas that predominate in this subtype (Figure S6). Ovarian cancer survival also varies substantially by age and race/ethnicity (Table S3). For example, overall 5-year survival for NHW women under 65 years of age is 60% compared to 29% for those 65 and older; among black women, these rates drop to 51% and 22%, respectively.[22] This partly reflects earlier stage diagnosis among younger women, in addition to fewer comorbidities, more aggressive treatment, and differences in subtype distribution.[28] However, inadequate treatment may also contribute; studies show that less than half of women ages 65 and older with advanced-stage ovarian cancer receive optimal treatment.[105, 106] Racial survival disparities are also at least partly due to later-stage diagnosis[107] and less receipt of guideline-adherent treatment among black women.[21, 108, 109] Similarly, slower dissemination of treatment advances, including less access to optimal debulking surgery and intraperitoneal chemotherapy,[110-112] may have contributed to the stagnation in 5-year relative survival over the past four decades among black patients, compared to an (absolute) increase of 11% among white women.[22] Survival also varies substantially by ovarian cancer subtype (Table S4). For example, the 5-year relative survival rate for germ cell tumors, which are most common in adolescents and younger women, is 93%, compared with 88% for sex cord-stromal tumors and 47% for epithelial tumors.[113]

Figure S6. Stage Distribution (%) for Ovarian Cancer by Histology, US, 2007-2013
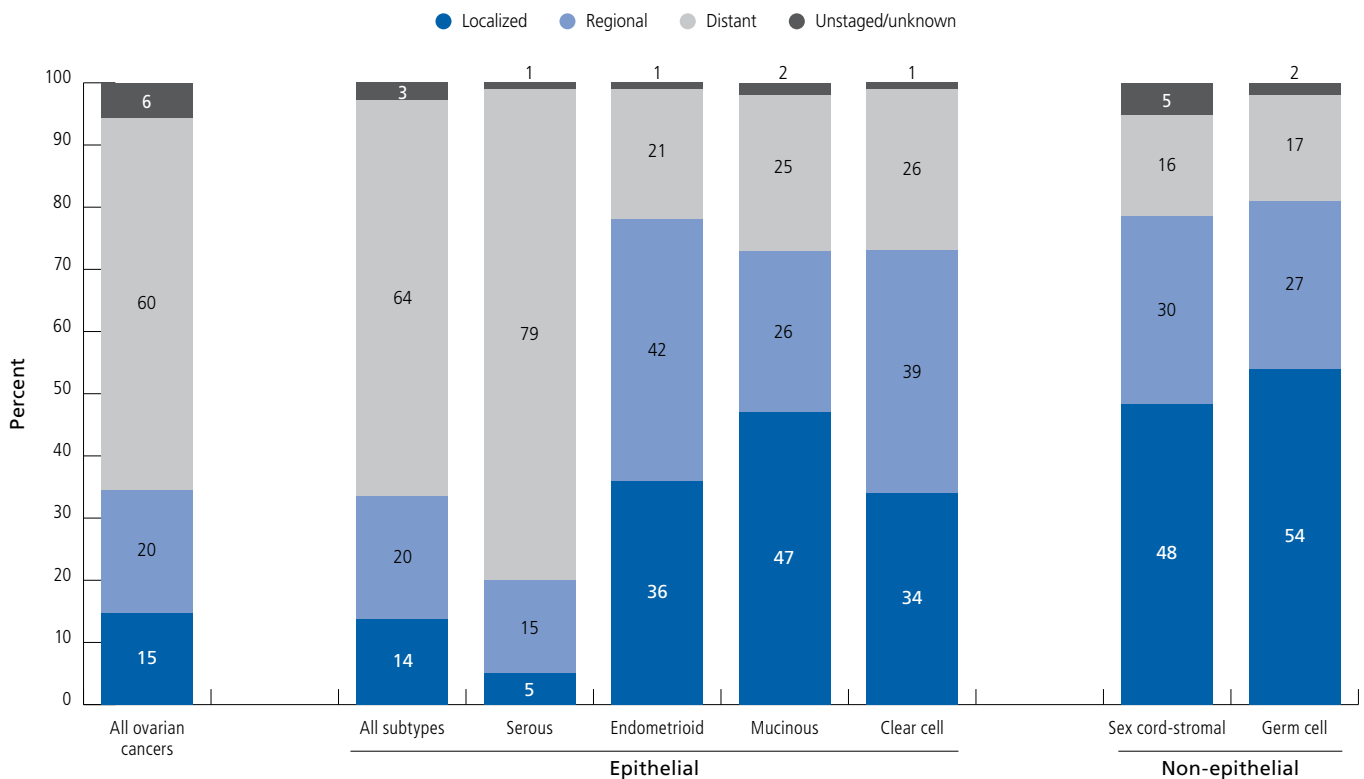
Table S3. Five-year Cause-specific Survival Rates* (%) for Ovarian Cancer by Stage at Diagnosis and Race/Ethnicity, US, 2007-2013

	All races	Non-Hispanic white	Non-Hispanic black	American Indian/ Alaska Native	Asian/Pacific Islander	Hispanic
All stages	47	46	39	41	57	54
Localized	92	92	88	^	92	95
Regional	73	73	62	57	79	74
Distant	29	29	22	29	35	35

*See Sources of Statistics, page 68, for more information on the calculation of cause-specific survival. ^Statistic not shown due to fewer than 25 cases.
Source: SEER 18 Registries, National Cancer Institute, 2017.

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Table S4. Five-year Relative Survival Rates* (%) for Ovarian Cancer by Stage at Diagnosis and Histology, US, 2007-2013

	Epithelial					Non-epithelial	
	All subtypes	Serous	Endometrioid	Mucinous	Clear cell	Sex cord-stromal	Germ cell
All stages	47	44	82	69	67	88	93
Localized	93	90	98	93	90	>99	98
Regional	74	75	87	81	74	89	93
Distant	30	35	48	18	26	53	77

*See Sources of Statistics, page 68, for more information on the calculation of relative survival.
Source: SEER 18 Registries, National Cancer Institute, 2017.

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How is ovarian cancer treated?

Treatment depends on the stage of the cancer; tumor characteristics and subtype; and the patient's age, health, and preferences, but typically includes surgery and often chemotherapy (platinum- and taxane-based). Surgery, called debulking, optimally removes as much of the tumor as possible because patient prognosis is strongly linked to the amount of cancer remaining. Debulking surgery usually involves removal of both ovaries and fallopian tubes (bilateral salpingo-oophorectomy), the uterus (hysterectomy), and the omentum (fatty tissue attached to some of the organs in the belly), along with biopsies of the peritoneum (lining of the abdominal cavity). In younger women with very early-stage disease who want to preserve fertility, only the involved ovary and fallopian tube may be removed. Among patients with early ovarian cancer, more accurate surgical staging (microscopic examination of tissue from different parts of the pelvis and abdomen) has been associated with better outcomes.[114] For women with advanced disease, debulking often involves removing parts or all of the other abdominal organs, with the goal of removing all visible disease or all tumors greater than

1 centimeter. For some women with advanced disease, chemotherapy may be administered prior to surgery to reduce tumor burden.[28, 115] Chemotherapy administered directly into the abdomen (intraperitoneal chemotherapy) improves survival for advanced-stage epithelial disease; however, in 2012, less than half of eligible women received this treatment, perhaps because of the high risk for side effects.[104, 116]

Recurrence is very common in ovarian cancer, and eventual resistance to standard platinum-based chemotherapy also frequently occurs.[117] There are an increasing number of treatment options for recurrence, including targeted therapies and treatments specifically for tumors associated with *BRCA1* and *BRCA2* mutations (PARP inhibitors).[117] Clinical observation is the primary recommendation to monitor for recurrence of epithelial tumors. Use of CA125 tests to monitor for recurrence remains common, although it has not been shown to improve overall survival and may reduce patient quality of life.[118] Imaging with CT , MRI, or positron emission tomography (PET)/CT when recurrence is suspected is being evaluated.[119, 120]

What supportive care is available for ovarian cancer patients?

Ovarian cancer patients cope with physical symptoms of the cancer, such as abdominal pain, bloating, cramping, and indigestion, in addition to side effects from treatment, some of which may last for years. Treatment side effects include pain, fatigue, numbness, hair loss, nausea, vomiting, and loss of appetite. Patients may also experience psychosocial effects, such as fear of recurrence or disease progression, depression, and anxiety. Younger women may cope with early menopause and loss of fertility.

Palliative care to improve patient quality of life by managing pain, relieving suffering, and addressing psychosocial needs optimally begins at diagnosis and continues through the end of life. Pain management strategies can be tailored to support quality-of-life goals and may include opioid analgesics. Chemotherapy or targeted drugs can be used as non-curative treatment to shrink tumors and diminish symptoms. Bowel obstruction caused by tumors can be relieved in select patients with surgery that may include an ostomy, which is an opening in the body for the elimination of waste. For patients with fluid accumulation in the abdomen, repeated drainage using paracentesis or continuous drainage using a semipermanent implanted tube may be used. Both bowel obstruction and fluid accumulation in the abdomen can cause lack of appetite; short-term nutrition can be provided through means other than eating, such as a feeding tube or intravenous delivery. A nutritionist can sometimes help patients with weight loss and loss of appetite.

At the end of life, palliative care services can help guide discussions about care options, including decisions to continue chemotherapy or receive invasive procedures, intensive care hospitalizations, and emergency department visits. In-home end-of-life care, or hospice, should be offered to all patients when treatment is palliative. Hospice services support individual quality-of-life goals, assist with pain control and comfort needs, and provide additional psychosocial services to patients and their families.

What is the American Cancer Society doing about ovarian cancer?

Caring, trained American Cancer Society staff connect people to information about ovarian cancer, our clinical trials matching service, health insurance assistance, American Cancer Society programs and services, and referrals to other services at our 24-hour helpline at 1-800-227-2345. In addition, our website, cancer.org, offers comprehensive accurate information and news about ovarian cancer, including in-depth information on treatments and side effects, and programs and services in your area. For more information about American Cancer Society programs and services, see page 58.

The American Cancer Society also funds and conducts research to better understand ovarian cancer risk factors, prevention, treatment, and survivorship. Our Guideline Development Group, which issues cancer screening recommendations based on a comprehensive evaluation of evidence, closely monitors research on screening for ovarian cancer.

Research

The American Cancer Society, through our Extramural Grants program, funds individual investigators in medical schools, universities, research institutes, and hospitals throughout the United States. Currently, this program is funding $12,353,400 in ovarian cancer research through 46 research grants. Ongoing research topics include:

- Therapeutic targeting of ovarian cancer stem cells

- Developing effective nanomedicine strategies to improve the infiltration and function of immune cells in ovarian tumors

- Testing cell-based cancer immunotherapeutics in ovarian cancer to reactivate the immune response against the disease

- Mechanisms of carboplatin resistance in ovarian cancer

- Activatable nanoparticles for radiotherapy of metastatic ovarian cancer

- Determining the impact of oophorectomy in BRCA mutation carriers on cardiac risk, bone health, and quality of life

The American Cancer Society Intramural Research program also conducts a wide range of research on ovarian cancer. For example, researchers from the Surveillance and Health Services Research program monitor trends in ovarian cancer occurrence and disparities in care. The group recently published a study showing that genetic testing for ovarian cancer risk increased from 2005 to 2015 among women with private or public insurance, but not among uninsured women.[122] Using data collected in our Cancer Prevention Study II (CPS-II), American Cancer Society epidemiologists have examined the relationship between ovarian cancer and various factors, including recreational physical activity,[84, 88] leisure time spent sitting,[84] diabetes mellitus,[123] menopausal hormone use,[124] and circadian disruption.[125] In addition, the CPS-II Nutrition Cohort is part of two large international research consortia. One of these, the Collaborative Group on Epidemiological Studies of Ovarian Cancer, helped to establish the links between ovarian cancer and excess body weight[33] and oral contraceptive use.[62] The other – Ovarian Cancer Cohort Consortium (OC3) – aims to identify lifestyle, hormonal, and genetic factors that contribute to the development of ovarian cancer subtypes. To date, OC3 researchers have reported that ovarian cancer associations with reproductive factors and tubal ligation are limited to endometrioid and clear cell carcinoma.[5]

Advocacy

ACS CAN works to ensure that ovarian cancer patients and survivors have access to quality, affordable, and comprehensive health care coverage in both public and private insurance markets. This coverage must include the patient protections that are critical to cancer patients and survivors, like prohibitions on preexisting condition exclusions and lifetime and annual limits, and standards like essential health benefits. ACS CAN and its partners in One Voice Against Cancer (OVAC), a collaboration of national nonprofits with the goal of ensuring sufficient

funding for cancer, are leading the effort to advocate for necessary government funding for cancer research and programs to reduce the toll of ovarian cancer. In particular, ACS CAN advocates for dedicated funding at the CDC in support of Johanna's Law, or The Gynecologic Education and Awareness Act, which provides for the education of women and medical professionals about the signs, symptoms, and early detection of ovarian and other gynecologic cancers. Federal funding for cancer-related initiatives have been under threat during the appropriations process. As the leading federal public health agency, the CDC must continue to receive the necessary funding to support lifesaving cancer education, prevention, and control initiatives.

What other resources are available?

- **National Cancer Institute**
  cancer.gov/types/ovarian

- **Department of Defense – Congressionally Directed Medical Research Programs: Ovarian Cancer**
  cdmrp.army.mil/ocrp

- **Ovarian Cancer Research Fund Alliance**
  ocrfa.org

- **National Ovarian Cancer Coalition**
  ovarian.org

References

1. SEER*Stat Database: NAACCR Incidence Data – CiNA Analytic File, 1995-2014, 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 2016.

2. Kurman RJ, Shih Ie M. The Dualistic Model of Ovarian Carcinogenesis: Revisited, Revised, and Expanded. *Am J Pathol*. 2016;186: 733-747.

3. Pearce CL, Rossing MA, Lee AW, et al. Combined and interactive effects of environmental and GWAS-identified risk factors in ovarian cancer. *Cancer Epidemiol Biomarkers Prev*. 2013;22: 880-890.

4. Prat J. New insights into ovarian cancer pathology. *Ann Oncol*. 2012;23 Suppl 10: x111-117.

5. Wentzensen N, Poole EM, Trabert B, et al. Ovarian Cancer Risk Factors by Histologic Subtype: An Analysis From the Ovarian Cancer Cohort Consortium. *J Clin Oncol*. 2016;34: 2888-2898.

6. Kurman RJ. Origin and molecular pathogenesis of ovarian high-grade serous carcinoma. *Ann Oncol*. 2013;24 Suppl 10: x16-21.

7. Meyn A, Lim B. A paradigm shift in the origin of ovarian cancer: the ovary is no longer to blame. *BJOG*. 2017;124: 859.

8. Morice P, Uzan C, Fauvet R, Gouy S, Duvillard P, Darai E. Borderline ovarian tumour: pathological diagnostic dilemma and risk factors for invasive or lethal recurrence. *Lancet Oncol*. 2012;13: e103-115.

9. Hauptmann S, Friedrich K, Redline R, Avril S. Ovarian borderline tumors in the 2014 WHO classification: evolving concepts and diagnostic criteria. *Virchows Archiv*. 2017;470: 125-142.

10. Schultz KA, Harris AK, Schneider DT, et al. Ovarian Sex Cord-Stromal Tumors. *J Oncol Pract*. 2016;12: 940-946.

11. Chen T, Surcel HM, Lundin E, et al. Circulating sex steroids during pregnancy and maternal risk of non-epithelial ovarian cancer. *Cancer Epidemiol Biomarkers Prev*. 2011;20: 324-336.

12. Sieh W, Sundquist K, Sundquist J, Winkleby MA, Crump C. Intrauterine factors and risk of nonepithelial ovarian cancers. *Gynecol Oncol*. 2014;133: 293-297.

13. Walker AH, Ross RK, Haile RW, Henderson BE. Hormonal factors and risk of ovarian germ cell cancer in young women. *Br J Cancer*. 1988;57: 418-422.

14. Heravi-Moussavi A, Anglesio MS, Cheng SW, et al. Recurrent somatic DICER1 mutations in nonepithelial ovarian cancers. *N Engl J Med*. 2012;366: 234-242.

15. Shah SP, Kobel M, Senz J, et al. Mutation of FOXL2 in granulosa-cell tumors of the ovary. *N Engl J Med*. 2009;360: 2719-2729.

16. Van Nieuwenhuysen E, Lambrechts S, Lambrechts D, Leunen K, Amant F, Vergote I. Genetic changes in nonepithelial ovarian cancer. *Expert Rev Anticancer Ther*. 2013;13: 871-882.

17. National Cancer Institute. Ovarian Germ Cell Tumors Treatment (PDQ) – Patient Version. Available from URL: https://www.cancer.gov/types/ovarian/patient/ovarian-germ-cell-treatment-pdq [accessed October 26, 2017].

18. Horta M, Cunha TM. Sex cord-stromal tumors of the ovary: a comprehensive review and update for radiologists. *Diagn Interv Radiol*. 2015;21: 277-286.

19. Wu AH, Pearce CL, Tseng CC, Pike MC. African Americans and Hispanics remain at lower risk of ovarian cancer than non-Hispanic whites after considering nongenetic risk factors and oophorectomy rates. *Cancer Epidemiol Biomarkers Prev*. 2015;24: 1094-1100.

20. Long B, Chang J, Ziogas A, Tewari KS, Anton-Culver H, Bristow RE. Impact of race, socioeconomic status, and the health care system on the treatment of advanced-stage ovarian cancer in California. *Am J Obstet Gynecol*. 2015;212: 468 e461-469.

21. Bristow RE, Powell MA, Al-Hammadi N, et al. Disparities in ovarian cancer care quality and survival according to race and socioeconomic status. *J Natl Cancer Inst*. 2013;105: 823-832.

22. Howlader N, Noone AM, Krapcho M, Miller D, Bishop K, Kosary CL, Yu M, Ruhl J, Tatalovich Z, Mariotto A, Lewis DR, Chen HS, Feuer EJ, Cronin KA (eds). *SEER Cancer Statistics Review, 1975-2014*, National Cancer Institute. Bethesda, MD, https://seer.cancer.gov/csr/1975_2014/, based on November 2016 SEER data submission, posted to the SEER web site, April 2017.

23. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence – SEER 13 Regs Research Data with Delay-Adjustment, Malignant Only, Nov 2016 Sub (1992-2014) <Katrina/Rita Population Adjustment> – Linked To County Attributes – Total U.S., 1969-2015 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2017, based on the November 2016 submission.

24. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence – SEER 9 Regs Research Data with Delay-Adjustment, Malignant Only, Nov 2016 Sub (1975-2014) <Katrina/Rita Population Adjustment> – Linked To County Attributes – Total U.S., 1969-2015 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2017, based on the November 2016 submission.

25. Yang HP, Anderson WF, Rosenberg PS, et al. Ovarian cancer incidence trends in relation to changing patterns of menopausal hormone therapy use in the United States. *J Clin Oncol*. 2013;31: 2146-2151.

26. Sopik V, Iqbal J, Rosen B, Narod SA. Why have ovarian cancer mortality rates declined? Part I. Incidence. *Gynecol Oncol*. 2015;138: 741-749.

27. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Mortality – All COD, Total U.S. (1990-2015) <Early release with Vintage 2015 Katrina/Rita Population Adjustment> – Linked To County Attributes – Total U.S., 1969-2015 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released June 2017. Underlying mortality data provided by NCHS (www.cdc.gov/nchs).

28. National Academies of Sciences, Engineering, and Medicine. *Ovarian cancers: evolving paradigms in research and care*. Washington, D.C.: The National Academies Press, 2016.

29. Bray F, Loos AH, Tognazzo S, La Vecchia C. Ovarian cancer in Europe: Cross-sectional trends in incidence and mortality in 28 countries, 1953-2000. *Int J Cancer*. 2005;113: 977-990.

30. Barnholtz-Sloan JS, Schwartz AG, Qureshi F, Jacques S, Malone J, Munkarah AR. Ovarian cancer: changes in patterns at diagnosis and relative survival over the last three decades. *Am J Obstet Gynecol*. 2003;189: 1120-1127.

31. Jones MR, Kamara D, Karlan BY, Pharoah PDP, Gayther SA. Genetic epidemiology of ovarian cancer and prospects for polygenic risk prediction. *Gynecol Oncol*. 2017.

32. Hunn J, Rodriguez GC. Ovarian cancer: etiology, risk factors, and epidemiology. *Clin Obstet Gynecol*. 2012;55: 3-23.

33. Collaborative Group on Epidemiological Studies of Ovarian Cancer. Ovarian cancer and body size: individual participant meta-analysis including 25,157 women with ovarian cancer from 47 epidemiological studies. *PLoS MEd*. 2012;9: e1001200.

34. Collaborative Group on Epidemiological Studies of Ovarian Cancer, Beral V, Gaitskell K, et al. Menopausal hormone use and ovarian cancer risk: individual participant meta-analysis of 52 epidemiological studies. *Lancet*. 2015;385: 1835-1842.

35. Lauby-Secretan B, Scoccianti C, Loomis D, et al. Body fatness and cancer – viewpoint of the IARC Working Group. *N Engl J Med*. 2016;375: 794-798.

36. Kerber RA, Slattery ML. The impact of family history on ovarian cancer risk. The Utah Population Database. *Arch Intern Med*. 1995;155: 905-912.

37. Tung KH, Goodman MT, Wu AH, et al. Aggregation of ovarian cancer with breast, ovarian, colorectal, and prostate cancer in first-degree relatives. *Am J Epidemiol*. 2004;159: 750-758.

38. Alsop K, Fereday S, Meldrum C, et al. BRCA mutation frequency and patterns of treatment response in BRCA mutation-positive women with ovarian cancer: a report from the Australian Ovarian Cancer Study Group. *J Clin Oncol*. 2012;30: 2654-2663.

39. U. S. Preventive Services Task Force. Genetic risk assessment and BRCA mutation testing for breast and ovarian cancer susceptibility: recommendation statement. *Ann Intern Med*. 2005;143: 355-361.

40. Norquist BM, Harrell MI, Brady MF, et al. Inherited mutations in women with ovarian carcinoma. *JAMA Oncol*. 2016;2: 482-490.

41. Gabai-Kapara E, Lahad A, Kaufman B, et al. Population-based screening for breast and ovarian cancer risk due to BRCA1 and BRCA2. *Proc Natl Acad Sci U S A*. 2014;111: 14205-14210.

42. Kuchenbaecker KB, Hopper JL, Barnes DR, et al. Risks of breast, ovarian, and contralateral breast cancer for BRCA1 and BRCA2 mutation carriers. *JAMA*. 2017;317: 2402-2416.

43. Finch AP, Lubinski J, Moller P, et al. Impact of oophorectomy on cancer incidence and mortality in women with a BRCA1 or BRCA2 mutation. *J Clin Oncol*. 2014;32: 1547-1553.

44. Walker JL, Powell CB, Chen LM, et al. Society of Gynecologic Oncology recommendations for the prevention of ovarian cancer. *Cancer*. 2015;121: 2108-2120.

45. Ramus SJ, Song H, Dicks E, et al. Germline mutations in the BRIP1, BARD1, PALB2, and NBN genes in women with ovarian cancer. *J Natl Cancer Inst*. 2015;107.

46. 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.

47. Ketabi Z, Bartuma K, Bernstein I, et al. Ovarian cancer linked to Lynch syndrome typically presents as early-onset, non-serous epithelial tumors. *Gynecol Oncol*. 2011;121: 462-465.

48. American Cancer Society. Special Section: Multiple Primary Cancers. *Cancer Facts & Figures 2009*. Atlanta, GA: American Cancer Society, 2009.

49. Walsh T, Casadei S, Lee MK, et al. Mutations in 12 genes for inherited ovarian, fallopian tube, and peritoneal carcinoma identified by massively parallel sequencing. *Proc Natl Acad Sci U S A*. 2011;108:18032-18037.

50. Rasmussen CB, Jensen A, Albieri V, Andersen KK, Kjaer SK. Is pelvic inflammatory disease a risk factor for ovarian cancer? *Cancer Epidemiol Biomarkers Prev*. 2017;26: 104-109.

51. Zhou Z, Zeng F, Yuan J, et al. Pelvic inflammatory disease and the risk of ovarian cancer: a meta-analysis. *Cancer Causes Control*. 2017;28: 415-428.

52. Barry JA, Azizia MM, Hardiman PJ. Risk of endometrial, ovarian and breast cancer in women with polycystic ovary syndrome: a systematic review and meta-analysis. *Hum Reprod Update*. 2014;20: 748-758.

53. Harris HR, Titus LJ, Cramer DW, Terry KL. Long and irregular menstrual cycles, polycystic ovary syndrome, and ovarian cancer risk in a population-based case-control study. *Int J Cancer*. 2017;140: 285-291.

54. Schildkraut JM, Schwingl PJ, Bastos E, Evanoff A, Hughes C. Epithelial ovarian cancer risk among women with polycystic ovary syndrome. *Obstet Gynecol*. 1996;88: 554-559.

55. Guo SW, Zilberberg MD, Hummelshoj L. Endometriosis and ovarian cancer. *Lancet Oncol*. 2012;13: e189-190; author reply e190.

56. Nezhat FR, Pejovic T, Reis FM, Guo SW. The link between endometriosis and ovarian cancer: clinical implications. *Int J Gynecol Cancer*. 2014;24: 623-628.

57. Pearce CL, Templeman C, Rossing MA, et al. Association between endometriosis and risk of histological subtypes of ovarian cancer: a pooled analysis of case-control studies. *Lancet Oncol*. 2012;13: 385-394.

58. Ness RB. Endometriosis and ovarian cancer: thoughts on shared pathophysiology. *Am J Obstet Gynecol*. 2003;189: 280-294.

59. Whittemore AS, Harris R, Itnyre J. Characteristics relating to ovarian cancer risk: collaborative analysis of 12 US case-control studies. II. Invasive epithelial ovarian cancers in white women. Collaborative Ovarian Cancer Group. *Am J Epidemiol*. 1992;136: 1184-1203.

60. Bevier M, Sundquist J, Hemminki K. Does the time interval between first and last birth influence the risk of endometrial and ovarian cancer? *Eur J Cancer*. 2011;47: 586-591.

61. Wu AH, Pearce CL, Lee AW, et al. Timing of births and oral contraceptive use influences ovarian cancer risk. *Int J Cancer*. 2017;141: 2392-2399.

62. Collaborative Group on Epidemiological Studies of Ovarian Cancer, Beral V, Doll R, Hermon C, Peto R, Reeves G. Ovarian cancer and oral contraceptives: collaborative reanalysis of data from 45 epidemiological studies including 23,257 women with ovarian cancer and 87,303 controls. *Lancet*. 2008;371: 303-314.

63. Hankinson SE, Colditz GA, Hunter DJ, Spencer TL, Rosner B, Stampfer MJ. A quantitative assessment of oral contraceptive use and risk of ovarian cancer. *Obstet Gynecol*. 1992;80: 708-714.

64. Tworoger SS, Fairfield KM, Colditz GA, Rosner BA, Hankinson SE. Association of oral contraceptive use, other contraceptive methods, and infertility with ovarian cancer risk. *Am J Epidemiol*. 2007;166: 894-901.

65. Shafrir AL, Schock H, Poole EM, et al. A prospective cohort study of oral contraceptive use and ovarian cancer among women in the United States born from 1947 to 1964. *Cancer Causes Control*. 2017;28: 371-383.

66. Cibula D, Widschwendter M, Majek O, Dusek L. Tubal ligation and the risk of ovarian cancer: review and meta-analysis. *Hum Reprod Update*. 2011;17: 55-67.

67. Sieh W, Salvador S, McGuire V, et al. Tubal ligation and risk of ovarian cancer subtypes: a pooled analysis of case-control studies. *Int J Epidemiol*. 2013;42: 579-589.

68. Falconer H, Yin L, Gronberg H, Altman D. Ovarian cancer risk after salpingectomy: a nationwide population-based study. *J Natl Cancer Inst*. 2015;107.

69. Jordan SJ, Nagle CM, Coory MD, et al. Has the association between hysterectomy and ovarian cancer changed over time? A systematic review and meta-analysis. *Eur J Cancer*. 2013;49: 3638-3647.

70. Gaitskell K, Green J, Pirie K, et al. Histological subtypes of ovarian cancer associated with parity and breastfeeding in the prospective Million Women Study. *Int J Cancer*. 2017.

71. Danforth KN, Tworoger SS, Hecht JL, Rosner BA, Colditz GA, Hankinson SE. Breastfeeding and risk of ovarian cancer in two prospective cohorts. *Cancer Causes Control*. 2007;18: 517-523.

72. Li DP, Du C, Zhang ZM, et al. Breastfeeding and ovarian cancer risk: a systematic review and meta-analysis of 40 epidemiological studies. *Asian Pac J Cancer Prev*. 2014;15: 4829-4837.

73. Luan NN, Wu QJ, Gong TT, Vogtmann E, Wang YL, Lin B. Breastfeeding and ovarian cancer risk: a meta-analysis of epidemiologic studies. *Am J Clin Nutr*. 2013;98: 1020-1031.

74. Diergaarde B, Kurta ML. Use of fertility drugs and risk of ovarian cancer. *Curr Opin Obstet Gynecol*. 2014;26: 125-129.

75. Trabert B, Lamb EJ, Scoccia B, et al. Ovulation-inducing drugs and ovarian cancer risk: results from an extended follow-up of a large United States infertility cohort. *Fertil Steril*. 2013;100: 1660-1666.

76. Rizzuto I, Behrens RF, Smith LA. Risk of ovarian cancer in women treated with ovarian stimulating drugs for infertility. Cochrane Database Syst Rev. 2013: CD008215.

77. Dixon SC, Nagle CM, Thrift AP, et al. Adult body mass index and risk of ovarian cancer by subtype: a Mendelian randomization study. *Int J Epidemiol*. 2016;45: 884-895.

78. Cairns BJ, Green J. Good news for "Alice": height and sex differences in cancer risk. *J Natl Cancer Inst*. 2013;105: 841-843.

79. Green J, Cairns BJ, Casabonne D, et al. Height and cancer incidence in the Million Women Study: prospective cohort, and meta-analysis of prospective studies of height and total cancer risk. *Lancet Oncol*. 2011;12: 785-794.

80. Collaborative Group on Epidemiological Studies of Ovarian Cancer, Beral V, Gaitskell K, et al. Ovarian cancer and smoking: individual participant meta-analysis including 28,114 women with ovarian cancer from 51 epidemiological studies. *Lancet Oncol*. 2012;13: 946-956.

81. World Cancer Research Fund / American Institute for Cancer Research. Continuous Update Project Report. Food, Nutrition, Physical Activity, and the Prevention of Ovarian Cancer 2014. Available at http://www.dietandcancerreport.org/cup/cup_resources.php.

82. Crane TE, Khulpateea BR, Alberts DS, Basen-Engquist K, Thomson CA. Dietary intake and ovarian cancer risk: a systematic review. *Cancer Epidemiol Biomarkers Prev*. 2014;23: 255-273.

83. Cannioto R, LaMonte MJ, Risch HA, et al. Chronic recreational physical inactivity and epithelial ovarian cancer risk: evidence from the Ovarian Cancer Association Consortium. *Cancer Epidemiol Biomarkers Prev*. 2016;25: 1114-1124.

84. Patel AV, Hildebrand JS, Campbell PT, et al. Leisure-time spent sitting and site-specific cancer incidence in a large U.S. cohort. *Cancer Epidemiol Biomarkers Prev*. 2015;24: 1350-1359.

85. Shen D, Mao W, Liu T, et al. Sedentary behavior and incident cancer: a meta-analysis of prospective studies. *PloS one*. 2014;9: e105709.

86. Xiao Q, Yang HP, Wentzensen N, Hollenbeck A, Matthews CE. Physical activity in different periods of life, sedentary behavior, and the risk of ovarian cancer in the NIH-AARP diet and health study. *Cancer Epidemiol Biomarkers Prev*. 2013;22: 2000-2008.

87. Zhang M, Xie X, Lee AH, Binns CW. Sedentary behaviours and epithelial ovarian cancer risk. *Cancer Causes Control*. 2004;15: 83-89.

88. Hildebrand JS, Gapstur SM, Gaudet MM, Campbell PT, Patel AV. Moderate-to-vigorous physical activity and leisure-time sitting in relation to ovarian cancer risk in a large prospective US cohort. *Cancer Causes Control*. 2015;26: 1691-1697.

89. Baandrup L, Faber MT, Christensen J, et al. Nonsteroidal anti-inflammatory drugs and risk of ovarian cancer: systematic review and meta-analysis of observational studies. *Acta Obstet Gynecol Scand*. 2013;92: 245-255.

90. Brasky TM, Liu J, White E, et al. Non-steroidal anti-inflammatory drugs and cancer risk in women: results from the Women's Health Initiative. *Int J Cancer*. 2014;135: 1869-1883.

91. Pinheiro SP, Tworoger SS, Cramer DW, Rosner BA, Hankinson SE. Use of nonsteroidal antiinflammatory agents and incidence of ovarian cancer in 2 large prospective cohorts. *Am J Epidemiol*. 2009;169: 1378-1387.

92. Prizment AE, Folsom AR, Anderson KE. Nonsteroidal anti-inflammatory drugs and risk for ovarian and endometrial cancers in the Iowa Women's Health Study. *Cancer Epidemiol Biomarkers Prev*. 2010;19: 435-442.

93. Trabert B, Ness RB, Lo-Ciganic WH, et al. Aspirin, nonaspirin nonsteroidal anti-inflammatory drug, and acetaminophen use and risk of invasive epithelial ovarian cancer: a pooled analysis in the Ovarian Cancer Association Consortium. *J Natl Cancer Inst*. 2014;106: djt431.

94. International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Vol 93 Carbon Black, Titanium Dioxide, and Talc.2010.

95. Gertig DM, Hunter DJ, Cramer DW, et al. Prospective study of talc use and ovarian cancer. *J Natl Cancer Inst*. 2000;92: 249-252.

96. Houghton SC, Reeves KW, Hankinson SE, et al. Perineal powder use and risk of ovarian cancer. *J Natl Cancer Inst*. 2014;106.

97. Goff BA, Mandel LS, Melancon CH, Muntz HG. Frequency of symptoms of ovarian cancer in women presenting to primary care clinics. *JAMA*. 2004;291: 2705-2712.

98. Pinsky PF, Yu K, Kramer BS, et al. Extended mortality results for ovarian cancer screening in the PLCO trial with median 15years follow-up. *Gynecol Oncol*. 2016;143: 270-275.

99. Moyer VA, U. S. Preventive Services Task Force. Screening for ovarian cancer: U.S. Preventive Services Task Force reaffirmation recommendation statement. *Ann Intern Med*. 2012;157: 900-904.

100. Jacobs IJ, Menon U, Ryan A, et al. Ovarian cancer screening and mortality in the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS): a randomised controlled trial. *Lancet*. 2016;387: 945-956.

101. Narod SA, Sopik V, Giannakeas V. Should we screen for ovarian cancer? A commentary on the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS) randomized trial. *Gynecol Oncol*. 2016;141: 191-194.

102. Berchuck A, Havrilesky LJ, Kauff ND. Is there a role for ovarian cancer screening in high-risk women? *J Clin Oncol*. 2017;35: 1384-1386.

103. Rosenthal AN, Fraser LSM, Philpott S, et al. Evidence of stage shift in women diagnosed with ovarian cancer during phase II of the United Kingdom Familial Ovarian Cancer Screening Study. *J Clin Oncol*. 2017;35: 1411-1420.

104. Hennessy BT, Coleman RL, Markman M. Ovarian cancer. *Lancet*. 2009;374: 1371-1382.

105. Lin JJ, Egorova N, Franco R, Prasad-Hayes M, Bickell NA. Ovarian cancer treatment and survival trends among women older than 65 years of age in the United States, 1995-2008. *Obstet Gynecol*. 2016;127: 81-89.

106. Thrall MM, Gray HJ, Symons RG, Weiss NS, Flum DR, Goff BA. Trends in treatment of advanced epithelial ovarian cancer in the Medicare population. *Gynecol Oncol*. 2011;122: 100-106.

107. Sakhuja S, Yun H, Pisu M, Akinyemiju T. Availability of healthcare resources and epithelial ovarian cancer stage of diagnosis and mortality among Blacks and Whites. *J Ovarian Res*. 2017;10: 57.

108. Bandera EV, Lee VS, Rodriguez-Rodriguez L, Powell CB, Kushi LH. Racial/ethnic disparities in ovarian cancer treatment and survival. *Clin Cancer Res*. 2016;22: 5909-5914.

109. Bristow RE, Chang J, Ziogas A, Campos B, Chavez LR, Anton-Culver H. Sociodemographic disparities in advanced ovarian cancer survival and adherence to treatment guidelines. *Obstet Gynecol*. 2015;125: 833-842.

110. Aranda MA, McGory M, Sekeris E, Maggard M, Ko C, Zingmond DS. Do racial/ethnic disparities exist in the utilization of high-volume surgeons for women with ovarian cancer? *Gynecol Oncol*. 2008;111: 166-172.

111. Bristow RE, Chang J, Ziogas A, Randall LM, Anton-Culver H. High-volume ovarian cancer care: survival impact and disparities in access for advanced-stage disease. *Gynecol Oncol*. 2014;132: 403-410.

112. Fairfield KM, Murray K, LaChance JA, et al. Intraperitoneal chemotherapy among women in the Medicare population with epithelial ovarian cancer. *Gynecol Oncol*. 2014;134: 473-477.

113. 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 2016 Sub (2000-2014) <Katrina/Rita Population Adjustment> – Linked To County Attributes – Total U.S., 1969-2015 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2017, based on the November 2016 submission.

114. Trimbos JB. Surgical treatment of early-stage ovarian cancer. *Best Pract Res Clin Obstet Gynaecol*. 2017;41: 60-70.

115. Wright AA, Bohlke K, Armstrong DK, et al. Neoadjuvant chemotherapy for newly diagnosed, advanced ovarian cancer: Society of Gynecologic Oncology and American Society of Clinical Oncology Clinical Practice Guideline. *J Clin Oncol*. 2016;34: 3460-3473.

116. Wright AA, Cronin A, Milne DE, et al. Use and effectiveness of intraperitoneal chemotherapy for treatment of ovarian cancer. *J Clin Oncol*. 2015;33: 2841-2847.

117. Luvero D, Milani A, Ledermann JA. Treatment options in recurrent ovarian cancer: latest evidence and clinical potential. *Ther Adv Med Oncol*. 2014;6: 229-239.

118. Esselen KM, Cronin AM, Bixel K, et al. Use of CA-125 Tests and Computed Tomographic Scans for Surveillance in Ovarian Cancer. *JAMA Oncol*. 2016;2: 1427-1433.

119. Lee SI, Catalano OA, Dehdashti F. Evaluation of gynecologic cancer with MR imaging, 18F-FDG PET/CT, and PET/MR imaging. *J Nucl Med*. 2015;56: 436-443.

120. Paik ES, Kim TJ, Lee YY, et al. Comparison of survival outcomes after recurrence detected by cancer antigen 125 elevation versus imaging study in epithelial ovarian cancer. *J Gynecol Oncol*. 2016;27: e46.

121. Kurian AW, Hughes E, Handorf EA, et al. Breast and ovarian cancer penetrance estimates derived From germline multiple-gene sequencing results in women. *JCO Precis Oncol*. 2017:1-12.

122. Han X, Jemal A. Recent patterns in genetic testing for breast and ovarian cancer risk in the U.S. *Am J Prev Med*. 2017;53:504-507.

123. Gapstur SM, Patel AV, Diver WR, et al. Type II diabetes mellitus and the incidence of epithelial ovarian cancer in the cancer prevention study-II nutrition cohort. *Cancer Epidemiol Biomarkers Prev*. 2012;21:2000-2005.

124. Hildebrand JS, Gapstur SM, Feigelson HS, Teras LR, Thun MJ, Patel AV. Postmenopausal hormone use and incident ovarian cancer: Associations differ by regimen. *Int J Cancer*. 2010;127:2928-2935.

125. Carter BD, Diver WR, Hildebrand JS, Patel AV, Gapstur SM. Circadian disruption and fatal ovarian cancer. *Am J Prev Med*. 2014;46:S34-41.

Tobacco Use

Tobacco use remains the world's most preventable cause of death. Despite decades of declines in cigarette smoking prevalence, almost one-third (32%) of cancer deaths in the US,[1] and as much as 40% in men in some Southern states,[2] are still caused by smoking. This is partly because cigarette smoking rates in certain segments of the population remain as high as 40%, comparable to the rate in the general population in the 1970s. Also concerning is the rapid increase in other forms of tobacco use, such as hookah (waterpipes), cigars, and e-cigarettes.

Cigarette Smoking

According to the Surgeon General, cigarette smoking increases the risk of 12 cancers: oral cavity and pharynx, larynx, lung, esophagus, pancreas, uterine cervix, kidney, bladder, stomach, colorectum, liver, and acute myeloid leukemia (Figure 4).[3] Accumulating evidence suggests that smoking also increases the risk of advanced-stage prostate cancer.[3,4]

- According to the National Health Interview Survey (NHIS), the prevalence of current cigarette smoking among adults 18 years of age and older has declined by more than half, from 42% in 1965 to 16% in 2016.[5,6]

- Still, more than 38 million American adults were current smokers in 2016.[5]

- Although historically men were much more likely to smoke than women, this gap has almost closed among non-Hispanic whites (NHWs), among whom smoking prevalence in 2016 was 19% in men versus 17% in women; in contrast, the gender gap remains large among Hispanics (13% in men versus 7% in women), non-Hispanic blacks (hereafter "black"; 22% versus 14%), and non-Hispanic Asians (hereafter "Asian"; 14% versus 6%).[5]

- Smoking is most common and has declined slowest among those with low levels of education. In 2016, smoking prevalence among adults 25 years of age and older was 26% in those with less than a high school diploma and 40% among those with a GED (General

Educational Development), or high school equivalency credential, compared to 5% in those with graduate degrees.[5]
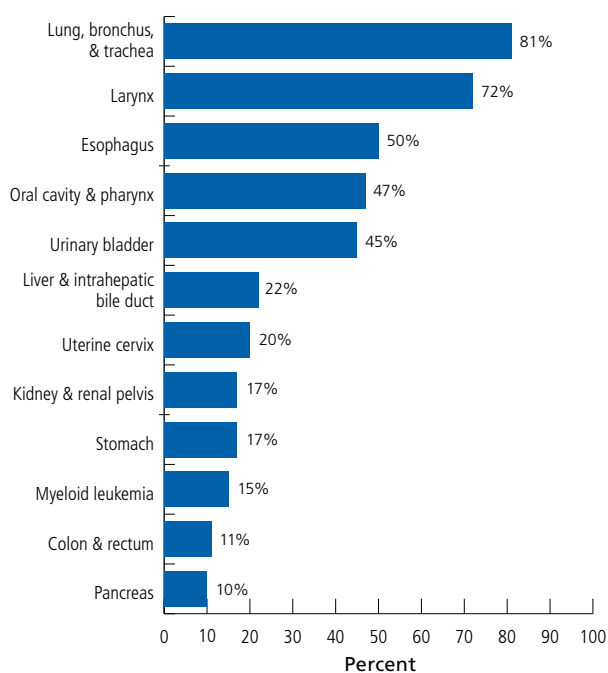
- According to 2016 Behavioral Risk Factor Surveillance System (BRFSS) data, the prevalence of adult smoking ranged from 9% in Utah to 25% in West Virginia.[7]

- Based on National Youth Tobacco Surveys (NYTS), current cigarette smoking (at least once in the past 30 days) among US high school students decreased from 29% in 1999 to 8% in 2016.[8,9]

- Cigarette smoking among high school students was more common in boys (9%) than girls (7%) and in NHWs (10%) than blacks (4%) and Hispanics (6%).[9]

Cigar Smoking

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.[10-12] The three main types of cigars in the US are large cigars, cigarillos, and small cigars, which resemble cigarettes in size and shape, but are taxed at a lower rate. Lower tax rates on cigars have caused some cost-conscious smokers to switch from cigarettes to small cigars.[13]

- From 2000 to 2016, while cigarette consumption dropped by over 40%, cigar consumption more than doubled after declining during most of the 20th century.[14]

- According to the 2016 NHIS, 4% of adults (7% of men and 1% of women) reported smoking cigars every day or some days.[5]

- Cigar use was more common in blacks (5%) and NHWs (4%) than Hispanics (3%) and Asians (1%).[5]

- Based on the 2016 NYTS, 8% of US high school students (boys: 9%, girls: 7%) had smoked cigars at least once in the past 30 days, down from 15% in 1999.[8,9]

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

Cancer site	Percent
Lung, bronchus, & trachea	81%
Larynx	72%
Esophagus	50%
Oral cavity & pharynx	47%
Urinary bladder	45%
Liver & intrahepatic bile duct	22%
Uterine cervix	20%
Kidney & renal pelvis	17%
Stomach	17%
Myeloid leukemia	15%
Colon & rectum	11%
Pancreas	10%

Percent axis: 0 10 20 30 40 50 60 70 80 90 100

Source: Islami F, Goding Sauer A, Miller KD, et al. *CA Cancer J Clin*. Nov 2017.

Secondhand Smoke

There is no safe level of exposure to secondhand smoke (SHS), which contains more than 7,000 chemicals, at least 69 of which cause cancer.[15] Nonsmokers who are exposed to SHS are at increased risk of lung diseases (including cancer), coronary artery disease, heart attacks, coughing, wheezing, chest tightness, and reduced lung function.[16-19] Laws that prohibit smoking in public places and create smoke-free environments are the most effective approach to prevent exposure to SHS. In addition, there is strong evidence that smoke-free policies decrease the prevalence of both adult and youth smoking.[18,20] Since 1990, smoke-free laws have become increasingly more common and comprehensive.

- Nationwide, SHS exposure among nonsmokers declined from 84% in 1988-1994[21] to 25% in 2011-2012,[22] likely reflecting widespread implementation of smoke-free laws, reductions in smoking, and increased awareness of the health hazards of SHS. However, poor individuals remain substantially more likely to be exposed than those who are more affluent.

- In the US, as of July 2017, more than 900 municipalities and 25 states, the District of Columbia, Puerto Rico, and the US Virgin Islands have comprehensive laws in place requiring all non-hospitality workplaces, restaurants, and bars to be smoke-free, covering almost 60% of the US population.[23]

- Still, in 2014, an estimated 5,840 nonsmoking adults in the US were diagnosed with lung cancer as a result of breathing SHS.[24]

- Approximately 10% of nonsmokers (12.6 million adults) were exposed to SHS in the workplace in 2015, a rate that had remained unchanged since 2010.[25]

E-cigarettes

Electronic nicotine delivery systems, or e-cigarettes, are battery-operated devices introduced in the US market around 2007 that allow the user to inhale aerosol produced from cartridges or tanks filled with a liquid commonly containing nicotine, propylene glycol and/or vegetable glycerin, other chemicals, and sometimes flavoring. E-cigarettes are promoted by some as a less harmful alternative to traditional cigarettes and/or as a way to bypass smoke-free laws. Although the evidence suggests that current-generation e-cigarettes are less harmful than conventional cigarettes, the risks associated with long-term use are unknown, and likely vary by product and frequency of use.[26] With more than 460 brands and nearly 8,000 flavors of e-cigarettes on the market,[27] evaluating health effects will be challenging. E-cigarettes may also promote nicotine addiction and be a gateway to combustible tobacco products among individuals who would otherwise have been nonsmokers. Current research indicates that adolescent and young adult e-cigarette users may be 2-4 times more likely than nonusers both to initiate combustible tobacco use and to become desensitized to the dangers of cigarettes.[28-30] However, it is unknown how many users would have gone on to try conventional cigarettes regardless, and a recent survey suggests that more than half of young e-cigarette users report vaping flavored aerosols without nicotine.[31] E-cigarette use has risen rapidly in the US, particularly among youth, for whom it is the most common tobacco product. However, the decline in high school students in the past data year may reflect a waning in the surge of experimentation with a previously novel product.

- Among high school students, current e-cigarette use (at least once in the past 30 days) increased rapidly from 2% in 2011 to 16% in 2015, then declined to 11% in 2016.[9]

- E-cigarette use in 2016 was more common in NHW (14%) and Hispanic (10%) high school students than in blacks (6%).[9]

- Among adults, 3% reported current (every day or some days) e-cigarette use, ranging from 1% in people 65 years of age and older to 5% in people ages 18-24 years.[5]

Smokeless Tobacco Products

Smokeless tobacco includes products such as 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; precancerous lesions of the mouth; gum recession; bone loss around the teeth; tooth staining; and nicotine addiction.[32] Switching from smoking to using smokeless tobacco products has been shown to result in a higher risk of tobacco-related death than complete tobacco cessation.[33] However, the tobacco industry continues to market smokeless tobacco as a cigarette alternative in smoke-free settings and develop new smokeless products, many of which have specific appeal to youth.

- Rates of smokeless tobacco use among adults in the US has remained stable since 2003.[34]

- According to the 2016 NHIS, about 3% of adults 18 years of age and older (5% of men and <1% of women) currently (every day or some days) used smokeless tobacco products.[5]

- In 2016, NHWs (4%) were more likely to use smokeless tobacco than blacks (<1%) or Hispanics (<1%).[5]

- Current adult smokeless tobacco use varied from 1% in the District of Columbia to 10% in Wyoming based on 2016 BRFSS.[7]

- In 2016, 6% of high school students (boys: 8%; girls: 3%) used smokeless tobacco in the past 30 days.[9]

Smoking Cessation

Smokers who quit, regardless of age, increase their longevity; those who quit by age 30 live an average of 10 years longer than if they had continued to smoke.[35] Smoking cessation reduces the risk of developing lung and other smoking-related cancers, as well as many other diseases caused by smoking, and improves the health of cancer survivors.[3]

- In 2016, 59% (54.5 million) of the 92.9 million Americans who ever smoked at least 100 cigarettes are now former smokers.[5]

- In 2016, 49% of current smokers attempted to quit for at least one day in the past year.[5]

- Although effective cessation treatments (i.e., counseling and medication) can double or triple a smoker's chances of long-term abstinence, only 31% of people who try to quit use these aids, usually because of lack of access.[36]

Reducing Tobacco Use and Exposure

Numerous federal, state, and local tobacco control policies have been enacted since the 1964 Surgeon General's Report on Smoking and Health, including increased cigarette prices; improved cessation treatment; enforced worksite, bar, and restaurant restrictions; improved health warnings; and restricted advertising.[37] These policies have helped reduce smoking and avert almost 2 million smoking-related deaths through 2014.[37]

Expanding federal initiatives in tobacco control holds promise for further reducing tobacco use. The Family Smoking Prevention and Tobacco Control Act of 2009 granted the US Food and Drug Administration (FDA) authority to regulate the manufacturing, selling, and marketing of tobacco products. Key provisions of the act include the prohibition of fruit and candy cigarette flavorings and misleading descriptors, such as light, low, or mild, on tobacco product labels. The FDA broadened its regulatory authority in 2016 to cover all tobacco products (e.g., e-cigarettes, cigars, and loose tobacco), and in 2017 announced a new harm-reduction strategy focused on making cigarettes less addictive by reducing

nicotine levels. 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, although for many smokers, minimum coverage falls short of what is needed for long-term cessation.

Tobacco control efforts were previously spearheaded primarily at the state level, and thus varied substantially across the country. In 2000, the US Surgeon General outlined goals for state tobacco control programs that focused on preventing smoking initiation, promoting cessation, eliminating exposure to SHS, and eliminating disparities in tobacco use.[38] The Centers for Disease Control and Prevention (CDC) recommends funding levels for comprehensive tobacco control programs for all 50 states and the District of Columbia. In fiscal year 2017, states averaged 15% of CDC-recommended funding levels for tobacco control programs, ranging from <1% in Connecticut, Missouri, New Hampshire, and New Jersey to 93% in Alaska and 101% in North Dakota.[39] States that have previously invested in comprehensive tobacco control programs, such as California, Massachusetts, and Florida, have reduced smoking rates and saved millions of dollars in tobacco-related health care costs.[38] Several states (Hawaii, California, New Jersey, Maine, and Oregon) and many localities have gone beyond established policies by increasing the purchase age for tobacco products from 18 to 21 years of age.[40] For more information about tobacco control, visit cancer.org/statistics to view the most recent edition of *Cancer Prevention & Early Detection Facts & Figures* and acscan.org/how-do-you-measure-up for comprehensive state comparisons in tobacco control.

Conclusion

Since the first Surgeon General's report on smoking and health in 1964, smoking prevalence has been reduced by more than half and millions of premature deaths have been averted. Nevertheless, much more can be done to further reduce the health and economic burden of tobacco, namely through interventions targeted at populations with high smoking prevalence. Numerous studies confirm that a comprehensive approach to tobacco control, including higher taxes, 100% smoke-free environments,

coverage for tobacco dependence treatment, plain cigarette packaging, and vigorous tobacco counter advertising, can be successful in reducing deaths, disabilities, and economic disruption from tobacco use.

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 e171.

2. 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.

3. US Department of Health and Human Services. *The Health Consequences of Smoking-50 Years of Progress. A Report from the Surgeon General*. Atlanta, GA; USA: Department of Health and Human Services. Center for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 2014.

4. Secretan B, Straif K, Baan R, et al. A review of human carcinogens – Part E: tobacco, areca nut, alcohol, coal smoke, and salted fish. *Lancet Oncol*. 2009 10: 1033-1034.

5. National Center for Health Statistics. National Health Interview Survey, 2016. Public-use data file and documentation. Available from URL: http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm [accessed July 10, 2017].

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

7. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System Survey Data, 2016. Available from URL: http://www.cdc.gov/brfss/data_documentation/index.htm [accessed October 16, 2017].

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

9. Jamal A, Gentzke A, Hu SS, et al. Tobacco Use Among Middle and High School Students – United States, 2011-2016. *MMWR. Morbid Mortal Wkly Rep*. 2017;66: 597-603.

10. Baker F, Ainsworth SR, Dye JT, et al. Health risks associated with cigar smoking. *JAMA*. 2000;284: 735-740.

11. 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.

12. 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.

13. 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*. 2015.

14. Boonn A, Campaign for Tobacco-Free Kids. The Rise of Cigars and Cigar-Smoking Harms 2017. [accessed September 13, 2017. tobaccofreekids.org/research/factsheets/pdf/0333.pdf].

15. US Department of Health and Human Services. *How Tobacco Causes Disease – The Biology and Behavioral Basis for Smoking-Attributable Disease*. Rockville, MD: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2010.

16. 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.

17. 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.

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

19. 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.

20. International Agency for Research on Cancer. *IARC Handbooks of Cancer Prevention. Volume 13: Evaluating the Effectiveness of Smoke-free Policies.* Lyon, France: IARC Press, 2009.

21. Centers for Disease Control and Prevention. Disparities in secondhand smoke exposure – United States, 1988-1994 and 1999-2004. *MMWR Morb Mortal Wkly Rep.* 2008;57: 744-747.

22. Homa DM, Neff LJ, King BA, et al. Vital signs: disparities in nonsmokers' exposure to secondhand smoke – United States, 1999-2012. *MMWR Morb Mortal Wkly Rep.* 2015;64: 103-108.

23. American Nonsmokers' Rights Foundation. Overview List – How many Smokefree Laws? Available from URL: http://www.no-smoke.org/pdf/mediaordlist.pdf [accessed July 12, 2017].

24. Islami F, Goding-Sauer AG, 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.* 2017; published online November 21.

25. Dai H, Hao J. The Prevalence of Exposure to Workplace Secondhand Smoke in the United States: 2010 to 2015. *Nicotine Tob Res.* 2016.

26. Dinakar C, O'Connor GT. The Health Effects of Electronic Cigarettes. *N Engl J Med.* 2016;375: 1372-1381.

27. Zhu SH, Sun JY, Bonnevie E, et al. Four hundred and sixty brands of e-cigarettes and counting: implications for product regulation. *Tob Control.* 2014;23 Suppl 3: iii3-9.

28. 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.

29. 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.

30. 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 pediatrics.* 2017;171: 788-797.

31. Miech R, Patrick ME, O'Malley PM, Johnston LD. What are kids vaping? Results from a national survey of US adolescents. *Tob Control.* 2016.

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

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

34. 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.

35. 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.

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

37. 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.

38. 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.

39. Campaign for Tobacco-Free Kids. History of Spending for State Tobacco Prevention Programs FY2000-2017. [accessed August 11, 2017].

40. Campaign for Tobacco-Free Kids. States and Localities that have Raised the Minimum Legal Sale Age for Tobacco Products to 21. [accessed August 11, 2017].

Nutrition & Physical Activity

Aside from not smoking, maintaining a healthy body weight, being physically active on a regular basis, eating a healthy diet, and limiting alcohol consumption are the most important ways to reduce cancer risk. A recent study led by American Cancer Society scientists estimated that 18% of cancer cases and 16% of cancer deaths in 2014 were attributable to the combined effects of excess body weight, physical inactivity, and an unhealthy diet (including excess alcohol).[1] The American Cancer Society (along with other organizations) has developed recommendations, described in detail herein, to help guide individuals in adopting healthy behaviors. Studies estimate that adults who most closely follow these healthy lifestyle recommendations are 10%-20% less likely to be diagnosed with cancer and 20%-30% less likely to die from the disease.[2] These guidelines also

include recommendations for community action because of the substantial influence of physical and social environments on individual food and activity choices. Visit cancer.org/healthy/eat-healthy-get-active/acs-guidelines-nutrition-physical-activity-cancer-prevention.html and *Cancer Prevention & Early Detection Facts & Figures* at cancer.org/statistics for additional information on these guidelines and how healthy behaviors influence cancer risk.

Recommendations for Individual Choices

Achieve and maintain a healthy weight throughout life.

- Be as lean as possible throughout life without being underweight.

- Avoid excess weight gain at all ages. For those who are currently overweight or obese, losing even a small amount of weight has health benefits and is a good place to start.

- Engage in regular physical activity and limit consumption of high-calorie foods and beverages as key strategies for maintaining a healthy weight.

The International Agency for Research on Cancer has concluded that being overweight or obese increases the risk of developing 13 cancers: uterine corpus, esophagus (adenocarcinoma), liver, stomach (gastric cardia), kidney (renal cell), brain (meningioma), multiple myeloma, pancreas, colorectum, gallbladder, ovary, female breast (postmenopausal), and thyroid.[3] There is limited evidence that excess body weight also increases risk of non-Hodgkin lymphoma (diffuse large B-cell lymphoma), male breast cancer, and fatal prostate cancer. Accumulating evidence suggests that overweight/obesity also decreases survival for several cancers.[4, 5] According to current national data for adults:

- Obesity prevalence among adults 20-74 years of age escalated from 15% during 1976-1980 to 40% during 2015-2016.[6, 7]

- Obesity prevalence was slightly higher in women (41%) than in men (38%) in 2015-2016.[7]

- Among men, obesity prevalence was higher among Hispanics (43%) than among non-Hispanic whites (38%) and non-Hispanic blacks (37%).[7]

- Among women, obesity prevalence was higher among Hispanics (51%) and non-Hispanic blacks (55%) than non-Hispanic whites (38%).[7]

- The proportion of overweight or obese adults who recently attempted to lose weight declined from 56% in 1988 to 49% in 2014, despite the potential health benefits of intentional weight loss.[8]

A healthy body weight is especially important during childhood because excess weight in youth often continues throughout life, resulting in long-term cumulative exposure to excess body fat and subsequent adverse health consequences.[9,10] Although obesity prevalence in US children and adolescents rose in parallel with that in adults during the 1980s and 1990s, since the mid-2000s it declined slightly in children ages 2-5 years and stabilized in ages 6-11.[11] During 2015-2016:

- Obesity prevalence was 14% in children ages 2-5; 18% in ages 6-11; and 21% in ages 12-19.[7]

- Obesity prevalence in children ages 2-19 was highest in Hispanic boys (28%) and non-Hispanic black girls (25%) and lowest in non-Hispanic white boys (15%) and girls (14%).[7]

Adopt a physically active lifestyle.

- Adults should engage in at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity activity each week, or an equivalent combination, preferably spread throughout the week.

- Children and adolescents should engage in at least 1 hour of moderate- or vigorous-intensity activity each day, with vigorous-intensity activity at least three days each week.

- Limit sedentary behavior such as sitting, lying down, and watching television and other forms of screen-based entertainment.

- Doing any intentional physical activity above usual activities can have many health benefits.

According to the World Cancer Research Fund, there is convincing evidence that physical activity decreases the risk of colon (but not rectal) cancer[12] and it probably also decreases risk of endometrial and postmenopausal breast cancer.[13, 14] In addition, accumulating research suggests that physical activity may also reduce the risk of other cancers, including liver, lung, and kidney.[15] Physical activity also indirectly reduces the risk of developing obesity-related cancers because of its role in helping to maintain a healthy weight. High levels of moderate-intensity activity (60-75 minutes per day) appear to offset the increased risk of death associated with prolonged sitting.[16] Even low amounts of physical activity appear to reduce cancer mortality compared to no activity at all.[17] Despite the wide variety of health benefits from being active, current national data indicate:

- 27% of adults reported no leisure-time activity (29% in females; 25% in males) in 2016, with blacks (37%) and Hispanics (36%) reporting higher inactivity than whites (23%).[18]

- 53% of adults reported meeting recommended levels of aerobic activity in 2016, up from 40% in 1998.

- Only 27% of high school students (36% and 18% in boys and girls, respectively) met recommendations in 2015 by engaging in at least 60 minutes of physical activity per day in the previous seven days.[19]

Consume a healthy diet with an emphasis on plant foods.

- Choose foods and beverages in amounts that help achieve and maintain a healthy weight.

- Limit consumption of red and processed meat.

- Eat at least 2½ cups of vegetables and fruits each day.

- Choose whole grains instead of refined-grain products.

There is strong scientific evidence that healthy dietary patterns, in combination with regular physical activity, are needed to maintain a healthy body weight and reduce cancer risk. Studies show that eating more processed and red meat, potatoes, refined grains, and sugar-sweetened beverages and foods is associated with a higher risk of developing or dying from a variety of cancers, whereas eating a variety of fruits and vegetables, whole grains, and fish or poultry and fewer red and processed meats is associated with reduced cancer risk. A review of the evidence found that people who have the healthiest diet have an 11%-24% lower risk of cancer death than those with the least healthy diet.[20] In addition, improving the quality of diet over time is associated with an overall reduced risk of death. [21] Unfortunately, most Americans do not consume a healthy diet. Current national data show:

- 29% of adults reported eating two or more servings of fruits per day and 16% consumed vegetables three or more times per day in 2015.[22]

- 32% of high school students reported consuming 100% fruit juice or fruit two or more times per day in 2015 and only 15% reported consuming vegetables three or more times per day.[19]

The scientific study of nutrition and cancer is challenging, largely because eating patterns are complex and difficult to assess.[23] While the evaluation of dietary patterns instead of individual food items is a promising new strategy, additional important questions about food components remain unanswered. Further research is needed to understand how single nutrients and other food constituents influence cancer risk throughout a person's life.

If you drink alcoholic beverages, limit consumption.

- Limit alcohol intake to no more than two drinks per day for men and one drink per day for women.

Alcohol consumption is a risk factor for cancers of the mouth, pharynx, larynx, esophagus, liver, colorectum, and female breast,[24] and heavy drinking (3 to 4 drinks daily) may also increase risk of stomach and pancreatic cancer.[25] Cancer risk increases with alcohol volume, and even a few drinks per week may be associated with a slightly increased risk of female breast cancer.[26] Alcohol consumption combined with tobacco use increases the risk of cancers of the mouth, larynx, and esophagus many-fold more than either drinking or smoking alone.[27] In 2011-2014, 33% of men reported drinking ≥2 alcoholic drinks per day on average or ≥5 drinks on a single occasion during the past 30 days, and 23% of women reported drinking ≥1 drink per day or ≥4 drinks on a single occasion.[28]

American Cancer Society Recommendations for Community Action

Public, private, and community organizations should work collaboratively at national, state, and local levels to implement environmental policy changes that:

- Increase access to affordable, healthy foods in communities, worksites, and schools and decrease access to, and marketing of, foods and beverages of low nutritional value, particularly to youth.

- Provide safe, enjoyable, and accessible environments for physical activity in schools and worksites, and for transportation and recreation in communities.

Many Americans encounter substantial barriers to consuming a healthy diet and engaging in regular physical activity, including limited access to affordable, healthy foods; increased portion sizes; marketing and advertising of foods and beverages high in calories, fat, and added sugar, particularly to kids; schools and worksites that are not conducive to good health; community design that hinders physical activity and promotes sedentary behavior; and economic and time constraints. The 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 in the community environment are required to increase healthy lifestyles and curb the obesity epidemic.

References

1. Islami F, Sauer AG, 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*. 2017; published online November 21.

2. Kohler LN, Garcia DO, Harris RB, Oren E, Roe DJ, Jacobs ET. Adherence to Diet and Physical Activity Cancer Prevention Guidelines and Cancer Outcomes: A Systematic Review. *Cancer Epid Biomarker Prev*. 2016;25(7):1018-1028.

3. Lauby-Secretan B, Scoccianti C, Loomis D, et al. Body Fatness and Cancer – Viewpoint of the IARC Working Group. *N Engl J Med*. 2016;375(8):794-798.

4. Campbell PT, Newton CC, Dehal AN, Jacobs EJ, Patel AV, Gapstur SM. Impact of body mass index on survival after colorectal cancer diagnosis: the Cancer Prevention Study-II Nutrition Cohort. *J Clin Oncol*. 2012;30(1):42-52.

5. Cao Y, Ma J. Body mass index, prostate cancer-specific mortality, and biochemical recurrence: a systematic review and meta-analysis. *Cancer Prev Res* (Phila). 2011;4(4):486-501.

6. Fryar CD, Carroll MD, Ogden CL. Prevalence of Overweight, Obesity, and Extreme Obesity Among Adults: United States, 1960-1962 through 2011-2012. National Center for Health Statistics. September 2014. National Center for Health Statistics 2014; http://www.cdc.gov/nchs/data/hestat/obesity_adult_11_12/obesity_adult_11_12.pdf.

7. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of obesity among adults and youth: United States, 2015–2016. NCHS data brief, no 288. Hyattsville, MD: National Center for Health Statistics. 2017.

8. Snook KR, Hansen AR, Duke CH, Finch KC, Hackney AA, Zhang J. Change in Percentages of Adults With Overweight or Obesity Trying to Lose Weight, 1988-2014. *JAMA*. 2017;317(9):971-973.

9. Lee JM, Pilli S, Gebremariam A, et al. Getting heavier, younger: trajectories of obesity over the life course. *Int J Obes*. 2010;34(4):614-623.

10. Song M, Willett WC, Hu FB, et al. Trajectory of body shape across the lifespan and cancer risk. *Int J Cancer*. 2016;138(10):2383-2395.

11. Ogden CL, Carroll MD, Lawman HG, et al. Trends in Obesity Prevalence Among Children and Adolescents in the United States, 1988-1994 Through 2013-2014. *JAMA*. 2016;315(21):2292-2299.

12. World Cancer Research Fund International/American Institute for Cancer Research. Continuous Update Project Report: Diet, nutrition, physical activity and colorectal cancer. 2017; http://wcrf.org/colorectal-cancer-2017.

13. World Cancer Research Fund/American Institute for Cancer Research. Continuous Update Project Report: Food, nutrition, physical activity, and the prevention of endometrial cancer. 2013; http://wcrf.org/sites/default/files/Endometrial-Cancer-2013-Report.pdf.

14. World Cancer Research Fund/American Institute for Cancer Research. Continuous Update Project Report: Diet, nutrition, physical activity and breast cancer. 2017; http://wcrf.org/breast-cancer-2017.

15. Moore SC, Lee IM, Weiderpass E, et al. Association of Leisure-Time Physical Activity With Risk of 26 Types of Cancer in 1.44 Million Adults. *JAMA Intern Med*. 2016;176(6):816-825.

16. 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.

17. O'Donovan G, Lee IM, Hamer M, Stamatakis E. 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(3):335-342.

18. National Center for Health Statistics. National Health Interview Survey, 2016. Public-use data file and documentation. 2017; http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm. Accessed July 30, 2017.

19. Kann L, McManus T, Harris WA, et al. Youth Risk Behavior Surveillance – United States, 2015. *MMWR Surveill Summ*. 2016;65(6):1-174.

20. 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(3):393-402.

21. 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(2):143-153.

22. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System Survey Data, 2015. Available from URL: http://www.cdc.gov/brfss/data_documentation/index.htm [accessed September 13, 2016].

23. Mayne ST, Playdon MC, Rock CL. Diet, nutrition, and cancer: past, present and future. *Nat Rev Clin Oncol.* 2016;13(8):504-515.

24. World Cancer Research Fund and American Institute for Cancer Research. Continuous Update Project 2016; http://www.wcrf.org/int/research-we-fund/continuous-update-project-cup.

25. Bagnardi V, Rota M, Botteri E, et al. Alcohol consumption and site-specific cancer risk: a comprehensive dose-response meta-analysis. *Br J Cancer.* 2015;112(3):580-593.

26. Chen WY, Rosner B, Hankinson SE, Colditz GA, Willett WC. Moderate alcohol consumption during adult life, drinking patterns, and breast cancer risk. *JAMA.* 2011;306(17):1884-1890.

27. World Cancer Research Fund/American Institute for Cancer Research. *The Associations Between Food, Nutrition and Phyisical Activity and the Prevention of Cancer: A Global Perspective.* Washington, DC: World Cancer Research Fund/American Institute for Cancer Research 2007.

28. Healthy People 2020. Substance Abuse Objectives. 2014; https://www.healthypeople.gov/2020/topics-objectives/topic/substance-abuse/objectives. Accessed September 16, 2016.

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 some 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 lower likelihood of standard treatment. Barriers to preventive care, early detection, and optimal treatment 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 in underserved populations.

Racial and Ethnic Minorities

Racial and ethnic disparities in the cancer burden largely reflect disproportionate poverty. According to the US Census Bureau, in 2016, 22% of blacks and 19% of Hispanics/Latinos lived below the poverty line, compared to 9% of NHWs and 10% of Asians. In addition, 11% of blacks and 16% of Hispanics/Latinos were uninsured, compared to 6% of NHWs and 8% of Asians. Discrimination also contributes to cancer disparities. 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 and/or inherited factors. For example, Hispanics and Asians overall have lower rates of lung cancer than NHWs because they are less likely to smoke (Table 9, page 54). Conversely, because a large number of Hispanics are recent immigrants, they have higher rates of cancers related to infectious agents (e.g., stomach) because of a higher prevalence of infection in their native countries. Genetic factors also explain some differences in cancer incidence, such as the higher frequency of mutations in the breast cancer susceptibility genes *BRCA1* and *BRCA2* among women of Ashkenazi Jewish descent. However, genetic differences associated with race or ethnicity make only a minor contribution to the disparate cancer burden between populations.

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 information for several racial and ethnic groups, especially American Indians and Alaska Natives (AIANs), is known to be incomplete due to misclassification on medical and death records. Although efforts are being made to collect more accurate information, rates presented for AIANs in particular likely do not represent the true cancer burden in this population.

Non-Hispanic Black: Non-Hispanic black (henceforth black) males have the highest overall cancer incidence (560.9 per 100,000) and death (246.1) rates of the major racial/ethnic groups, 10% and 23% higher, respectively, than non-Hispanic white males (510.7 and 200.7) (Table 9, page 54). Cancer death rates in black males are twice those in Asian and Pacific Islanders (APIs, 120.4), who have the lowest rates. Prostate cancer death rates in blacks are more than double those of any other group. Black females have 14% higher cancer death rates than NHW females despite 7% lower incidence rates. See *Cancer Facts & Figures for African Americans*, available online at cancer.org/statistics, for more information.

Hispanic/Latino: Cancer patterns in US Hispanics generally reflect those in immigrant countries of origin, but become more similar to non-Hispanic white

Americans across generations due to acculturation. As an aggregate group, Hispanics have lower rates for the most common cancers (female breast, colorectum, lung, and prostate), but among the highest rates for cancers associated with infectious agents. For example, Hispanics have cervical cancer incidence rates that are nearly 40% higher than those in NHWs, and liver and stomach cancer incidence rates that are about double (Table 9, page 54). See *Cancer Facts & Figures for Hispanics/Latinos*, available online at cancer.org/statistics, for more information.

Asian and Pacific Islander (API): 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, page 54). Like Hispanics, lung cancer rates in APIs are about half those in NHWs because of historically low smoking rates. However, some API populations with high smoking rates, such as Native Hawaiians, have lung cancer rates more similar to those of non-Hispanic whites. This example of the variation in cancer occurrence within the API population reflects its diversity in terms of geographic origin, language, acculturation, and socioeconomic status. Unfortunately, most cancer data are currently 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 Indian and Alaska Native (AIAN): AIANs have the highest kidney cancer incidence and death rates of any racial or ethnic population – 3 times higher than those among APIs, who have the lowest rates (Table 9, page 54). However, like other broad racial and ethnic groups, cancer rates vary greatly within the AIAN population because of differences in behaviors that influence disease risk. For example, kidney cancer death rates are twofold higher among AIAN men living in the Northern and Southern Plains than in those living in the East and Pacific Coast regions, likely because of differences in the prevalence of smoking, obesity, and hypertension. Likewise, variations in smoking patterns among AIAN men are reflected in their lung cancer rates, which are about 50% higher than whites for those living in the Northern Plains or Alaska, but less than half those

Table 9. Incidence and Mortality Rates* for Selected Cancers by Race and Ethnicity, US, 2010-2015

Incidence, 2010-2014	All races	Non-Hispanic white	Non-Hispanic black	Asian/ Pacific Islander	American Indian/ Alaska Native†	Hispanic/ Latino
All sites						
Male	501.9	510.7	560.9	302.8	425.3	386.3
Female	417.9	436.0	407.4	287.6	388.7	329.6
Breast (female)	123.6	128.7	125.5	90.8	100.7	91.9
Colon & rectum						
Male	45.9	45.2	56.4	37.0	50.1	41.9
Female	34.8	34.5	41.7	27.0	41.3	29.3
Kidney & renal pelvis						
Male	21.8	22.1	24.8	10.9	30.0	20.7
Female	11.3	11.3	12.9	4.9	17.4	12.0
Liver & intrahepatic bile duct						
Male	12.1	10.0	17.2	20.0	20.1	19.8
Female	4.2	3.4	5.1	7.6	8.8	7.6
Lung & bronchus						
Male	73.0	75.9	87.9	45.2	71.9	40.6
Female	52.8	57.6	50.1	27.9	55.9	25.2
Prostate	114.9	107.0	186.8	58.4	78.3	97.0
Stomach						
Male	9.2	7.9	14.3	14.1	11.6	12.9
Female	4.7	3.5	7.8	8.1	6.5	7.8
Uterine cervix	7.6	7.0	9.5	6.0	9.1	9.7
Mortality, 2011-2015						
All sites						
Male	196.7	200.7	246.1	120.4	181.4	140.0
Female	139.5	143.7	163.2	87.7	127.6	96.7
Breast (female)	20.9	20.8	29.5	11.3	14.3	14.2
Colon & rectum						
Male	17.3	16.9	25.1	12.0	20.2	14.6
Female	12.2	12.1	16.5	8.6	13.6	9.0
Kidney & renal pelvis						
Male	5.6	5.8	5.7	2.6	8.4	5.0
Female	2.4	2.5	2.4	1.1	4.1	2.3
Liver & intrahepatic bile duct						
Male	9.4	8.2	13.5	14.0	14.8	13.0
Female	3.8	3.4	4.7	6.0	7.0	5.9
Lung & bronchus						
Male	53.8	56.3	66.9	31.0	45.0	26.4
Female	35.4	39.0	34.4	17.7	30.6	13.3
Prostate	19.5	18.2	40.8	8.7	19.7	16.1
Stomach						
Male	4.3	3.4	8.5	6.8	7.3	6.7
Female	2.3	1.7	4.0	4.2	3.5	4.0
Uterine cervix	2.3	2.1	3.8	1.8	2.6	2.6

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

Source: Incidence – North American Association of Central Cancer Registries, 2017. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2017.

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in whites for AIAN men living in the Southwest. Notably, Alaska Natives have the highest colorectal cancer incidence in the US, more than double that in NHWs (91 versus 40 per 100,000) and almost 90% higher than in blacks (49 per 100,000).

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

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 7 deaths worldwide – more than HIV/AIDS, tuberculosis, and malaria combined. In 2012, there were an estimated 14.1 million cases of cancer diagnosed around the world and 8.2 million cancer deaths. More than 60% of cancer deaths occurred in low- and middle-income countries (LMICs), many of which lack the medical resources and health systems to support the disease burden. By 2030, the global burden is expected to reach 21.6 million new cancer cases and 13.0 million cancer deaths solely due to the growth and aging of the population. These projections may increase 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 LMICs. Tobacco use is a major contributor to the global burden of cancer, accounting for more than 20% of cancer deaths worldwide.

Worldwide Tobacco Use

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

- Tobacco was responsible for more than 7 million deaths in 2015, including 886,000 deaths from secondhand smoke exposure among nonsmokers. More than 75% of tobacco-attributable deaths are in LMICs.

- Between 2002 and 2030, tobacco-attributable deaths are expected to decrease from 1.6 million to 1.5 million in high-income countries, but double in LMICs (from 3.4 million to 6.8 million).

- The tobacco industry has been aggressively pursuing legal challenges to tobacco control interventions around the globe and promoting falsehoods about illicit trade and the livelihoods of smallholder tobacco farmers in order to further promote tobacco use.

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. A number of major tobacco-producing nations, including Argentina, Indonesia, Malawi, and the United States, are among the few nations that have not yet ratified the treaty.

- About 63% of the world's population was covered by at least one comprehensive tobacco control measure in 2016, up from about 15% in 2008.

- The WHO estimates that 20% of the world's population lives in smoke-free environments and only 10% is covered by comprehensive tobacco tax policy.

The Role of the American Cancer Society

With more than a century of experience in cancer control, the American Cancer Society is uniquely positioned to help save lives from cancer and tobacco globally by assisting and empowering the world's cancer societies and anti-tobacco advocates. The American Cancer Society Global Cancer Control and Intramural Research departments are raising awareness about the growing global cancer burden and promoting evidence-based cancer and tobacco control programs 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. Although 67% of these deaths occur in LMICs, less than 2% of private and public health funding is allocated to prevent and control NCDs in these areas. The American Cancer Society helps make cancer and other NCDs a global public health priority by

collaborating with key partners, including the NCD Alliance, the Union for International Cancer Control, the World Health Organization (WHO), the International Agency for Research on Cancer, the NCD Roundtable, and the Taskforce on Women and Non-Communicable Diseases. An example of recent progress in this effort occurred in 2015 at a United Nations summit, where government leaders formally recognized NCDs as a major challenge to sustainable development for the first time, committing to develop national responses to NCDs as part of the Sustainable Development Goals, including strengthening the implementation of the FCTC and improving access to vaccines and medicines for cancer and other NCDs.

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

Help 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 tobacco taxation initiative that promotes the Sustainable Development Goal of a 30% reduction in smoking prevalence by 2025. This program actively seeks to engage specific cancer organizations, most of which have not been involved in this area, particularly in LMICs, and also provides capacity building and technical assistance to interested organizations and governments. Further, because issues

around illicit trade have been so tied to tobacco taxation, the initiative takes advantage of the EHPR's knowledge and experience to help governments navigate the challenges around implementing tobacco taxation successfully amid tobacco industry opposition. The EHPR team is also leading a multi-year program – with support from the US National Institutes of Health, the Bloomberg Philanthropies, and the World Bank – to examine the livelihoods of tobacco farmers in Indonesia, Kenya, Malawi, the Philippines, and Zambia to dispel the tobacco industry's myth that tobacco control harms small tobacco farmers.

Make effective pain treatment available to all in need. 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, 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. The American Cancer Society is also training health workers in more than 30 teaching and referral hospitals across the 5 countries through the Pain-Free Hospital Initiative, a 1-year hospital-wide quality improvement initiative designed to change clinical practice by integrating effective, high-quality pain treatment into hospital-based services.

Increase awareness about the global cancer burden. The 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, the American Cancer Society partnered with the International Agency for Research on Cancer and the Union for International Cancer Control to produce *The Cancer Atlas, Second Edition* and its interactive website (canceratlas.cancer.org). The *Atlas*, which highlights the complex nature of the global cancer landscape while pointing to strategies governments can use to reduce their cancer burden, is available in English, French, Spanish, Russian, Arabic, Chinese, Hindi, Turkish, Farsi and Portuguese. Similarly,

The Tobacco Atlas, Fifth Edition (tobaccoatlas.org), a collaboration with Vital Strategies, is the most comprehensive resource on the evolving worldwide tobacco epidemic (and available in six languages). Tobaccoatlas.org receives more than 30,000 visitors each month, with more than two-thirds of those visitors coming from 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 its print publications, the American Cancer Society's website, cancer.org, provides cancer information to millions of individuals throughout the world. In 2015, 43% of visits to the website came from outside the US. Information is currently available in English, Spanish, Chinese, Bengali, Hindi, Korean, Urdu, and Vietnamese.

The American Cancer Society

The American Cancer Society was founded in 1913 as the American Society for the Control of Cancer by 15 prominent physicians and business leaders in New York City. The organization's aim was to bring cancer into the mainstream of public disclosure through education campaigns, working to inform both health practitioners and the public about the disease. The American Cancer Society now works with nearly 2 million volunteers to lead the fight for a world without cancer. Although our message and methods have changed over the past 100-plus years, our goal remains the same: save lives. Thanks in part to our contributions, more than 2.3 million cancer deaths have been averted in the US in the past two decades.

How the American Cancer Society Is Organized

The American Cancer Society, Inc., is a 501(c)(3) nonprofit corporation governed by a Board of Directors composed entirely of volunteers from the medical and lay communities. The Board is responsible for setting policy, establishing long-term goals, monitoring general operations, and approving organizational outcomes and the allocation of resources. The organization is comprised of local offices in 6 geographic Regions and a global headquarters in Atlanta, Georgia. The headquarters is responsible for overall strategic planning; corporate support services such as human resources, financial management, IT, etc.; development and implementation of global and nationwide endeavors such as our

groundbreaking research program, our global cancer control program, and our 24-hour call center; and providing technical support and materials for Regions and local offices for local delivery. Our Regions and local offices are organized to engage communities in helping to save lives from cancer, delivering potentially lifesaving programs and services, and raising money at the local level. Offices are strategically located around the country in an effort to maximize the impact of our efforts while being as efficient as possible with donor dollars.

The American Cancer Society also works closely with our nonprofit, nonpartisan advocacy affiliate, the American Cancer Society Cancer Action Network[SM] (ACS CAN). As the nation's leading cancer advocacy organization, ACS CAN is working every day to make cancer issues a top national priority. With staff and volunteers in all 50 states and the District of Columbia, ACS CAN uses applied policy analysis, direct lobbying, grassroots action, and media advocacy to ensure elected officials nationwide pass and effectively implement laws that help save lives from cancer.

Volunteers

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

How the American Cancer Society Saves Lives

As an organization of nearly 2 million dedicated volunteers and staff, the American Cancer Society is leading the fight for a world without cancer.

Prevention and Early Detection

Smoking still causes about one-third of all cancer deaths in the US, including more than 80 percent of lung cancer deaths. The American Cancer Society continues its long history of work to reduce tobacco use among children and adults through research (see page 61), education, and advocacy (see page 66). We've recently established the American Cancer Society Center for Tobacco Control to work toward the adoption and implementation of smoke- and tobacco-free policies in all workplaces, public places, and other important venues such as multi-unit residential settings. In addition, we're taking an increasingly proactive role in addressing the changing landscape related to rapidly emerging tobacco-related markets, including for electronic smoking products such as e-cigarettes, and for other changes globally.

For Americans who do not smoke, the most important way to reduce cancer risk is to maintain a healthy, active lifestyle. The American Cancer Society publishes guidelines on nutrition and physical activity for cancer prevention in order to review the accumulating scientific evidence on diet and cancer; to synthesize this evidence into clear, informative recommendations for the general public; to promote healthy individual behaviors and environments that support healthy eating and physical activity; and, ultimately, to reduce cancer risk. Those guidelines form the foundation for our communication, worksite, school, and community strategies designed to encourage and support people in making healthy lifestyle behavior choices.

Finding cancer at its earliest, most treatable stage gives patients the greatest chance of survival. Moreover, screening tests for cervical and colorectal cancer can detect precancers, allowing for cancer prevention. To help the public and health care providers make informed decisions about cancer screening, the American Cancer

Society publishes early-detection guidelines for cancers of the breast, cervix, colorectum, endometrium, lung, and prostate to ensure that recommendations are based on the most current scientific evidence. In addition, the American Cancer Society has a history of implementing aggressive campaigns to increase awareness among the public and health care professionals of cancer screening tests. Campaigns to increase use of Pap testing and mammography have helped contribute to a 70% decrease in cervical cancer death rates since 1969 and a 39% decline in breast cancer death rates between 1989 and 2015. Building on previous colorectal cancer prevention and early-detection efforts, we joined the National Colorectal Cancer Roundtable (NCCRT) in 2013 in its 80% by 2018 initiative to increase colorectal cancer screening among adults 50 and older to 80% by 2018, with an emphasis on economically disadvantaged individuals, who are least likely to be tested. We also continue to encourage the early detection of breast cancer through public awareness and other efforts targeting poor and underserved communities.

Similarly, seeing the need to reduce the incidence of and mortality from human papillomavirus (HPV)-associated cancers, 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. With a variety of programs such as the NCCRT, the National HPV Vaccination Roundtable, and the Community Health Advocates implementing Nationwide Grants for Empowerment and Equity (CHANGE) Grant Program, we work with community health partners and corporations across the nation to increase access to preventive care and improve health equity. Together in 2016, we contributed to more than 750,000 outreach interventions and nearly 200,000 cancer screenings. 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 will be diagnosed in the US this year. That's why the American Cancer Society and other members of the National Council on Skin Cancer Prevention have designated the Friday

before Memorial Day as Don't Fry Day. We promotes skin cancer prevention and awareness educational messages in support of Don't Fry Day and year-round.

The American Cancer Society also works with companies across the US to help their employees learn more about taking action to help reduce their cancer risk. Using an evidence-based approach to evaluate health and wellness, we work alongside employers to strengthen a culture of health and provide employee-focused resources and information.

Some products we offer include:

- **Quit For Life® Program:** This is the nation's leading tobacco cessation program, offered by 26 states and more than 700 employers and health plans throughout the US. Operated by Optum, the program is built on the organizations' more than 35 years of combined experience in tobacco cessation. It employs an evidence-based combination of physical, psychological, and behavioral strategies to enable participants to overcome their addiction to tobacco. A critical mix of medication support, phone-based cognitive behavioral coaching, text messaging, web-based learning, and support tools produces a higher-than-average quit rate.

- **80% by 2018 Employer Challenge Guide:** This resource provides companies with the tools and resources they need to educate and encourage their employees 50 and older to get screened for colorectal cancer and help reach the 2018 goal.

Treatment

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

Information, 24 Hours a Day, 7 Days a Week

Caring, trained American Cancer Society staff connect people to answers about a cancer diagnosis, our clinical trials matching service, health insurance assistance,

American Cancer Society programs and services, and referrals to other services at our 24-hour helpline at 1-800-227-2345. Our website, cancer.org, offers thousands of pages of reliable and accurate cancer information and news, including in-depth information on treatments and side effects for every major cancer type, and programs and services nearby. We also help people who speak languages other than English or Spanish find the assistance they need, offering services in more than 200 languages.

The American Cancer Society also publishes a wide variety of brochures and books that cover a multitude of topics, from patient education, quality of life, and caregiving issues to healthy living. Visit cancer.org/bookstore for a complete list of books that are available to order. Call 1-800-227-2345 or visit cancer.org for brochures. We also publish three peer-reviewed scientific journals for health care providers and researchers: *Cancer*, *Cancer Cytopathology*, and *CA: A Cancer Journal for Clinicians*. Visit acsjournals.com to learn about the journals and their content.

Day-to-day Help and Support

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

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

cancer on multiple facets of survivors' lives and on developing and testing interventions to help survivors actively engage in their health care and improve their health and well-being through and beyond treatment.

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

Help navigating the health care system: Learning how to navigate the cancer journey and the health care system can be overwhelming for anyone, but it is particularly difficult for those who are medically underserved, those who experience language or health literacy barriers, and those with limited resources. The American Cancer Society Patient Navigator Program reaches those most in need. The largest oncology-focused patient navigator program in the country, it has specially trained patient navigators at more than 120 sites across the nation. Patient navigators can help: find transportation to and from cancer-related appointments; assist with medical financial issues, including insurance navigation; identify community resources; and provide information on a patient's cancer diagnosis and treatment process. In 2016, nearly 45,000 people relied on the Patient Navigator Program to help them through their diagnosis and treatment. We collaborate with a variety of organizations, including the National Cancer Institute's Center to Reduce Cancer Health Disparities, the Center for Medicare and Medicaid Services, numerous cancer treatment centers, and others to implement and evaluate this program.

Transportation to treatment: For many cancer patients, transportation is a roadblock to getting to vitally needed treatment. The American Cancer Society Road To Recovery® program provides free rides to the medical treatments they need. Trained volunteer drivers donate their time and the use of their personal vehicles to provide rides to patients.

In 2016, the American Cancer Society provided nearly 335,000 rides to cancer patients. Other transportation programs are also available in certain areas.

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 2016, more than 30 Hope Lodge locations provided more than 465,000 nights of free lodging to nearly 24,000 patients and caregivers – saving them $37 million in hotel expenses. Through our Hotel Partners Program, we also partner with local hotels across the country to provide free or deeply discounted lodging for patients who are not able to make frequent trips for treatment appointments.

Breast cancer support: Through the American Cancer Society Reach To Recovery® program, breast cancer patients are paired with trained volunteers who have had similar diagnoses and treatment plans to provide more personal, one-on-one support. In 2016, the program assisted more than 8,000 patients.

Hair-loss and mastectomy products: Some women wear wigs, hats, breast forms, and special bras to help cope with the effects of a mastectomy and hair loss. The American Cancer Society *"tlc" Tender Loving Care*® publication offers affordable hair loss and mastectomy products, as well as advice on how to use those products. The *"tlc"*™ products and catalogs may be ordered online at tlcdirect.org or by calling 1-800-850-9445.

Help with appearance-related side effects of treatment: The Look Good Feel Better® program teaches women how to cope with appearance-related side effects of cancer treatment. Group workshops are free and led by licensed volunteer beauty professionals (cosmetologists, estheticians, and nail technicians). Skin care, makeup, and hair loss solution techniques and tips are provided in a supportive environment. Information and materials are also available for men and teens. This program is a collaboration of the American Cancer Society, the Look Good Feel Better Foundation, and the Professional Beauty Association.

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

Research

Research is at the heart of the American Cancer Society's mission. For more than 70 years, we have been finding answers that help save lives – from changes in lifestyle to new approaches in therapies to improving cancer patients' quality of life. No single private, nongovernmental organization in the US has invested more to find the causes and cures of cancer than the American Cancer Society. We relentlessly pursue the answers that help us understand how to prevent, detect, and treat all cancer types. We combine the world's best and brightest researchers with the world's largest and most effective community-based organization to put answers into action.

The American Cancer Society's comprehensive research program consists of extramural grants, as well as intramural programs in epidemiology, surveillance and health services research, behavioral research, economic and health policy research, and statistics and evaluation. Intramural research programs are staffed by our own research scientists.

Extramural Research
The American Cancer Society Extramural Research program currently supports research and training in a wide range of cancer-related disciplines at more than 200 institutions. As of August 1, 2017, we are funding 732 research and training grants totaling more than $390 million. Grant applications are solicited through a nationwide competition and are subjected to a rigorous external peer-review process, ensuring that only the most promising research is funded. The American Cancer Society primarily funds investigators early in their

research careers, thus giving the best and the brightest a chance to explore cutting-edge ideas at a time when they might not find funding elsewhere. In addition, the Extramural Research program focuses on needs that are unmet by other funding organizations, such as coordinating with the National Palliative Care Research Center to augment research in palliative care for cancer patients. The American Cancer Society is honored to have given funding to 47 investigators who went on to win the Nobel Prize, considered the highest accolade any scientist can receive. This is a tribute to our research program and the strength of its peer-review process.

The Extramural Research department is comprised of six grant programs that span the continuum from basic bench research to public policy.

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

Cancer Cell Biology and Metastasis: The primary goal of this program is to provide an understanding of the nature of cancer cells so they can be more effectively treated. Emphases include understanding the fundamental controls of normal and cancer cells with a focus on the regulation of cell growth, division, and death; how cells create an identity and relate to their local environment and to other cells; and regulation of when and how cells move from one site to another. To most completely reach the program goal, a wide variety of cells are used so all aspects of cell biology can be examined. This program is directed by Charles (Karl) Saxe, PhD.

Translational Cancer Research: This program focuses on the interface between laboratory investigations and human testing. The scope of the program includes investigations of the role of infectious diseases in cancer, the synthesis and discovery of cancer drugs, the creation

and use of animal models of cancer, and the role of individual or groups of genes in different types of cancer. This program is directed by Lynne Elmore, PhD.

Clinical Cancer Research, Nutrition, and Immunology: This program's investigations include basic, preclinical, clinical, and epidemiological studies of new modalities for cancer prevention, diagnosis, and treatment. In addition, the program seeks to improve understanding of cancer-related inflammatory responses and the use of the immune system for cancer prevention and therapy. Focus areas also include increased understanding of the effects of nutrition and the environment on cancer prevention, initiation, progression, and treatment. This program is directed by Susanna Greer, PhD.

Cancer Control and Prevention Research: This program focuses on the development and testing of interventions to influence health behaviors and health care delivery. Research projects focus on cancer risk reduction and delivery of high-quality health promotion, screening, early detection, and treatment services. Projects are also directed at health services, outcomes, and policy research to assess the effectiveness of interventions and impact of polices on access to care, as well as quality and costs of cancer care. Special emphasis is placed on health equity research addressing disparities in disadvantaged groups and social determinants of health that drive inequities. This program is directed by Elvan Daniels, MD, MPH.

Health Professional Training in Cancer Control: This program provides grants in support of nurses, physicians, and social workers to pursue training in outstanding programs that meet high standards for excellence. The immediate goal is to encourage highly qualified individuals to enter careers in cancer prevention and control practice. The grant program goal is to accelerate the application of research findings in cancer prevention and control by increasing the number of nursing and social work clinicians and researchers with expertise in and career commitment to cancer control, and generalist physicians actively engaged in cancer control. This program is directed by Virginia Krawiec, MPA.

Intramural Research

In 1946, under the direction of E. Cuyler Hammond, ScD, a small researcher group focused on investigating the causes of cancer and improving the quality and availability of cancer data was created at the American Cancer Society. Since then, our Intramural Research program has grown into 5 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.

Epidemiology: The Epidemiology Research program seeks to reduce the cancer burden by conducting large, nationwide prospective studies that advance the understanding of cancer and inform cancer prevention and control. To accomplish this goal, in 1952 Hammond pioneered the idea of engaging the American Cancer Society's nationwide network of volunteers to enroll and follow large cohorts. The first cohort, known as the Hammond-Horn Study, was conducted from 1952 through 1955 and provided the first US prospective evidence to confirm the association between cigarette smoking and premature death from lung cancer and other diseases in men. The success of this effort established the foundation on which we invested in a series of large prospective studies – the Cancer Prevention Studies – and in the creation and growth of the Epidemiology Research program. With help from more than 150,000 American Cancer Society volunteers to enroll and collect information from more than 2.2 million US men and women, findings from the Hammond-Horn Study, Cancer Prevention Study-I (CPS-I, 1959-1972), and CPS-II (1982-ongoing) have played a major role in cancer prevention initiatives at our organization and worldwide. For example:

- The Hammond-Horn Study, which linked smoking to higher lung cancer and overall death rates, contributed to the Surgeon General's landmark 1964 conclusion that smoking causes lung cancer and helped drive a decline in adult smoking rates. The American Cancer Society's epidemiologic studies

continue to document the ongoing health impact of smoking. In 2014, the Surgeon General used our results to show that more than 480,000 Americans die each year from smoking cigarettes.

- CPS-I provided the first epidemiologic evidence that excess body weight increases risk of premature death; subsequent studies from CPS-II helped to establish the link between excess body weight and death from breast, colorectal, and other cancers.

- CPS-II was the first prospective study to link regular aspirin use with lower risk of colorectal cancer, a finding confirmed by many later studies. These results opened the door to studies to find out if aspirin might lower the risk of other cancers and to better understand the overall risks and benefits of aspirin use.

- Our studies showing that high red and processed meat and alcohol intake, low physical activity, and longer sitting time increase the risk of cancer or mortality have contributed to the scientific evidence used to develop the American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention. Findings from CPS-II were used to demonstrate the lifesaving potential of a lifestyle consistent with these guidelines.

- Findings from CPS-II contributed substantially to evidence associating increasing levels of specific types of air pollution with higher deaths rates from cardiovascular disease and lung cancer. These studies are cited prominently by both the Environmental Protection Agency and World Health Organization in policies and recommendations for US and worldwide air pollution limits.

- CPS-II data and biospecimens have been included in studies of nearly every confirmed breast, prostate, and pancreatic cancer gene variant to date. This work has led to a better understanding of the heritable component of these cancers.

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

Surveillance and Health Services Research: The Surveillance and Health Services Research (SHSR) program analyzes and disseminates data on cancer occurrence, risk factors, prevention, early detection, treatment, and outcomes to strengthen the scientific basis for and promote cancer control nationally and globally. Researchers in the SHSR program produce *Cancer Facts & Figures*, published annually since 1951, and the accompanying Cancer Statistics article, published in *CA: A Cancer Journal for Clinicians* (cacancerjournal.com) since 1967. These publications are the most widely cited sources for cancer statistics 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). In 2016, an interactive website called the Cancer Statistics Center (cancerstatisticscenter.cancer.org) was launched to provide consumers with a comprehensive, dynamic, and mobile-friendly way to access cancer statistics. Seven supplemental *Cancer Facts & Figures* reports focus on a specific topic (e.g., breast cancer, cancer risk factors) or subpopulation (e.g., Hispanics). Information on the worldwide cancer burden is disseminated in *Global Cancer Facts & Figures*, as well as *The Cancer Atlas* (canceratlas.cancer.org), which are collaborations with the International Agency for Research on Cancer and the Union for International Cancer Control.

Surveillance epidemiologists also conduct and publish high-quality epidemiologic research to help advance the understanding of cancer. Since 1998, American Cancer Society epidemiologists have collaborated with the National Cancer Institute, the Centers for Disease Control and Prevention, the National Center for Health

Statistics, and the North American Association of Central Cancer Registries to produce the Annual Report to the Nation on the Status of Cancer, a highly cited, peer-reviewed journal article that reports current information related to cancer rates and trends in the US. Other research topics include socioeconomic, racial, and geographic disparities in cancer risk factors, screening, and occurrence and generating scientific evidence to support American Cancer Society priority areas for cancer prevention, control, and advocacy. Recent surveillance studies reported that about one-third of men 50 and older received prostate-specific antigen testing to screen for prostate cancer, with no continued decline from 2013 to 2015; increases in colorectal cancer incidence and mortality in adults under age 55 years; and about 20% of cancer patients are diagnosed with a rare cancer (<6 cases per 100,000), for which 5-year survival is 15%-20% lower in absolute terms than common cancers.

Health Services Research (HSR) activities began in the late 1990s, with a primary objective of performing high-quality, high-impact research to evaluate disparities in cancer treatment and outcomes in support of the 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 cancer registry jointly sponsored by the American Cancer Society and the American College of Surgeons. Other data sources include the SEER-Medicare database, a linkage of population-based cancer registry data with Medicare claims data, and the Medical Expenditure Panel Survey Data linked with National Health Interview Survey Data. Findings from HSR researchers have been instrumental in the American Cancer Society's and the American Cancer Society Cancer Action Network's (ACS CAN) support of the Affordable Care Act (ACA) and its effect on public health. Recent studies reported that 1) prophylactic contralateral mastectomy among early-stage breast cancer patients 20-44 years increased from 11% in 2004 to 33% in 2012 and varies substantially by state; 2) financial constraints alter prescription drug use more often for cancer survivors than for those without a history of cancer; and 3) the prevalence of genetic testing for abnormalities associated with increased risk of breast and ovarian

cancer has increased among insured women, but remained stagnant among those without health insurance.

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 medicines and the direct and indirect costs of cancer and its treatment. The dissemination of this research comes in multiple forms, including publications in high-impact, peer-reviewed scientific journals; the release of public scientific reports; and local, national, and international capacity-building programs with governments, international governmental organizations, and civil society.

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 WHO Tobacco Free Initiative, the Secretariat and Parties of the WHO Framework Convention on Tobacco Control, the Centers for Disease Control and Prevention, the Campaign for Tobacco-Free Kids, Johns Hopkins University, and the University of Illinois-Chicago, 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 effective and economical policy interventions. Major global health donors, including the Bloomberg Philanthropies, the Bill & Melinda Gates Foundation, and the US National Institutes of Health, have supported these efforts through additional 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 partners including the World Bank,

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

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 fifth edition and its corresponding website, tobaccoatlas.org, were released in March 2015 and are available in five other languages – French, Spanish, Portuguese, Chinese, and Arabic. The website is popular around the globe, receiving tens of thousands of hits monthly. An exciting, new sixth edition and companion website will be released in March 2018 in Cape Town, South Africa, at the World Conference on Tobacco or Health.

Behavioral Research Center: The mission of the Behavioral Research Center (BRC) is to conduct original research to reduce cancer disparities, modify cancer risk behaviors, and improve cancer outcomes and quality of life among cancer survivors, caregivers, and the general population. BRC survivorship studies, such as the American Cancer Society Studies of Cancer Survivors, explore the prevalence, correlates, and longitudinal course of short- and long-term effects of cancer and its treatment. In addition, the utility of patient-reported outcomes is being evaluated to assess symptoms in the clinical setting and inform efforts to improve symptom control, quality of life, functioning, and treatment adherence among cancer survivors. The BRC works to reduce cancer disparities by collaborating with partners such as United Way 2-1-1, a nationwide information and referral service for socioeconomically disadvantaged individuals. *Cancer Communication Channels in Context: The 4C Study* is currently assessing 2-1-1 clients' cancer information needs, communication preferences, and factors influencing health behavior and health care utilization.

The BRC also examines and develops strategies to address health behaviors that influence cancer occurrence, such as diet, physical activity, cancer screening, and tobacco use. For example, studies of social, psychological, biological, and environmental influences on smokers' ability to quit inform efforts to improve smoking cessation programs. Populations vulnerable to greater tobacco use, such as socioeconomically disadvantaged individuals, are a focus. The BRC increasingly evaluates technology-based psycho-educational and peer-support interventions due to their low cost, wide reach, and customizability. The study of Tailored Email Messages for Smoking Cessation demonstrated that emails offering personalized (i.e., tailored) smoking cessation advice before and after smokers' identified quit date helped them abstain from tobacco. The BRC is also evaluating Springboard Beyond Cancer (survivorship.cancer.gov), an online self-management tool providing essential information to help survivors manage symptoms, deal with stress, develop healthier behaviors, and communicate more effectively.

The BRC also provides behavioral science expertise to American Cancer Society staff and leadership to inform programs and activities, in addition to convening scientific experts and other stakeholders (e.g., health care providers, program administrators, advocates, policy makers) to advance the field. For example, since 2002 the BRC has co-hosted the Biennial Cancer Survivorship Research Conference, which has been instrumental in establishing cancer survivorship as a necessary area of research to inform the needs of survivors, caregivers, and practitioners. The BRC is currently developing focused workshops that will create research agendas to advance knowledge and practice in critical areas, such as gaps in implementing personalized and risk-stratified survivorship care).

Statistics & Evaluation Center: Founded in 2005, the Statistics & Evaluation Center's (SEC) mission is to deliver accurate, reliable, and timely evidence-based information to American Cancer Society leadership and staff to ensure delivery of efficient, high-quality programs and services. Expertise in the social, behavioral, statistical, geospatial, medical, health, and epidemiological sciences allows SEC staff to collaborate effectively with colleagues from across

our organization, as well as with our advocacy affiliate, the American Cancer Society Cancer Action Network, in Washington, DC, and inform decisions at all levels of the American Cancer Society.

The SEC achieves its mission by: 1) providing leadership on evaluation of mission and income-delivery programs, including strategic thinking; logic models grounded in program theory; and all aspects of study design and data analysis and reporting, including strategic recommendations; 2) developing and implementing web-based surveys that provide data for evaluation efforts, mainly via the SEC's Survey Research Resource; 3) providing state-of-the-art geospatial research, data visualization, and decision-support tools, mainly via the SEC's geospatial science team; and 4) providing leadership on the application of design research to problem-solving using a methodological approach that fosters a culture of evaluation and systematic iterative testing in the development, implementation, and diffusion of interventions.

The SEC also conducts community- and hospital-based collaborative research initiatives and evaluations for cancer control and quality-of-life programs with the goal of scaling-up successful pilot study initiatives for population-wide impact. Staff have implemented innovative and multidisciplinary research approaches that have greatly improved the American Cancer Society's ability to deliver services, identify barriers, and provide better access to quality health care to those people most in need.

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 Americans, 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.

Created in 2001, ACS CAN is the force behind a powerful grassroots movement uniting and empowering cancer patients, survivors, caregivers, and their families to save lives from cancer. As the nation's leading voice advocating for public policies that are helping to defeat cancer, ACS CAN works to encourage elected officials and candidates to make cancer a top national priority. In recent years, ACS CAN has successfully worked to pass and implement laws at the federal, state, and local levels that assure cancer patients access to adequate and affordable health insurance coverage; increase funding for groundbreaking cancer research; improve access to prevention and early detection measures, treatment, and follow-up care; and improve quality of life for cancer patients.

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 2017 and do not take into account any potential changes to health care being considered by Congress and the administration.

Access to Care

ACS CAN continues to advocate successfully to protect key patient protections enacted as part of the Affordable Care Act (ACA), including eliminating insurance coverage exclusions, preventing preexisting condition exclusions, eliminating annual and lifetime benefit caps, and removing co-pays for key cancer prevention and early-detection services like mammography and colonoscopy. ACS CAN is also 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.

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

- Permanent funding for cost-sharing reduction subsidies to help low-income enrollees in individual insurance plans afford deductibles, co-pays, and co-insurance

- Market stabilization measures

- Full federal funding for community health centers, which provide community-oriented primary care in underserved areas

- Access to preventive services without cost sharing

- 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. Each year, nearly $5 billion in grant funding for cancer research is distributed to investigators working in cancer centers, universities, and labs in every state of the country. Federal budget pressures threaten this funding every year, and ACS CAN views this driver of the research pipeline to be of prime importance in the search for cures, and fights not only to protect this funding, but also to expand it.

ACS CAN also works to enhance the patient voice in the drug development and approval. Through the 21st Century Cures Act, passed in 2016, and the Food and Drug Administration Reauthorization Act, passed in 2017, ACS CAN has fought to formalize patient consultations by drug developers and the US Food and Drug Administration.

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. California closed gaps in its smoke-free law in 2016, bringing the percentage of the US population covered by comprehensive laws to nearly 60%.

- Working to increase the price of tobacco products via federal and state taxes on all tobacco products and defending against tax rollbacks. The average state tax rate for cigarettes rose to $1.71 per pack (as of September 1, 2017), largely due to a $2.00 increase in California's cigarette tax that took effect on April 1, 2017.

- 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, 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

- Continuing to support implementation of the Healthy, Hunger-Free Kids Act of 2010, which reauthorizes federal child nutrition programs advocating 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 indoor tanning devices

Quality of Life

ACS CAN supports balanced pain policies at the federal and state levels that ensure continued patient and survivor access to the pain relief medications. ACS CAN 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 the case may be. 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 ACS CAN to organize and execute advocacy campaigns. Together, these committed volunteers recruit and support other volunteers dedicated to the most critical components of successful advocacy campaigns: grassroots mobilization, media outreach, fundraising, and integrating advocacy into the American Cancer Society Relay For Life®, Making Strides Against Breast Cancer®, Colleges Against Cancer® and Coaches vs. Cancer® signature programs and events.

Sources of Statistics

Estimated new cancer cases. The number of cancer cases diagnosed in 2018 was estimated using a spatiotemporal model and time series projection based on incidence from 48 states and the District of Columbia (DC) during 2000-2014 that provided consent and met the North American Association of Central Cancer Registries' (NAACCR) high-quality data standard. 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 the Centers for Disease Control and Prevention's National Program of Cancer Registries. The case projection method considers geographic variations in sociodemographic and lifestyle factors, medical settings, and cancer screening behaviors as predictors of incidence, and also accounts for expected delays in case reporting. (For more information on this method, see "A" in Additional information on the next page.)

The number of in situ cases of female breast carcinoma and melanoma diagnosed in 2018 was estimated by 1) approximating the actual number of cases in the 10 most recent data years (2005-2014) by applying annual age-specific incidence rates (based on 46 states and DC) to corresponding population estimates; 2) calculating the average annual percent change (AAPC) in cases over this

time period; and 3) using the AAPC to project the number of cases four years ahead. In contrast to 2017 estimates, in situ estimates for 2018 were 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. Age-adjusted rates should only be compared to rates that are adjusted to the same population standard. State-specific incidence rates were previously published in NAACCR's publication *Cancer Incidence in North America, 2010-2014*. National rates presented herein may differ slightly from those previously published by NAACCR due to the exclusion of Kansas. (See "B" in Additional information on the next page for full reference.)

Trends in cancer incidence rates provided in the text of this publication are based on delay-adjusted incidence rates from the nine oldest SEER registries. Delay-adjustment accounts for delays and error corrections that occur in the reporting of cancer cases, which is substantial for some sites, particularly those less often

diagnosed in a hospital, such as leukemia. Delay-adjustment is not available for some cancer types. Trends were originally published in the *SEER Cancer Statistics Review (CSR) 1975-2014*. (See "C" in Additional information on the next page for full reference.)

Estimated cancer deaths. The number of cancer deaths in the US in 2018 is estimated by fitting the number of cancer deaths from 2001 to 2015 to a statistical model and then using the most recent trend (APC) to forecast the number in 2018. 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 the next 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 2015.

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. Cause-specific survival, which is used to describe

survival by race/ethnicity in the special section on ovarian cancer, is the percentage of people who have not died from a specific disease within a certain time (usually 5 years). Many of the survival rates presented in this publication were previously published in the *CSR 1975-2014*. Trends in 5-year survival are based on data from the nine oldest SEER registries, which go back to 1975, whereas contemporary 5-year survival rates are based on data from all 18 SEER registries, which provide greater population coverage. In addition to 5-year relative survival rates, 10- and 15-year survival rates are presented for selected cancers. These rates were generated using the NCI's SEER 18 database and SEER*Stat software version 8.3.4. (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 6.7.5, 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 Copeland G, Lake A, Firth R, et al. (eds). Cancer in North America: 2010-2014. Volume Two: Registry-specific Cancer Incidence in the United States and Canada. Springfield, IL: North American Association of Central Cancer Registries, Inc. June 2017. Available at www.naaccr.org/cancer-in-north-america-cina-volumes/#Vol2

C Howlader N, Noone AM, Krapcho M, et al. (eds). SEER Cancer Statistics Review, 1975-2014. National Cancer Institute. Bethesda, MD, 2017. 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 2016 Sub (1973-2014 varying) – Linked To County Attributes – Total U.S., 1969-2015 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2017, based on the November 2016 submission.

F DevCan: Probability of Developing or Dying of Cancer Software, Version 6.7.5; Statistical Research and Applications Branch, National Cancer Institute, 2017. 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 undergo regular screening mammography starting at age 45. Women ages 45 to 54 should be screened annually. Women should have the opportunity to begin annual screening between the ages of 40 and 44.
	Women, ages 55+		Transition to biennial screening, or have the opportunity to continue annual screening. Continue screening as long as overall health is good and life expectancy is 10+ years.
Cervix	Women, ages 21-29	Pap test	Screening should be done every 3 years with conventional or liquid-based Pap tests.
	Women, ages 30-65	Pap test & HPV DNA test	Screening should be done every 5 years with both the HPV test and the Pap test (preferred), or every 3 years with the Pap test alone (acceptable).
	Women, ages 66+	Pap test & HPV DNA test	Women ages 66+ who have had ≥3 consecutive negative Pap tests or ≥2 consecutive negative HPV and Pap tests within the past 10 years, with the most recent test occurring in the past 5 years should stop cervical cancer screening.
	Women who have had a total hysterectomy		Stop cervical cancer screening.
Colorectal†	Men and women, ages 50+	Guaiac-based fecal occult blood test (gFOBT) with at least 50% sensitivity or fecal immunochemical test (FIT) with at least 50% sensitivity, **OR**	Annual testing of spontaneously passed stool specimens. Single stool testing during a clinician office visit is not recommended, nor are "throw in the toilet bowl" tests. In comparison with guaiac-based tests for the detection of occult blood, immunochemical tests are more patient-friendly and are likely to be equal or better in sensitivity and specificity. There is no justification for repeating FOBT in response to an initial positive finding.
		Multi-target stool DNA test, **OR**	Every 3 years
		Colonoscopy, **OR**	Every 10 years
		CT Colonography, **OR**	Every 5 years
		Flexible sigmoidoscopy (FSIG), **OR**	Every 5 years alone, or consideration can be given to combining FSIG performed every 5 years with a highly sensitive gFOBT or FIT performed annually.
		Double-contrast barium enema	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.

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

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